INITIATIVE ON
Diversification in East and Southern Africa

Many Partners, Big Numbers? Estimating the extent of reach and use of innovations under the CGIAR Research Initiative – Diversification in East and Southern Africa

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Executive summary

As resource envelops to fund international development activities become tighter, it is increasingly critical to demonstrate value for money. This is difficult for various reasons; chief among these is the failure to embed evaluation frameworks right from the start of projects. The multiplicity of scaling partners, and their interests and levels of involvement, makes it even more complicated to ensure consistent monitoring and evaluation. This paper develops and applies a replicable, population-based survey methodology based on computer assisted telephone interviewing (CATI) that can be used to assess the extent of reach, adoption and potential impacts of international development projects in contexts where baseline data are missing. We apply this method to the CGIAR Research Initiative – Diversification in East and Southern Africa, also known as Ukama Ustawi (UU) implemented with several scaling partners, across 12 countries in Eastern and Southern Africa: Eswatini, Ethiopia, Kenya, Madagascar, Malawi, Mozambique, Rwanda, Uganda, South Africa, Tanzania, Zambia, and Zimbabwe. This assessment was restricted to five countries only (Ethiopia, Kenya, Malawi, Zambia, and Zimbabwe).

The goal of the assessment was to measure the extent of reach and use of agricultural innovations promoted under UU across five project countries. We used quantitative primary data collected through CATI from a random sample of 6,445 rural people across 27 districts in five project intervention countries. The sample was randomly selected from all intervention districts using population-weighted sampling approaches to allow for inference to the population level within the sample districts. Awareness of technologies was notably high in Zimbabwe (97%), Zambia (65%), and Malawi (72%), although this did not translate to similarly high usage rates. For livestock-related practices, Kenya showed the highest awareness levels, with Zimbabwe following in second place. The study found a consistent gap between awareness and use of technologies across all countries. For instance, while 61% of the study population in Zimbabwe were aware of two-wheel tractors, only 10% used them. Similarly, despite high awareness of post-harvest technologies in Zimbabwe, Zambia and Malawi, usage rates remained lower at 59%, 21% and 19%, respectively. However, Ethiopia demonstrated lower awareness levels for minimum tillage and rotation/intercropping/mulching practices due to the shorter exposure period that Ethiopian districts received from UU interventions.

Overall, approximately 1.05 million people (about 8.4%) out of the 12.5 million rural population in target districts were aware of UU activities, with Kenya and Zambia showing the highest awareness at 16%. Through various interventions and across the project sites in the five project target countries, a total of 164,363 people benefited from UU through using various innovations promoted by UU as of September 2024. Among these, 135,767 people or 82% were direct beneficiaries in districts where specific interventions were implemented and are users of unique interventions (i.e., without spillovers), whereas the higher number also represents people who benefitted from "spillover effects". More than half of the beneficiaries (52%) were female and 56% were youth aged 18-35. These results demonstrate that UU exceeded the end of initiative outcome of 100,000 farmers by 36% without spillovers and 64% with spillovers, and the 40% women and 40% youth participation target by 12 – 16%. In terms of adoption of the promoted technologies, Zimbabwe showed the highest rates for minimum tillage and post-harvest mechanization technologies, closely followed by Malawi most likely due to a strong focus by the Government (e.g., the Pfumvudza program in Zimbabwe) and non-governmental organization partners promoting these technologies alongside UU.

The study provides important insights into how international agricultural development initiatives can cost-effectively, measure their impacts and the extent of reach. The study also highlights the

need for targeted approaches in project design and implementation to enhance technology adoption among smallholder farmers in East and Southern Africa. The success of the UU Initiative, particularly in countries like Malawi and Zimbabwe, provides valuable lessons on the need to build on from previous projects. This approach is a practical guide to future agricultural development programs in East and Southern Africa. The additional costs of nudging people to adopt technologies are lower in places where target innovations have been promoted before. Leveraging these advantages requires intentional efforts to build synergies and harmony to minimize conflicts, duplication and competition among development practitioners. National governments have a big role to play to actualize a harmonized approach to development facilitation by guiding where interventions are needed in the countries. Development practitioners too, need to do a better job to identify ongoing projects and find ways to build synergies. The methodology applied in this study can be easily replicated and applied in different settings. One potential improvement is to use cluster randomized sampling approaches and computing sampling weights at different clusters.

1. Introduction

Agriculture employs approximately 65% of the population, contributing over 30% of the Gross Domestic Product (GDP) in East and Southern Africa (ESA) (IFAD, 2022). Currently, the region faces significant challenges driven in part by climate change, low productivity, soil degradation and input supply disruptions and input price spikes occasioned by the COVID-19 pandemic and the Russia-Ukraine crisis (Giller et al., 2021; Kim et al., 2021). Climate change-induced droughts, floods and extreme weather events such as cyclones, El-Niño, and La-Niña have become more frequent and severe, negatively affecting smallholder agriculture, food and nutrition security in the ESA region (Haile et al., 2020; Kapuka and Hlásny, 2021). Poor soil health, limited use of quality inputs like organic and inorganic fertilizers and improved multi-stress tolerant seeds, and reliance on traditional and rudimentary farming methods add to the challenges caused by climate change in the region. This is exacerbated by limited access to market opportunities, rising labor shortages and rural wages, and credit rationing, which limits smallholder access to financial resources, especially among youths and women (Marenya, 2020).

Despite the implementation of numerous solutions through multiple stakeholders, including those implemented by the CGIAR programs, challenges persist in scaling the newly generated innovations, capacities, and support systems. Large gaps, also known as know-do gaps, remain between innovations generated by research and what is used by farmers in their own fields (Ngoma et al 2024). The CGIAR Research Initiative on Diversification in ESA, also known as Ukama Ustawi (UU) was designed to bridge this gap. The implementation approach sought to co-develop and co-design agricultural innovations to transform agroecological systems and strengthen food, land, and water systems (Jacobs-Mata and Girvetz, 2021). At the core, UU aimed to address food and nutrition security risks arising from an overreliance on maize through climate-resilient, water-secure, and socially inclusive approaches in ESA since 2021. Through these efforts, UU contributed to long-term agricultural development in the ESA vulnerable to climate shocks and economic instability. UU was funded by various donors through the CGIAR Trust Fund. The Initiative was implemented across 12 countries in Eastern and Southern Africa: Eswatini, Ethiopia, Kenya, Madagascar, Malawi, Mozambique, Rwanda, Uganda, South Africa, Tanzania, Zambia, and Zimbabwe.

While the Initiative made significant strides in promoting sustainable agricultural practices, there is limited evidence of the impact and scalability of the technologies and innovations promoted. In addition, more evidence is needed on the extent and intensity of the adoption of the various innovations promoted to inform scaling among smallholder farmers in the project sites. Addressing these knowledge gaps is crucial to draw lessons from innovations promoted by UU to inform similar international development projects and subsequent CGIAR science programs broader, and sustainable applicability across different regions and communities. The learnings from this assessment are critical to inform the CGIAR Scaling for Impact program, a part of the CGIAR Research Agenda 2025-2030, and the successor to UU. We assessed the extent of reach and use of the various interventions and technologies, or more generally, innovations promoted under the UU across five countries. The goal of the assessment was to measure and estimate the reach, awareness, and adoption of the promoted technologies. A secondary goal was to develop a consistent survey-based methodology that could be applied by other CGIAR and other international development programs to assess the extent of program reach and impacts.

UU builds on several previous CGIAR projects in the region guaranteeing long-standing partnerships and continuation of program level long-term research interventions. The main ones include Research in Sustainable Intensification for the Next Generation (Africa RISING) which promoted sustainable intensification through research and development initiatives targeted at increasing crop yields, boosting soil fertility, and incorporating livestock production to boost income and resilience (Kangethe et al., 2021; Mekonnen et al., 2024; Odhong and Manners, 2024). The second major project was the Sustainable Intensification of Maize-Legume Cropping Systems for Food Security in Eastern and Southern Africa (SIMLESA) focusing on improving maize-legume cropping systems and food security through research and best practice dissemination (Marenya, 2020). The third major precursor to UU was the Sustainable Intensification of Maize-Legume Systems for Eastern Province, Zambia (SIMLEZA). This was a geographically concentrated effort that focused on improving maize-legume systems in Zambia's Eastern Province (Andersson, 2014; Mupangwa, 2015). Drawing on lessons learned from these and other related interventions, UU continued to help millions of vulnerable smallholders in the dominant maize-mixed systems to sustainably intensify, diversify, and de-risk agrifood systems.

Ukama Ustawi promoted a wide range of innovations (technologies and practices) that were designed to improve the efficiency and sustainability of farming systems. These include

Conservation Agriculture (CA) principles such as minimum tillage, which can be achieved using tools like rippers, direct seeders, and dibble sticks, as well as planting basins. In addition, permanent soil cover, achieved through mulching or cover crops, was promoted to improve soil water retention, add organic matter to the soil, and moderate temperature. Crop diversification is also a key strategy, encouraging farmers to cultivate a variety of crops in space and time to reduce risks associated with low input use, pests, diseases, and market fluctuations. These practices work together to create a more resilient farming system that can better withstand the challenges posed by climate change.

Given the need to reduce drudgery and to improve efficiency in smallholder farming systems in the region, UU also included a targeted promotion of appropriate smallholder mechanization services. These services were introduced using a service provider (SP) model where a few of the farmers were linked to sets of machinery such as the two-wheel tractor with ancillary equipment and these farmers would provide services to the other farmers at a fee. The introduction of irrigation systems further supported farmers by ensuring water availability during dry spells, while the integration of livestock provided additional revenue streams and improved soil fertility through animal manure use. These technologies and practices were based on scientific research and field trials, drawing from different studies (Bouis & Saltzman, 2017; Duncan et al., 2016; Durga et al., 2024; Thierfelder et al., 2024, 2017), which have demonstrated the positive impact of the innovations on agricultural productivity, nutrition, and resilience. Collectively, these interventions aim to create a more sustainable and equitable agricultural landscape that benefits both farmers and the wider community. We focused on several innovations for this assessment in spanning agronomy, mechanization, nutrition, livestock, and irrigation (Table 1).

Table 1: Project interventions in each country

Country	Agronomy	Mechanization	Nutrition	Livestock	Irrigation
Ethiopia	yes	yes	yes	yes	yes
Kenya	yes	yes	yes	yes	yes
Malawi	yes	yes	yes	no	no
Zambia	yes	yes	yes	yes	yes
Zimbabwe	yes	yes	yes	yes	yes

Table 2 shows the details within each broad category. Key agronomic practices included minimum tillage, crop rotation, intercropping, and mulching. When these practices are used in combination, they make a full CA system. Mechanization technologies included two-wheel tractors, groundnut shellers, multi-crop threshers, and irrigation equipment. Livestock management involved fodder production and the use of mechanization tools such as feed chopper grinders and feeding troughs to prepare livestock feed. For the nutrition component, high-iron fortified bean varieties were promoted to improve dietary quality. The bean varieties were distributed using different means such as school feeding programs.

Table 2: Specific interventions promoted

Activity	Variable	Variable description
Agronomy	MT	Minimum tillage (planting basins, ripping, dibble stick, direct seeder)
	MT+rot	Minimum tillage and crop rotation
	MT+int	Minimum tillage and intercropping/strip cropping
	MT + mulch	Minimum tillage and mulching
	Full CA	Minimum tillage and rotation/intercropping/strip cropping and mulching
Mechanization & irrigation	2WT	Two-wheel tractor
	Post-harvest mechanization	Groundnut sheller
		Groundnut roster
		Peanut butter maker
		Multicrop thresher
	Irrigation	Irrigation equipment
Livestock	Livestock	Fodder production
		Feed chopper grinder
		Feed trough
Nutrition	Iron-rich beans	High iron-rich beans

2. Methods and Approaches

The research used quantitative methods that included primary and secondary data. Primary data were collected using a structured questionnaire and secondary data (i.e., rural population for study districts) were gathered from national statistics agency websites for the five countries.

2.1. Sampling strategy and data collection methods

2.2. Sampling

We used the Cochran sample size formula (Cochran, 1977) to determine the required sample size. This formula is considered appropriate in situations with large or infinite populations, and it is given by:

$$n_0 = \frac{[Z^2pq]}{e^2} \qquad [1]$$

where n_0 is the minimum ideal sample given a desired level of precision, the desired confidence level, and the estimated proportion of the attribute in the population; Z is the z-score corresponding to the desired confidence level (1.96 for 95% confidence); e is the desired level of precision (i.e. the margin of error, 5%); p is the estimated proportion of the population which has the attribute (30%, 0.3), q is 0.7 (1 – p). We calculated the sample for each of the countries, taking the population as the sum of the rural population in the operational districts.

We then allocated the sample across districts using the formula

$$n_d = n \cdot \left(\frac{\sqrt{pop_d}}{\sum\sqrt{pop_d}}\right) \qquad [2]$$

where n_d is the sample size determined for a given district; n is the overall sample size to be allocated, $\sqrt{pop_d}$ is the square root of the population size of a given district; $\sum\sqrt{pop_d}$ is the sum of the square root of the population size over all districts involved in the allocation. This allocation has precision, estimation, and cost advantages over the equal proportion of population allocation (Qing and Valliant, 2024).

To estimate the reach of interventions, we used population weights estimated as $w_d = \frac{pop_d}{n_d}$. where w_d is the calculated population weight for a given district; $p_o p_d$ is population size for all districts involved in the allocation; n_d is the sample size determined for a given district. Thus, to get the population weights, we divided the rural district population by the sample interviewed in the district.

2.3. Sample size determination

Different sample sizes were determined across the five countries and then distributed to the 27 districts covered in the survey. The sample sizes calculated using both infinite and finite populations were about 196 people per district, but the samples collected were mostly larger. We adjusted the numbers for potential non-response. Combined, in all five countries, the target sample size was 6,500 of which 99% or 6,445 was achieved. This is much higher compared to other computer-assisted personal interviewing or mobile phone surveys (Wu et al., 2022). Table 3 shows the sample details including target and achieved and rural population by district, while Figure 1 shows the location of the survey districts by country.

2.4. Confidence intervals and margin of error

Given the sample achieved per country, we conducted post-sample calculations of the margins of error using the formula

$$me = z \cdot \sqrt{\frac{p \cdot q}{n_0}} \cdot \qquad [3]$$

Where me is the desired level of precision (i.e., the margin of error, 5%); z is the z-score corresponding to the desired confidence level (1.96 for 95% confidence); n is the minimum ideal sample given a desired level of precision; p is the (estimated) proportion of the population which has the attribute (30%, 0.3); and q is $0.7\ (1 - p)$. Overall, across all countries, we calculated the statistics of interest with a very small margin of error and the sample distributions across all five countries are provided in Table 3.

Table 3: Sample size for each district by country

	Rural pop	Target	Actual	Percent (%)
Kenya				
Embu	532,524	210	225	107
Makueni	910,616	280	265	95
Nakuru	1,115,696	410	409	100
Narok	1,057,138	300	284	95
Total	**3,615,974**	**1,200**	**1,183**	**99**
Ethiopia				
Adami Tullu and Jido Kombolcha	211,827	265	216	82
Hawassa Zuria	161,914	232	263	113
Meskan	218,370	270	254	94
Lemo	157,107	229	272	119
Soddo	194,253	254	227	89
Total	**943,471**	**1,250**	**1,232**	**99**
Malawi				
Balaka	447,359	202	205	101
Dowa	843,331	268	262	98
Machinga	844,610	267	266	100
Nkhotakota	405,687	189	271	143
Salima	501,430	213	188	88
Zomba	728,800	261	223	85
Total	**3,771,217**	**1,400**	**1,415**	**101**
Zambia				
Chipangali	169,357	187	217	116
Kasama	195,538	269	219	81
Lundazi	109,985	179	220	123
Mazabuka	125,304	219	184	84
Monze	201,861	235	271	115
Sinda	208,845	211	173	82
Total	**1,010,890**	**1,300**	**1,284**	**99**
Zimbabwe				
Bindura	169,841	208	241	116
Masvingo	230,960	250	224	90
Makonde	209,960	231	249	108
Murehwa	188,388	219	218	100
Mutoko	147,559	194	200	103
Shamva	164,482	205	199	97
Total	**1,111,190**	**1,307**	**1,331**	**102**

2.5. Data collection

For this study, we partnered with the international data collection firm GeoPoll, which used Computer-Assisted Telephone Interviewing (CATI) as the primary method for collecting data. CATI is particularly effective in maintaining data quality and consistency, as it allows for immediate validation of responses and ensures that the survey process is standardized across different locations. To ensure clarity and consistency in the data collection process, a comprehensive glossary of all key terms and interventions, as well as a detailed training manual for enumerators, were developed with technical support from CIMMYT. This glossary was designed to ensure that enumerators understood the specific terminology related to the agricultural interventions being studied, helping to avoid confusion and ensuring that the data collected were both accurate and comparable across respondents. The survey tools (questionnaire and glossary) were translated into the major local languages used in the study areas. The sampling frames were provided by GeoPoll, which has extensive experience in conducting large-scale surveys across multiple regions. These were supplemented where possible by data from CGIAR partners, ensuring a broad-based survey across the 27 target districts across the five countries.[1] Figure 1 shows the location of the survey districts by country.

[1] Note that districts as they are called in southern Africa are equivalent counties in Kenya and worredas in Ethiopia.

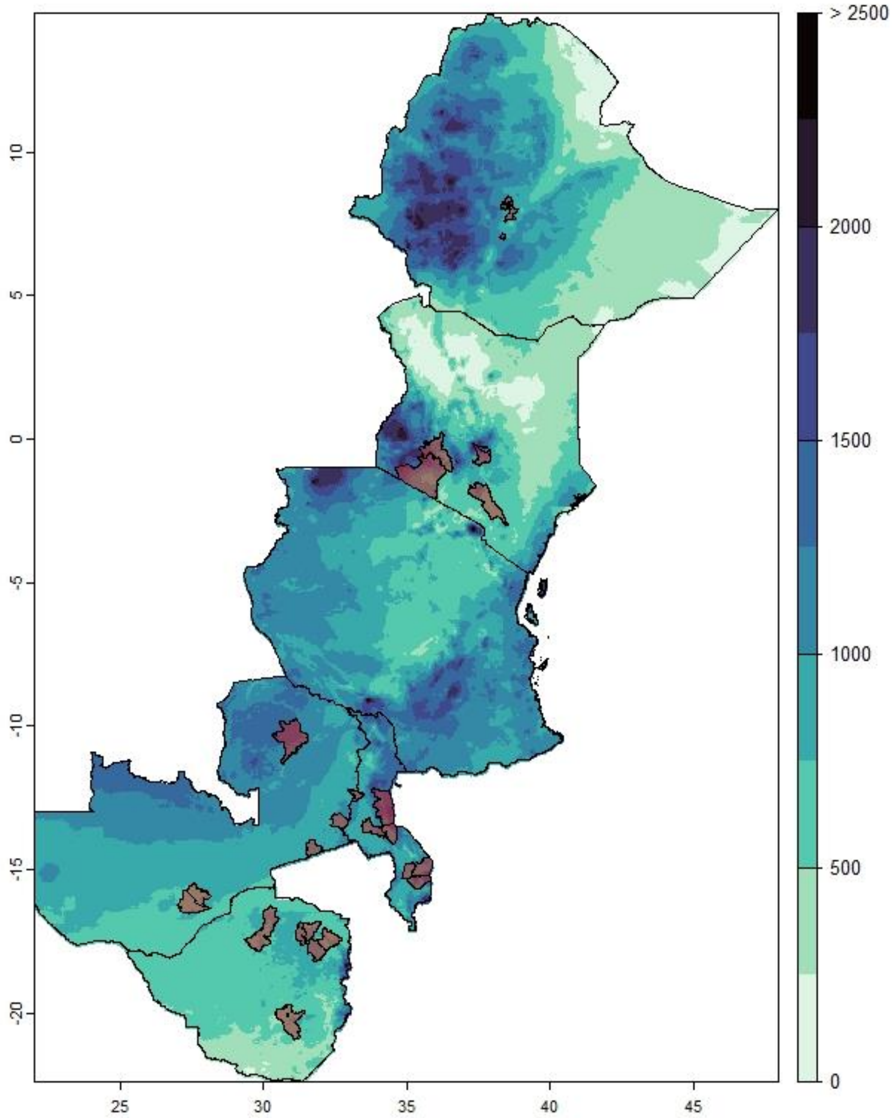

Figure 1: Relative location of survey districts (in orange) in Ethiopia and Kenya and in Malawi, Zambia and Zimbabwe

Notes: The background layer is average yearly rainfall between 1981 and 2023 from the Climate Hazards Group InfraRed Precipitation with Station data (CHIRPS).

3. Results and discussion

3.1. Awareness and use of conservation agriculture, mechanization, livestock and nutrition interventions

Results show that Zimbabwe had the highest rates of awareness and usage of minimum tillage and post-harvest mechanization technologies, followed closely by Malawi (Figure 2). Ethiopia had the lowest rates of awareness and usage of minimum tillage and its combinations with rotation, intercropping, and mulching. Kenya had the highest number of people (43%) using livestock practices, followed by Zimbabwe (14%). Despite these positive trends, we found large gaps between awareness and use of technologies, as highlighted in previous studies (Cheesman et al., 2017; Hermans et al., 2021; Ngoma et al., 2024). Our results are in line with (Agbenyo et al., 2022; Glover et al., 2016; Hermans et al., 2021; Ngoma et al., 2024; Pangapanga-Phiri et al., 2024; Tufa et al., 2023) who found that farmers often lack access to extension services, information, training, and credit, limiting their ability to invest in sustainable intensification technologies and good agronomic practices. For instance, 61% of the population was aware of two-wheel tractors in the study sites in Zimbabwe, but only 10% utilized them. Similarly, awareness of post-harvest technologies was high in Zambia (65%) and Malawi (72%), but usage was low at 21% and 19%, respectively. Stakeholders, including governments, NGOs, and the private sector, have invested in CA and promoted it, contributing to the high awareness of CA in Malawi and Zimbabwe. This is in line with Tufa et al. (2023), who found high awareness of minimum tillage and crop residue retention in Malawi and Zimbabwe. The higher use of minimum tillage in Zimbabwe is due to the nationwide roll-out of the Pfumvudza program in the 2020/2021 season, which is promoting planting basins-based CA. Overall, these findings suggest that while projects created much awareness of specific technologies, farmers face intellectual or material bottlenecks to adoption.

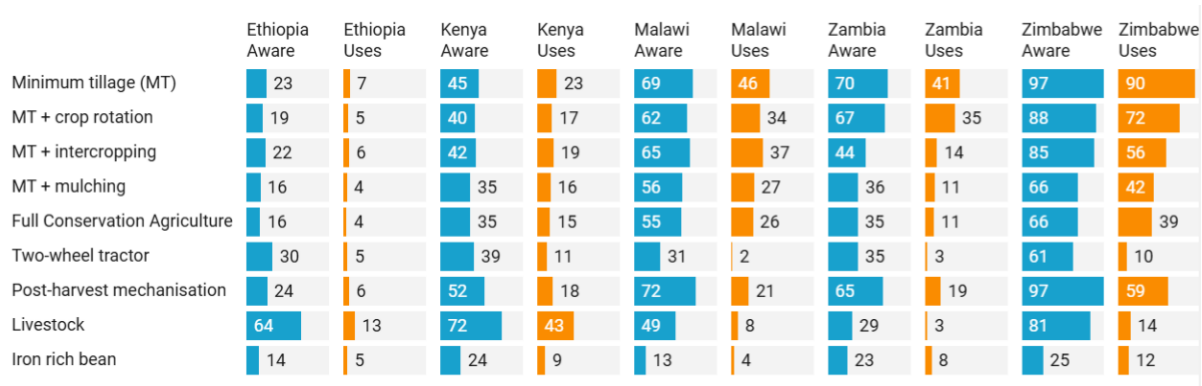

Figure 2: Sample percentage awareness and use of promoted interventions

3.2. Number of people using promoted technologies in the UU intervention sites

3.2.1. Use of minimum tillage practices

Figures 3 – 6 present the population-based results on the number of people using the different innovations in the UU intervention areas. These results do not yet consider whether this is because of UU. With regards to minimum tillage elements, Zimbabwe had the highest use rates, with 55% of the study population having used ripping, 32% direct seeding, 30% basins, and 10% dibble stick (Figure 3). In Malawi, 23% of the population used basins, 18% used the dibble stick, and 13% used ripping. Ripping was the most used minimum tillage practice in Zambia and Kenya, used by 24% and 12%, respectively. Our results confirm the findings of Ngoma et al., (2024) and Pangapanga-Phiri et al., (2024), that minimum tillage adoption rates outside intensive promotional areas, although rising, remain slow in Malawi, Zambia and Zimbabwe. Except for ripping used by 12% in Kenya, Ethiopia and Kenya had the least number (less than 5%) of users for the other specific minimum tillage practices. This finding is similar to Marenya et al., (2017) who found low adoption rates of minimum tillage in Ethiopia and Kenya.

	Dibble stick users	Dibble stick % of pop	Direct seeder users	Direct seeder % of pop	Ripping users	Ripping % of pop	Basins users	Basins % of pop
Ethiopia	10,042	1	7,724	1	29,421	3	6,211	1
Kenya	92,389	2	146,560	3	610,476	12	139,855	3
Malawi	742,872	18	91,807	2	536,476	13	930,144	23
Zambia	18,515	1	14,641	1	327,439	24	59,356	4
Zimbabwe	114,882	10	375,453	32	641,954	55	354,020	30
Total	978,700	8	636,185	5	2,145,766	17	1,489,586	12

Figure 3: Population-based number and percentage of people using minimum tillage practices

3.2.2. Use of intercropping practice

Traditional intercropping was widely used across the region, with Malawi exhibiting the highest prevalence at 69% (Figure 4). Adoption rates for specialized intercropping techniques in Ethiopia were estimated at 17% for two-row strip cropping, 10% cereal-legume *Gliricidia* intercropping systems and 5% adopting four-row strip cropping. Zambia had the least number of people using all the intercropping techniques (i.e., less than 6%). In Zimbabwe, two- and four-row strip cropping systems were used by 7% and 5%, respectively, whereas traditional intercropping was used by 40% of people. These variations highlight the staggered adoption of various sustainable intensification practices, with newer options still least adopted. The low adoption of strip corresponds to findings in Thierfelder et al., (2024) who found that strip cropping requires more labor than traditional intercropping, even if it confers higher financial returns. The high labor requirements with strip cropping can be addressed using appropriate mechanization.

	Traditional intercropping users	Traditional intercropping % of pop	2-row strip cropping users	2-row strip cropping % of pop	4-row strip croppping users	4-row strip croppping % of pop	Cereal-legume & gliricidia intercopping users	Cereal-legume & gliricidia intercopping % of pop
Ethiopia	202,559	21	156,935	17	43,611	5	93,100	10
Kenya	2,124,271	43	256,392	5	113,312	2	45,612	1
Malawi	2,814,575	69	214,178	5	176,520	4	190,851	5
Zambia	290,460	21	23,525	2	33,689	2	3,800	0
Zimbabwe	466,098	40	82,278	7	62,546	5	29,867	3
Total	5,897,963	47	733,308	6	429,678	3	363,230	3

Figure 4: Population-based number and percentage of people using intercropping and strip cropping practices

3.2.3. Use of livestock interventions

The use of fodder production-specific practices was minimal (<12%) across most of the countries, with few exceptions. For instance, feed chopper grinders were used by 10.9% of the population in Kenya, 4.5% in Zimbabwe, and 2.5% in Ethiopia (Figure 5). Approximately 5% of the population in the study areas were engaged in the production of *Bracharia ssp.* fodder grass species. Even though fewer people produced fodder crops, Kenya had the highest number of producers of velvet beans (*Mucuna ssp.*) and *Bracharia* ssp. at 1.3% and 5%, respectively, while Ethiopia had the highest number of producers of lablab (2.1%). There are two possible reasons for the minimal production of fodder crops. First, many people may be unaware of the benefits of fodder crops, such as their ability to suppress weeds, provide livestock feed, and enhance soil fertility. Second, there is limited access to seed for fodder crops as was found by Chakoma, (2012). This has been a known reason for the lack of adoption of green manure /cover crops. In addition, as suggested by Arslan et al., (2022), adoption of livestock activities requires high upfront financial investments in land, labor, seed, knowledge and skills. This could also explain the low adoption rates for fodder production interventions.

	Mucuna producers	Mucuna production % of pop	Lablab producers	Lablab production % of pop	Bracharia producers	Bracharia production % of pop	Fodder chopper users	Fodder chopper % of pop
Ethiopia	3,014	0.3	19,772	2.1	6,624	0.7	23,941	2.5
Kenya	65,661	1.3	48,025	1	245,623	5	535,202	10.9
Malawi	16,686	0.4	4,407	0.1	25,271	0.6	32,275	0.8
Zambia	4,890	0.4	463	0	1,630	0.1	13,515	1
Zimbabwe	12,847	1.1	7,060	0.6	7,909	0.7	53,090	4.5
Total	103,098	0.8	79,727	0.6	287,057	2.3	658,023	5.3

Figure 5: Population-based number and percentage of people using livestock production practices

3.2.4. Use of post-harvest practices

Multi-crop threshers were most prevalent in Malawi (14%) and Kenya (12%), reflecting their potential suitability for diverse cropping systems common (Figure 6). In contrast, Zimbabwe saw greater adoption of groundnut roasters and shellers, with 14% and 11% of farmers, respectively, using these technologies. These findings confirm Muganyizi and Rejikumar, (2023) assertion that high cost, local unavailability, and limited knowledge and awareness about improved postharvest technologies limited the adoption of these technologies. The regional variation in adoption highlights the need for context-specific interventions to promote the adoption of appropriate technologies in different agroecological zones.

	G/nut sheller users	G/nut sheller % of pop	Multicrop thresher users	Multicrop thresher % of pop	G/nut roaster users	G/nut roaster % of pop
Ethiopia	12,718	1	49,156	5	0	0
Kenya	47,362	1	571,438	12	37,412	1
Malawi	319,459	8	571,129	14	57,222	1
Zambia	64,969	5	52,952	4	15,165	1
Zimbabwe	165,859	14	74,553	6	131,078	11
Total	610,367	5	1,319,228	11	240,877	2

Figure 6: Population-based number and percentage of people using post-harvest practices

3.3. Awareness of Ukama Ustawi activities

The levels of awareness of the UU project interventions ranged from 5 to 16% across the study areas in the five countries (Figure 7). Intervention districts in Zambia and Kenya had the highest levels of awareness at about 16%. Intervention districts in Ethiopia had the least awareness at 5% of the study population. In Malawi and Zimbabwe, about 5.7% and 8.2% of the people were aware of UU interventions. The differences in the levels of awareness can be explained by how long UU interventions have been implemented in each geographic location. For example, UU activities started in 2021 in both Kenya and Zambia where there was the highest awareness. In contrast, UU activities only started in earnest in Ethiopia towards the end of 2023, and this could explain the low awareness levels in that country, alongside varied socio-political contexts.

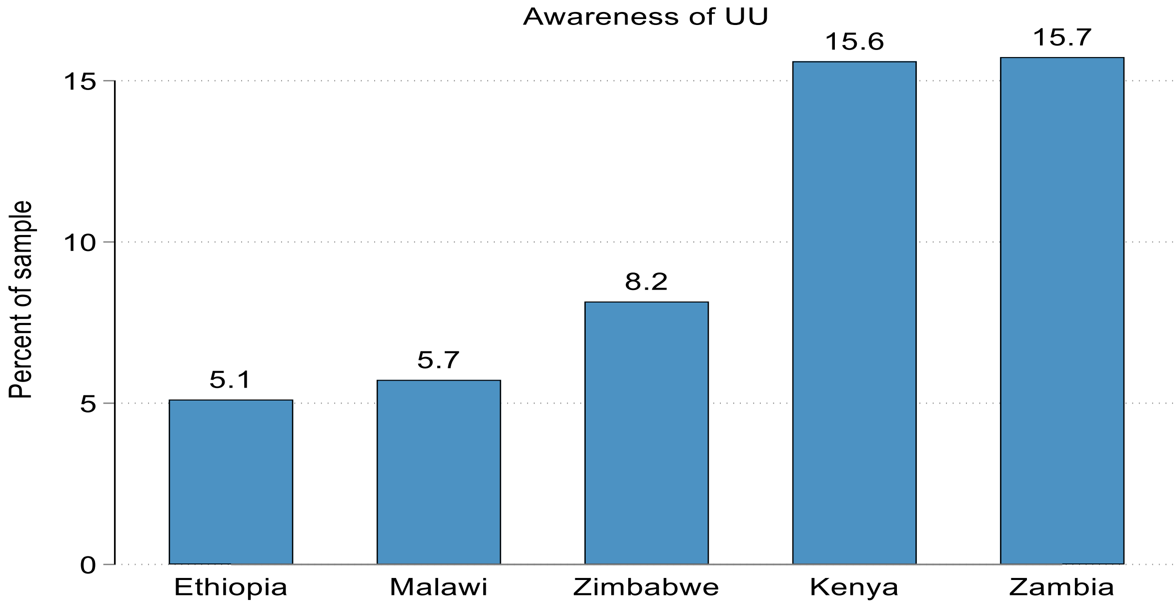

Figure 7: Levels of awareness (%, sample) of Ukama Ustawi activities by country

We found no particular pattern of awareness by gender and by youth as shown in Figure 8. More men than women were aware of project interventions in Ethiopia and Kenya, whereas more women than men were aware of project interventions in Malawi, Zambia and Zimbabwe (Figure 8, left panel). When disaggregated by age, more youths (aged 18 to 35) were aware of project interventions than non-youths in Kenya and Zambia (Figure 8, right panel). In contrast, more non-youths were aware of project interventions in Zimbabwe and Ethiopia compared to youths. Without testing for significance, there is little difference in awareness of UU among youths and non-youths in Malawi.

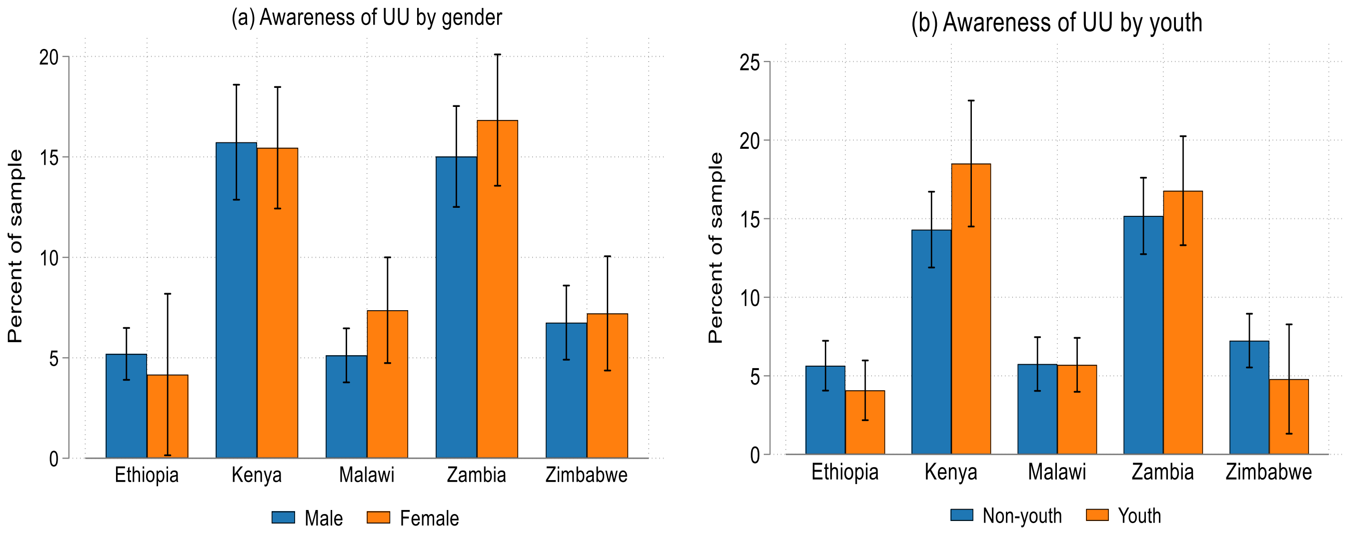

Figure 8: Levels of awareness (%, sample) of Ukama Ustawi activities by gender (left panel) and youth (right panel).

3.4. How people interacted with Ukama Ustawi

Overall, about a quarter (28%) of the population interacted with Ukama Ustawi project interventions through training facilitated by different implementation partners (Figure 9). Other important avenues included agronomy activities (22%), exchange visits (16%), nutrition and livestock, each at 14%, and mechanization activities at 5%. These avenues represent hosting/attending agronomy, mechanization, nutrition and livestock demonstrations and field days. At the country level, training was the most common pathway through which farmers interacted with the project in Kenya (50%) and Zambia (29%). Agronomy demonstrations were most popular in Zimbabwe (32%) and Malawi (31%), whereas nutrition demonstrations were most popular in Zambia (21%). In Ethiopia, about 40% of the population had interacted with the project during exchange visits and 25% through livestock activities. Except for Ethiopia where exchange visits and livestock activities were the main ways farmers interacted with UU, training of some sort and agronomy interventions were the top two ways through which farmers interacted with UU in all the other four countries.

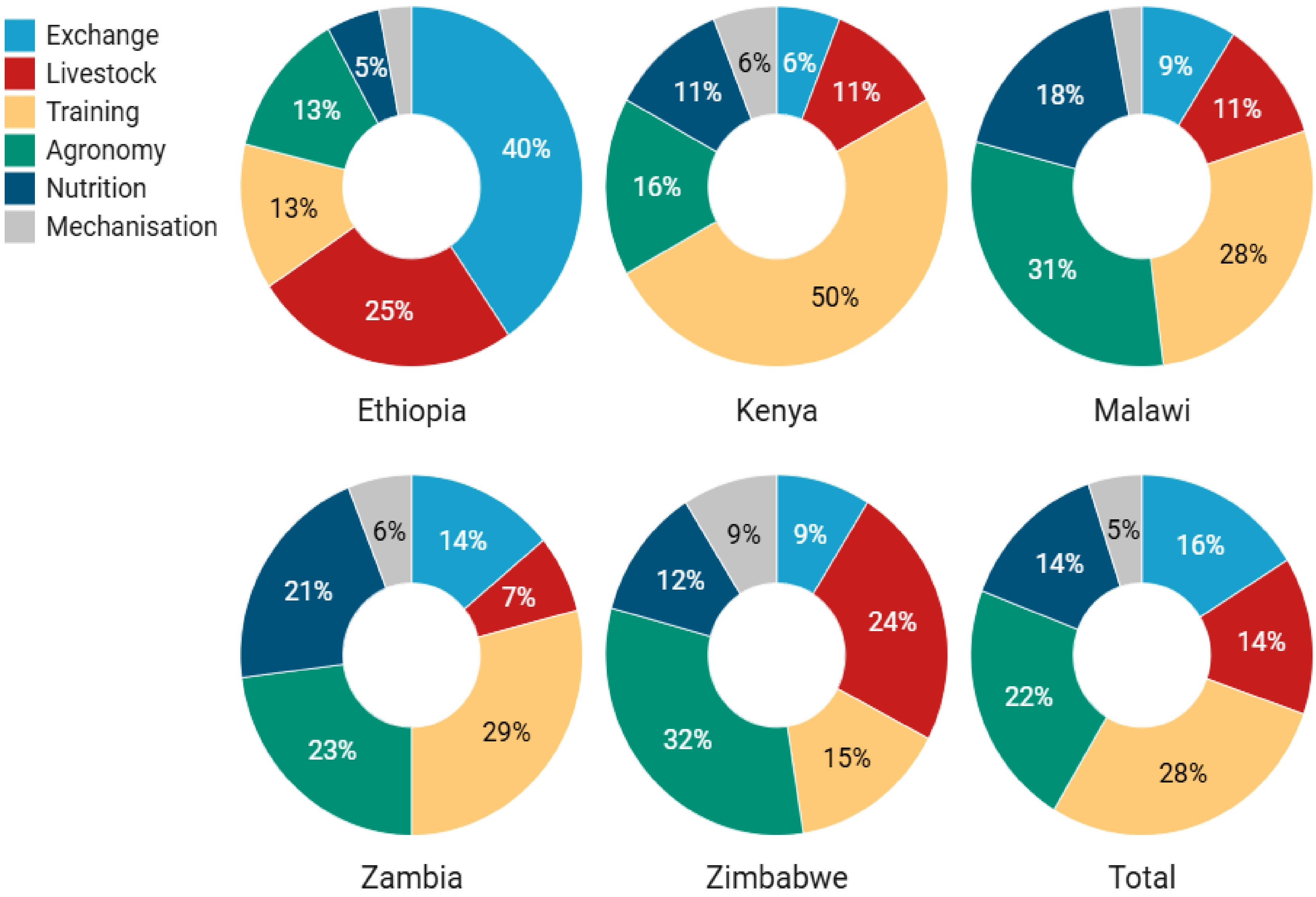

Figure 9: Various ways in which people interacted with Ukama Ustawi in project sites

3.5. The extent of reach of UU activities

The project activities reached approximately 1.05 million people across the targeted countries. When disaggregated by country, Kenya had the highest number of people reached, with a total of 565,000 people (Figure 10). This figure represents nearly half of the total number of people reached by the project. The high number of people reached in Kenya is potentially due to the diversity of interventions in the country. In comparison, the numbers of people reached are lower in other countries. In Malawi, UU reached 212,000 people, while 160,000 people were reached in Zambia. In Zimbabwe, UU reached 61,000 people, and 48,000 people were reached in Ethiopia.

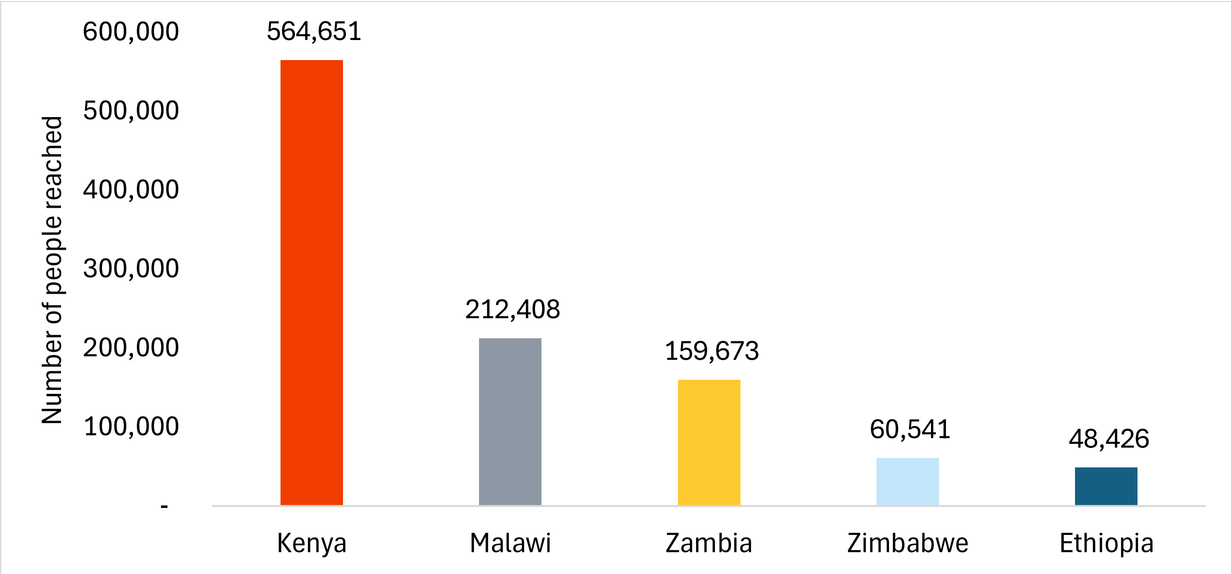

Figure 10: Number of people reached by Ukama Ustawi interventions in the different countries

3.6. Number of beneficiaries of Ukama Ustawi innovations

Across the project sites in the five project target countries, a total of 164,363 people benefited from UU through using various innovations promoted by the Initiative as of September 2024 (Figure 11). Among these, 135,767 people or 82% were direct beneficiaries meaning that they were in districts where specific interventions were implemented and are users of unique interventions (i.e., without spillovers). It's worth mentioning that youth and women also participated in the project activities with a total of 86,008 females (accounting for 52% of the participants) using various innovations. Additionally, 92,847 youths (both men and women), who represent 56% of the total participants were using UU innovations. These results highlight the project's commitment to promoting gender equity and youth empowerment.

The project had the highest engagements in Malawi, where 66,014 people were using the different innovations (Table 4). These results are in contrast with Tufa et al., (2023), who found higher adoption of CA in Zambia and Zimbabwe than Malawi but align to Pangapanga-Phiri et al., (2024) who found higher adoption in the Nkhotakota district where interventions have been ongoing even before UU started. In addition, these differences could be explained by differences in sampling approaches. For example, Unlike Tufa et al (2023) who used a random sample of areas where CA had been promoted in the last ten years from the time of their study, the sampling in this is study is similar to Pangapanga-Phiri et al (2024) who used a more granular approach and sampled from specific project sites.

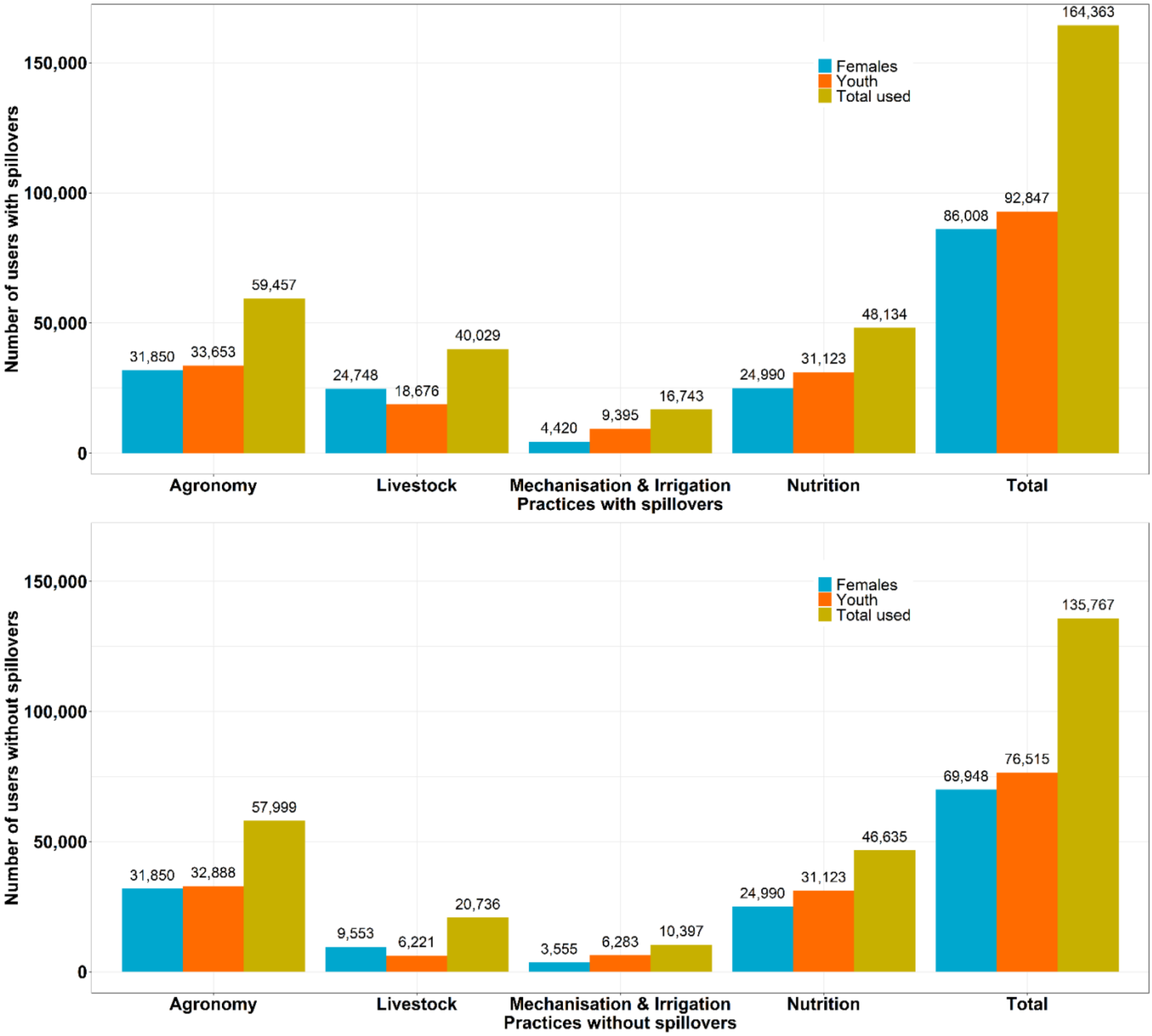

Figure 11: Number of beneficiaries using various Ukama Ustawi innovations overall (top panel) and without spillovers (bottom panel)

Kenya is ranked second with 37,470 people using UU innovations, and this can be partly attributed to the diversity of interventions promoted in the country. Zimbabwe ranked third closer to Kenya with 37,258 people who used UU innovations. One possible reason for the high numbers in Zimbabwe is that all the project's interventions were actively promoted. In contrast, Ethiopia had the lowest number of people using the project innovations (7,413). This lower result in Ethiopia can be attributed to a few key factors, notably the late start of the project in the country and the fewer innovations that were introduced initially. Overall, there were possible challenges faced in different regions as shown by the distribution of people using different project innovations (See Tables S1 – S4 in the Annex).

Table 4: Number of beneficiaries using various Ukama Ustawi innovations by country

Used without spillovers					Used with spillovers			
Country	**Total used**	**SE**	**[95% conf. interval]**		**Total used**	**SE**	**[95% conf. interval]**	
Ethiopia	1,571	1,111	(607)	3,749	7,413	3,798	(32)	14,858
Kenya	37,470	17,886	2,407	72,533	37,470	17,886	2,407	72,533
Malawi	49,812	16,712	17,051	82,573	66,014	22,395	22,113	109,915
Zambia	14,578	5,380	4,030	25,126	16,208	6,068	4,312	28,104
Zimbabwe	32,336	8,673	15,333	49,339	37,258	9,771	18,103	56,413
Total	**135,767**	**49,763**	**38,214**	**233,320**	**164,363**	**59,918**	**46,902**	**281,824**

Note: Disaggregating by technology across countries was not feasible due to low numbers for some technologies

An alternative way to interpret these results is to use the benefit-reach ratio, which is the quotient of the number of beneficiaries relative to those reached by a project. The benefit-reach ratio was highest in Zimbabwe at 61%, followed by Malawi at 31%, Ethiopia at 15%, Zambia at 10% and Kenya at 7%. This means that UU activities were most effective at converting reach to benefits in Zimbabwe, Malawi, Ethiopia, and Zambia than in Kenya, when in absolute sense, more people were reached in Kenya.

3.7. Bundles of technologies used

Figure 12 provides a detailed overview of the distribution of people using different combinations of agricultural practices, shedding light into the varying preferences and adoption patterns. Agronomy and nutrition combination was the most widely adopted, with over 40,000 people (28%) using these two practices simultaneously. This bundle of technologies is followed by agronomy and livestock, which were used by around 38,000 people (23%). Splitting the results with spillovers and without spillovers showed a similar trend in the popularity of these combinations. As would be expected, the least common bundle was the integration of all four technologies: agronomy, mechanization, nutrition, and livestock. This combination was used by only 10,000 people (6%). The distribution of users for these various combinations underscores the importance of understanding the specific needs and resource availability of farmers when designing and promoting integrated agricultural interventions. In addition, despite the likely multiplicative benefits of technologies bundles, we found that the uptake of bundles remains low. This calls for more efforts by development practitioners and national governments to promote technology bundles for enhanced benefits.

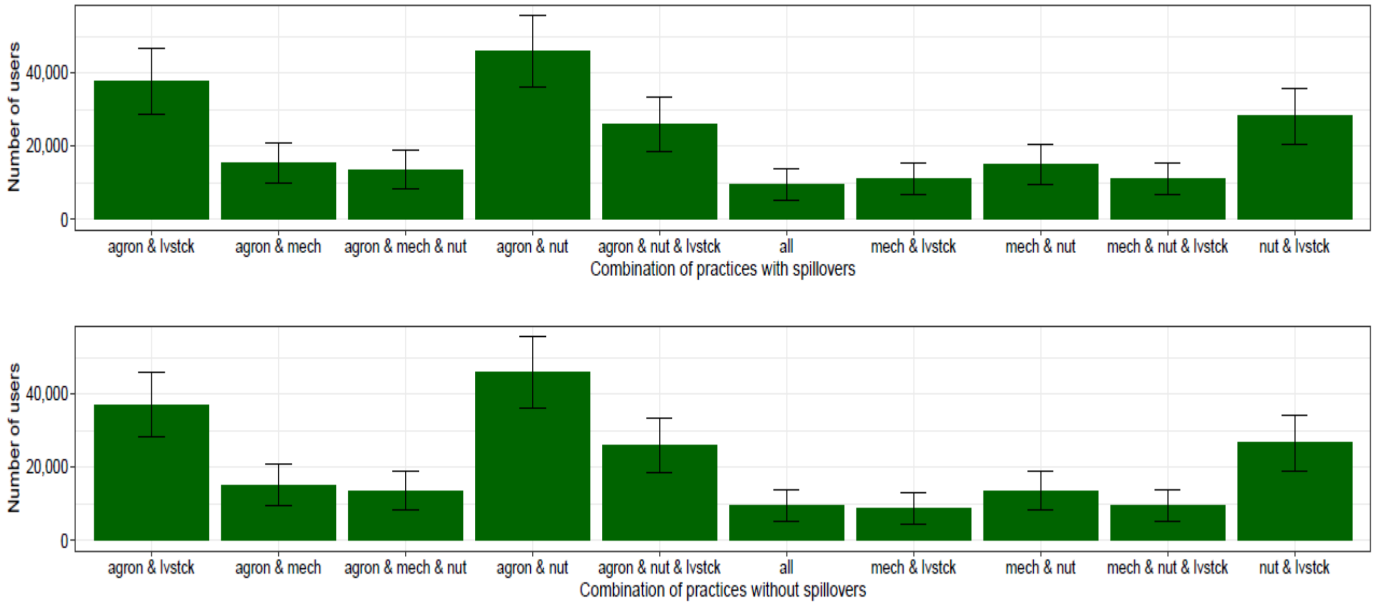

Figure 12: Number of people using various Ukama Ustawi innovations bundles

Notes: agron & lvstck - agronomy and livestock; agron & lvstck & nut- agronomy and livestock and nutrition; agron & mech – agronomy and mechanization; agron & mech & nut – agronomy and mechanization and nutrition; all – all main broad innovations; mech & nut – mechanization and nutrition; mech & nut & lvstck– mechanization and nutrition and livestock; nut & lvstck - nutrition and livestock; spikes represent error bars.

In sum, the results in this paper demonstrate that the sampling approaches influence adoption numbers as suggested by Ngoma et al., (2021). Whether the goal is to estimate representative statistics that allow for inferences to larger geographic areas matters. We demonstrate a conscious attempt to guarantee representativeness within the examined districts by drawing a random sample from the intervention districts using a population-weighted sampling technique. This strategy seeks to improve the precision of the estimates and the generalizability of findings within the administrative units. It is important to recognize any potential restrictions imposed by the sampling technique. For example, the adoption figures may not fairly represent the actual adoption rates for all demographic segments if specific subpopulations within the districts were not included or under-represented at sample design.

3.8. Conclusion and policy implications

It is increasingly critical for international development projects and programs to demonstrate value for money. This is crucial to support scaling efforts and achieve greater impact. Doing so is difficult for various reasons. Chief among these is the failure to embed evaluation frameworks right from the start of interventions. The multiplicity of scaling partners makes it even more complicated to ensure consistent monitoring and evaluation. This paper develops and applies a replicable, population-based survey methodology based on computer-assisted telephone interviewing (CATI) that can be used to assess the extent of reach, adoption and potential impacts of international development projects in contexts where baseline data are missing. We apply this method to the CGIAR Research Initiative for Diversification in East and Southern Africa also known as Ukama Ustawi (UU) implemented with several scaling partners across 12 countries in Eastern and Southern Africa: Eswatini, Ethiopia, Kenya, Madagascar, Malawi, Mozambique, Rwanda, Uganda, South Africa, Tanzania, Zambia, and Zimbabwe. This assessment was restricted to five countries only: Ethiopia, Kenya, Malawi, Zambia, and Zimbabwe. The goal of the assessment was to measure and estimate the reach, awareness, and adoption of agronomy, mechanization and irrigation, livestock, and nutrient-dense crop interventions. We used quantitative primary data collected through CATI from a random sample of 6,445 rural people across 27 districts in five project intervention countries.

Overall, we found that UU Initiative made significant progress in promoting agricultural innovations across Ethiopia, Kenya, Malawi, Zambia, and Zimbabwe, although with varying degrees of success. Out of approximately 12.5 million rural people in the project areas, about 1.05 million (8.4%) were aware of UU activities, with Kenya and Zambia showing the highest awareness levels at around 16% each.

The Initiative successfully reached 164,363 people across the intervention districts, with 135,767 people being direct beneficiaries in areas where specific interventions were implemented. Notably, the project demonstrated strong inclusion, with 52% of beneficiaries being female and 56% being youth (aged 18-35 years), although these proportions varied significantly by country. These results demonstrate that UU exceeded the End of Initiative Outcome of 100, 000 farmers by 36% without spillovers and 64% with spillovers, and the target participation of 40% women and 40% youth by 12 – 16%. At country level, the benefit-reach ratio was highest in Zimbabwe at 61%, followed by Malawi at 31%, Ethiopia at 15%, Zambia at 10% and Kenya at 7%. This means that UU activities were most effective at converting reach to benefits in Zimbabwe, Malawi, Ethiopia, and Zambia than in Kenya, when in absolute sense, more people were reached in Kenya.

We found that technology adoption patterns varied considerably across countries. Zimbabwe and Malawi demonstrated the highest awareness and usage rates of conservation agriculture (CA) practices, particularly minimum tillage technologies. These countries had the highest benefit-reach ratio. This success can be attributed to sustained investments in CA promotion by various stakeholders, including non-governmental organizations (NGOs), and importantly, national governments (e.g., the Pfumvudza/Intwasa Governmental program that promotes CA in Zimbabwe). The study also revealed that the adoption of technology bundles is low, with the combination of agronomy and nutrition practices being the most widely adopted, followed by agronomy and livestock practices.

The research highlighted a persistent gap between awareness and adoption of technologies, a common challenge in agricultural development projects and programs. This suggests the need for more targeted approaches in project design and implementation, particularly in addressing barriers to adoption and scaling. There is a need to embed evaluation frameworks right from project inception and to deliberately target traditionally underrepresented groups to enhance the inclusivity of international development interventions like UU.

The success of the UU Initiative, particularly in countries like Malawi and Zimbabwe, provides valuable lessons on the need to build on from previous projects. This approach is a practical guide to future agricultural development programs in East and Southern Africa. The additional costs of nudging people to adopt technologies are lower in places where target innovations have been promoted before. Leveraging these advantages requires intentional efforts to build synergies and harmony to minimize conflicts, duplication and competition among development practitioners. National governments have a big role to play to actualize a harmonized approach to development facilitation by guiding where interventions are needed in the countries. Development practitioners too need to do a better job to identify ongoing projects and find ways to build synergies.

It is therefore recommended that successor projects to UU, like the CGIAR Scaling for Impact and other development interventions that will co-locate in the same intervention sites build on the UU legacy to strengthen the adoption and scalability of the promoted interventions. This will ultimately help improve the overall impacts and benefits to smallholder farmers – the primary beneficiaries of international development programs. The methodology used in this study can be easily replicated and applied in different settings. One potential improvement is to use cluster randomized sampling approaches and computing sampling weights at different clusters.

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Appendix

Table S1: UU reach by gender with spillovers

Technology	Total used	Youth	Females
Agronomy	59,457	33653	31,850
Mechanization & Irrigation	16,743	9395	4,420
Nutrition	48,134	31123	24,990
Livestock	40,029	18676	24,748
Total	**164,363**	**92,847**	**86,008**
Percentage		**56%**	**52%**

Table S2: UU reach by youth without spillovers

Technology	Total used	Youth	Females
Agronomy	57,999	32,888	31,850
Mechanization & Irrigation	10,397	6,283	3,555
Nutrition	46,635	31,123	24,990
Livestock	20,736	6,221	9,553
Total	**135,767**	**76,515**	**69,948**
Percentage		**56%**	**52%**

Table S3: UU reach with spillovers

Technology	Total used	Std Error	[95% conf. interval]	
Agronomy	59,457	11,115	37,668	81,246
Mechanization & irrigation	16,743	5,590	5,784	27,702
Nutrition	48,134	10,010	28,512	67,756
Livestock	40,029	9,013	22,360	57,698
Total	**164,363**	**35,728**	**94,324**	**234,402**

Table S4: UU reach without spillovers

Technology	Total used	Std Error	[95% conf. interval]	
Agronomy	57,999	11,068	36,302	79,696
Mechanization & Irrigation	10,397	4,352	1,866	18,928
Nutrition	46,635	9,954	27,121	66,149
Livestock	20,736	6,442	8,108	33,364
Total	**135,767**	**31,816**	**73,397**	**198,137**

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