INITIATIVE ON Gender Equality

INITIATIVE ON Diversification in East and Southern Africa

Alliance Bioversity & CIAT

Identifying and measuring the effectiveness of socio-technical innovation bundles on empowerment and resilience in Kenya: a baseline report

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EXECUTIVE SUMMARY

Background of the UU and HER+ initiatives

Ukama Ustawi (UU) is one of the CGIAR initiatives that aims to support climate-resilient agriculture and livelihoods in 12 countries in East and Southern Africa. The initiative supports millions of smallholders to intensify, diversify, and reduce the risks in maize-based farming systems through improved extension services, small and medium enterprise development, governance frameworks and increased investment with a gender and social inclusion lens. In pursuit of achieving its aim, the initiative has collaborated with Harnessing Gender and Social Equality for Resilience in Agrifood Systems (HER+) initiative. HER+ is a CGIAR Action area initiative which tackles different dimensions of gender inequality in agrifood systems to build climate change resilience and empowerment through research.

The HER+ initiative Work Package 2 (WP2), i.e., EMPOWER, works with participants in UU sites in Kenya to identify and prioritize socio-technical innovations bundles for women's empowerment and resilience. Through the learning labs concept, the initiative provides spaces for co-designing of social innovations that are often overlooked during bundling of technical advancements. The absence or limited attention to social innovation often limits access to, control over, and utilization of technology by women, due to the influence of intersectional factors, norms, and policy environment. Inadequate attention to social innovations may lead to processes that may inadvertently exclude women as partners in designing, promoting, and using climate-smart solutions. WP2 contributes to filling the gap by providing evidence about the reasons for women's limited uptake of innovations and developing decision-support tools to guide the design and implementation of STIBs, particularly paying attention to gender and social inclusion. To support the achievement of its objectives, HER+ collected baseline data from UU project sites to establish the status of use of STIBs across agro-ecologies in Kenya, measure the effectiveness of different combination of STIB on resilience and women's empowerment, and identify key indicators for monitoring and evaluation activities.

Methodology

The study was conducted in Embu (Runyenjes and Manyatta sub-counties), Makueni (Makueni and Mbooni sub-counties), and Nakuru (Rongai, Njoro and Gilgil sub-counties) counties in Kenya. Mixed methods combining both quantitative and qualitative data collection techniques were used to collect information from different stakeholders. Quantitative data was collected using a structured questionnaire administered through face-to-face interviews. A total of 806 farmers were interviewed, consisting of 376 UU farmers from 17 groups hosting mother and baby demos and 430 non-UU farmers. About 65% of the sampled farmers were women while 35% were men. Descriptive statistics were used to analyze quantitative data.

Key findings

Respondents' characterization and land utilization

Farmers in Nakuru were older and more experienced in farming, while farmers in Embu were relatively younger. Each household had five members across county, gender, and farmer type. Non-UU farmers were slightly more experienced in farming than UU members but with variations across counties. More UU farmers were married compared to non-UU farmers. Men farmers are highly educated compared to women farmers regardless of farmer type and counties. Crop farming was the main source of income for both UU and non-UU farmers, but UU farmers' average annual income (KES 229, 213 – $1,494) was relatively higher than income earned by non-UU farmers (KES 180,480 – $1,177). Majorly, the land is owned by men, especially among male-targeted farmers, as indicated by 82% of UU farmers and 90% of non-UU farmers. This is attributed of the traditional patriarchal norms, where land titling or registration initiatives commonly focus on households and typically designate ownership to the individual identified as the "head of household," which is predominantly characterized as a male, as well as traditional inheritance norms where men predominantly inherit land. Land owned ranged between 1.75 acres in Embu and 3.37 acres in Makueni, reflecting differences in resource endowments across the counties. UU farmers

> The study was conducted in Embu (Runyenjes and Manyatta sub-counties), Makueni (Makueni and Mbooni sub-counties), and Nakuru (Rongai, Njoro and Gilgil sub-counties) counties in Kenya.

owned larger pieces (2.54 acres) of land than non-UU farmers (1.93 acres). There were gender differences in land ownership and access across the counties, where men UU farmers owned larger parcels (2.67 acres) than women UU farmers (2.50 acres), and a similar trend was observed among the non-UU farmers.

Mechanization of farm operations

Mechanization of farm operations was low across counties and farmer types which could be a barrier to the adoption and scaling of CA practices. Almost all farmers in Embu relied on manual labor compared to 68% in Nakuru and 64% in Makueni. Disaggregated findings by gender indicated that more men farmers (34% of UU farmers and 21% of non-UU farmers) had mechanized their farming operations compared to women farmers (27% of UU farmers and 18% of non-UU farmers). Ox-plough is the most owned mechanization equipment, indicating that either farmers are not or are slow in modernizing farming. Therefore, there is a need to explore different models of accessing machinery or emphasize alternative additional practices like residue retention (currently demonstrated in the mother demo but least preferred by farmers).

Participation in the UU initiative activities

There were high levels of participation in mother (88%) and baby (78%) demonstration setups across the counties. Makueni County had the least participation rate (42%) in baby demonstrations attributed to the late distribution of startup kits. Participation in the co-designing processes was relatively low as reported by 36%, 35%, and 31% of sampled UU farmers in Embu, Makueni, and Nakuru, respectively. Further, 48% of sampled UU farmers across the counties attended nutrition sensitization sessions, only 13% attended the gender-sensitive nutrition trainings in Makueni and Nakuru counties. The majority UU farmers across counties received training on CA techniques (90%) and proper use of inputs (82%). Despite trainings being held in rural communities, men reported higher attendance in most of the training areas than women. This disparity could be linked to mobility challenges emanating from cultural norms and responsibilities that could have limited women's ability to attend training sessions.

The study revealed that intercropping (94%), strip cropping (82%), crop rotation (81%) and minimum tillage (73%) were the most demonstrated CA practices in mother demos. Ripping was common in Makueni (88%) and Nakuru (83%), whereas furrowing and ridging were dominant in Embu (40%). Most farmers anticipated that their participation in the UU initiatives presented opportunities for improving their knowledge in agricultural practices, increasing crop yields and food security, enhancing resilience to climate change, and has improving household nutrition and health.

Adoption of Socio-Technical Innovation Bundles

The study revealed that 63% of the surveyed farmers adopted STIBs. STIBs adoption was higher among UU farmers (98%) compared to non-UU farmers (33%) which could be attributed to their participation in the UU initiative. STIBs adoption rate among women in Embu and Makueni was slightly lower than the rate of STIBs among men. This suggests possible underlying socioeconomic issues obstructing women from using STIBs. More (45%) non-UU farmers in Embu adopted STIBs compared to Nakuru (38%) and Makueni (17%). Technological innovations as components of STIBs were the most adopted (99%) compared to social innovations (89%) and technical innovations (72%). UU farmers had higher adoption rates of the different innovation components of STIBs. The disparities in use of

STIBs components between UU and non-UU farmers could be attributed to better access to information and support provided through the UU initiative. In terms of numbers adopted, farmers reported an average of 3 to 7 technological innovations and 1 to 3 technical and social bundles. The UU farmers had a higher number of technological, technical, and social innovations compared to non-UU farmers. Most farmers have used STIBs within the last two years as evidenced by 63% of non-UU farmers and 70% of the UU farmers.

There was a total of 485 unique STIBs in the dataset with majority (69%) reported by women and UU farmers (71%). About 40% of the STIBs were reported in Nakuru County. Improved seed, farmer training, and group membership were the most used STIBs by farmers (9 farmers out of 499 STIBs adopters) across the learning labs. Majority of the STIBs were reported women (69%) and UU farmers (71%).

Effectiveness of UU and HER+ initiatives

Productivity was higher in baby demonstration plots than in general plot. Bean productivity in from demo was 64% higher than harvest from general plot. Maize productivity for UU baby demonstration plots 81% higher than maize harvested from the general plot. This demonstrates the effectiveness of the interventions by the initiatives to enhance productivity. There was a narrow gender gap in bean productivity in baby demonstration plots compared to bean productivity in the general plot.

Farmers experimented with four out of the six CA no till (NT) ripping practices on farmers' fields. The most selected and experimented CA practice on the baby demo was the standard maize-common bean intercrop as reported by 49% of UU farmers. Strip cropping common bean-maize strips, common bean-maize intercrop double row configuration, and continuous maize were experimented by 32%, 13%, and 2% of the UU farmers in Nakuru respectively.

About 30% of sampled UU farmers replicated the CA practices experimented in the mother and baby demos on the general plot. Replication of CA practices on the general plot was higher in Makueni (39%) and the least (15%) in Embu County, possibly due to the severity of climate-related shocks in Makueni. Standard maize-bean intercrop was the most replicated CA practice in Nakuru County (49%) and Makueni County (47%), whereas standard maize-common bean intercrop was the most replicated CA practice in Embu County (40%). Gender disaggregated findings indicated that more men farmers replicated CA practices than female farmers. This finding points to the possibility of female farmers lacking resources to implement the CA practices or possible influence of social norms which grant men powers to decide practices implement.

Empowerment

Most of the agricultural decisions across counties, gender, and farmer types were made jointly. There was a considerable percentage of women making decisions in the female targeted farmers and men making decision among male targeted farmers. Farmers who adopted STIBs reported higher empowerment score (2.37) compared to non-adopters (2.19). UU farmers had a higher empowerment score (2.25) compared to non-UU farmers (2.21).

Contribution of UU and HER+ activities to food security and resilience

More (19%) UU farmers were food secure compared to non-UU farmers (10%). Farmers in Nakuru county were more food secure (19%), while Makueni had the least percentage of food secure households (10%). Both men and women UU farmers performed better in terms of food security status compared to non-UU farmers implying that they always had access to enough food for an active, healthy life for all household members. Participation in nutrition sessions/ gender sensitive trainings led to modification of dietary practices (79%) and increased in consumption of biofortified foods (64%).

About 96% of farmers surveyed experienced climate related shocks. STIBs significantly enhance resilience capacities for all farmers, with UU farmers showing notably higher capacities (23.58) than non-UU counterparts (14.97), and equitable effectiveness across genders. Higher anticipative and absorptive resilience capacities were reported, especially among UU farmers.

However, transformative resilience capacity was low across farmer types.

Resilience impact varied by county, with Makueni leading in STIBs effectiveness, reflecting the potential influence of local climate conditions. Most of the UU farmers attributed their status of climate resilience to knowledge exchange and capacity building, training in agricultural practices and crop production, access to improved inputs and technologies and climate-smart agriculture adoption.

Conclusion

In several respects, the study team notes that UU and HER+ initiatives are on course in achieving its objectives and is making good strides in sustained improvement empowerment and building resilience among male and female farmers in that target counties through adoption of CA practices and STIBs. Despite the progress made in the space of the techno-centric approaches, there are relatively sufficient evidence of gender gap that favors men that has contributed to worse outcomes compared to the male counterparts. The initiatives have been effective in replicating technology from demonstration plots to general plots. The STIBs have been widely adopted by farmers but with varying intensity. There is strong evidence that STIBs have influenced the food systems among the targeted farmers through effective in achieving higher productivity, food and nutrition and enhancing climate resilience. However, while the outcomes so far have been effective in contributing to sustained improvement in the food systems and empowerment of men and women, the overall objective can only be fully attained and sustained if results obtained are consolidated, intensified, and up scaled. The hallmark of success in sustained interventions to achieve wider adoption of the CA practices and STIBs by critical mass of technological champions among the farmers.

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LIST OF ABBREVIATIONS AND ACRONYMS

AECL	AfriDev Economic Consulting Limited
ABC	Alliance of Bioversity International & CIAT
CA	Conservation Agriculture
CGIAR	Consortium of International Agricultural Research Centers
CIAT	International Center for Tropical Agriculture
CSA	Climate Smart Agriculture
ESA	East and Southern Africa
FAO	Food and Agriculture Organization
FCS	Food Consumption Score
GPS	Global Positioning System
HER+	Harnessing Gender and Social Equality for Resilience
HFIAS	Household Food Insecurity Access Scale
HH	Household
IIED	International Institute for Environment and Development
KALRO	Kenya Agricultural and Livestock Research Organization
KES	Kenya Shillings
NT	No Till
PII	Personally Identifiable Information
SDGs	Sustainable Development Goals
SI	Sustainable intensification
SMEs	Small and Medium Enterprises
STIBs	Socio-Technical innovation Bundles
UU	Ukama Ustawi
WP2	Work Package 2

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CHAPTER ONE: INTRODUCTION

1.1 Background and context- Ukama Ustawi and HER+ initiatives

Smallholder farmers play a crucial role in global food systems, serving as the primary providers of food. Their role is more pronounced in sub-Saharan and Asia for they supply up to 80% of food in the two regions[1]. According to the Food and Agriculture Organization (FAO), there are about 600 million smallholder farmers operating on five acres of land or less. The primary objective of their endeavors is to sustain food availability of affordable, fresh, and nutritious food to their households and local communities[2],. However, their operations are often impeded by a myriad of challenges, including lack of funding, gender biases, limited resources, climate change and low resilience to climate change, improper infrastructure, and other socioeconomic related factors.

Climate change, a phenomenon characterized by global warming, rise in the sea level and melting of ozone layer is a threat to sustainability of smallholder production. Climate change is increasing the frequency and severity of droughts, flooding, pests, and diseases, leading to adverse impacts such as crop failure, low crop productivity, human health, water availability and biodiversity loss[3]. This has posed a threat to global food security and undermining nutritional status of the people. Women are disproportionately affected by natural disasters, as they bear the brunt of the effect due to their direct reliance on natural resources and local ecosystems in their efforts to support their families[4]. The primary contributing factors to this phenomenon can be attributed to the unequal ownership and access to resources, high poverty rates in comparison to their male counterparts, and limited support systems that could aid in their preparedness for and recovery from natural calamities.

Over the past decades, development organizations and governments have promoted the use of agricultural technologies, dubbed as techno-centric approaches, as effective ways of addressing the impact of climate change[5]. However, improving food production and resilience to climate change requires the adoption of technologies that are not only cost-effective and environmentally sustainable but also socially acceptable and culturally compatible[6]. The associated livelihood impacts of technological innovations adoption are hinged on pathways of improvement in agricultural productivity and reduced poverty by increasing the income and consumption of farm households[7]. Moreover, the adoption of agricultural technology increases production and productivity for home consumption and reduced food prices, which encourages more food consumption contributing to food security[8].

Despite the success mentioned above, the techno-centric approaches have not yielded the desired outcome as evidenced by slow progress towards achievement of Sustainable Development Goals (SDGs). Inequalities in food systems persist as women farmers and marginalized socio-economic groups are constrained by social and gender norms as well as structural barriers. Furthermore, the imbalance is pegged on the understanding that technologies are exogenous and often packaged with innovations that are rarely co-designed by the most affected groups. Most existing innovation bundles ignore local context, such as the indigenous knowledge, culture, and institutions. Considering this, the concept of socio-technical innovation bundles (STIBs), coined by Barret et al. (2022)[9], has gained significant attention in the field of agriculture and food systems. The STIBs have a potential transforming the agrifood system towards gender and social inclusiveness. STIBs uniquely bundles technological innovations with compatible social and technical innovations such as training, access to credit, access to agricultural inputs and

1 Livingston, G., Schonberger, S., & Delaney, S. (2011, January). Sub-Saharan Africa: The state of smallholders in agriculture. In *IFAD Conference on New Directions for Smallholder Agriculture* (Vol. 24, p. 25).
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3 Harvey, C. A., Rakotobe, Z. L., Rao, N. S., Dave, R., Razafimahatratra, H., Rabarijohn, R. H., ... & MacKinnon, J. L. (2014). Extreme vulnerability of smallholder farmers to agricultural risks and climate change in Madagascar. *Philosophical Transactions of the Royal Society B: Biological Sciences,* 369(1639), 20130089.
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5 Ruzzante, S., Labarta, R., & Bilton, A. (2021). Adoption of agricultural technology in the developing world: A meta-analysis of the empirical literature. *World Development,* 146, 105599.
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8 Biru, W. D., Zeller, M., & Loos, T. K. (2020). The impact of agricultural technologies on poverty and vulnerability of smallholders in Ethiopia: a panel data analysis. Social Indicators Research, 147(2), 517-544.
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access to output market among others to enable farmers especially women to achieve a healthy, equitable, resilient, and sustainable outcomes[10]. The bundling of STIBs lays emphasis on gender and social inclusion, thus contributing to women empowerment and resilience in the agrifood systems. The development and implementation of STIBs in Kenya is coordinated by Ukama Ustawi (UU) initiative in collaboration with the Harnessing Gender and Social Equality for Resilience in Agrifood Systems (HER+) initiative.

The UU initiative is a regional CGIAR initiative that focuses on Diversification for Resilient Agribusiness Ecosystems in East and Southern Africa (ESA). The UU aims to help smallholders transition to sustainably intensified, diversified, and de-risked agri-food systems based on maize in 12 ESA countries. Specifically, it seeks to enable 50,000 value chain actors, including farmers (at least 40% women, 40% youth), to adopt climate-smart maize-based intensification and diversification practices and one million to access digital agro-advisory services[11]. Emphasizing the role of the private sector in driving such transformation, UU targets to support at least 30 start-ups and Small and Medium Enterprises (SMEs). The UU initiative aligns with the CGIAR 2030 Research and Innovation Strategy, with a focus on enhancing smallholder productivity, diversification, and risk mitigation in maize-based farming across 12 countries in ESA. One of the features of UU initiative is the use of four interconnected platforms: a scaling hub, a policy hub, an accelerator program, and a learning platform. This provides spaces for exchange and learning with partners across all CGIAR Initiatives in the region. The platforms aim to change the knowledge, attitudes, and practices of millions of farmers in ESA. In Kenya, the UU works in Nakuru, Embu and Makueni counties and its activities are coordinated by the Alliance of Bioversity International and CIAT (ABC) and implemented by Kenya Agricultural & Livestock Research Organization (KALRO), Cereal Growers Association (CGA), Africa Conservation Tillage Network (ACTN), development and County Governments in target sites[12].

10 Socio-Technical Innovation Bundles (STIBs) for women's empowerment and resilience in the agrifood system: https://www.cgiar.org/news-events/news/socio-technical-innovation-bundles-stibs-for-womens-empowerment-and-resilience-in-the-agrifood-system/

11 CCARDESA and IMWI Partner Under Ukama Ustawi for Learning and Policy Support: https://www.ccardesa.org/ccardesa-and-imwi-partner-under-ukama-ustawi-learning-and-policy-support

12 Bundling Social Technical Innovations for a Diversification, Inclusive and Resilient Agri-Food System in Kenya: https://alliancebioversityciat.org/stories/bundling-social-technical-innovations-diversification-inclusive-resilient-agri-food-system-kenya

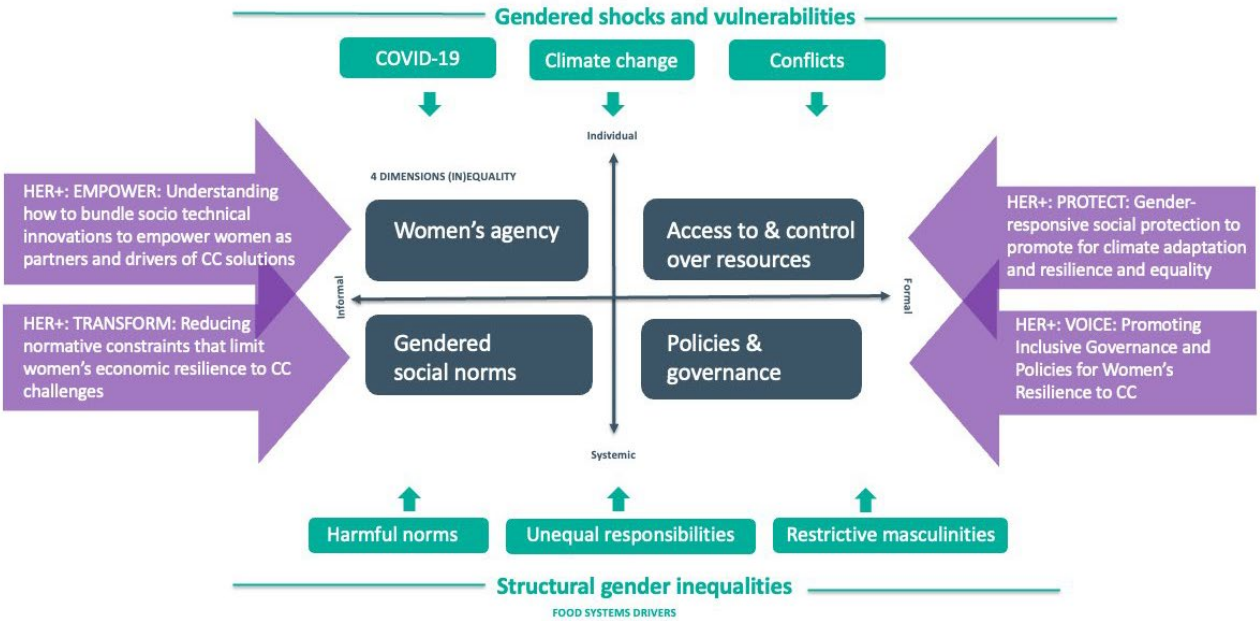
The CGIAR's Gender Equality Initiative "Harnessing Gender and Social Equality for Resilience in Agrifood Systems (HER+)" was hinged on the UU learning hubs initiative. The aim of HER+ is to achieve climate resilience by strengthening gender equality and social inclusion across food systems in the Global South[13]. HER+ initiative tackles the four main dimensions of gender inequality in agrifood systems (Figure 1) to build climate change resilience through research on (i) women's agency: their ability to define and act on goals, make decisions that matter to them, and participate in the economy and public life; (ii) women's lack of access to and control over resources; (iii) social norms that discriminate based on gender; and (iv) policies and governance that fail to include and benefit women[14]. Specifically, the HER+2 leverages on UU to mainstream STIBs in UU activities for inclusive contribution to resilience to climate change and women empowerment. HER+2 uses UU sites as learning labs for co-designing STIBs.

> "The UU initiative is implementing on-farm demonstrations of conservation agriculture through mother and baby trial designs.

13 Bundling socio-technical innovations to empower women as partners and drivers of climate change solutions: https://alliancebioversityciat.org/publications-data/bundling-socio-technical-innovations-empower-women-partners-and-drivers-climate#:~:text=The%20CGIAR%20Initiative%20on%20Gender,systems%20in%20the%20Global%20South.

14 HER+: Harnessing Gender and Social Equality for Resilience in Agrifood Systems: https://www.google.com/search?q=HER%2B+tackles&oq=HER%2B+tackles&gs_lcrp=EgZjaHJvbWUyBggAEEUYOTIICAEQABgWGB4yCggCEAAYhgMYigUyCggDEAAYhgMYigXSAQg2NTg0ajBqN6gCALACAA&sourceid=chrome&ie=UTF-8#ip=1

Figure 1: Conceptualization of HER+ entry points to tackling gender inequalities in agrifood systems.



This study is under Work Package 2 (WP2) of HER+, i.e., EMPOWER: Bundled Innovations for Women's Empowerment. WP2 co-designs and tests context-specific and gender responsive for women's empowerment and resilience to climate change. It seeks to address the constraints to technology access, use and control that differ by gender and intersect with other vulnerabilities due to factors such as limited access to resources, decision-making processes, services, or information. WP2 contributes to filling the gap by providing evidence about the reasons for women's limited uptake of innovations and developing decision-support tools to guide the design and implementation of Socio-Technical Innovation Bundles (STIBs).

Based on the foregoing, HER+ engaged AfriDev Economic Consulting Limited (AECL) to undertake the field data collection to support the achievement of its objectives by:

- Co-identify, co-develop, and test context specific STIBs to collaboratively address climate change and empowerment.
- Co-design and engage multiple partners and use diverse pathways, and processes to boost the adoption of climate smart STIBs among farmers, especially women.
- Contribute to the development of a comprehensive toolbox that provides guidance on the data, tools, and processes essential for creating, implementing, and evaluating climate smart STIBs, ensuring women's empowerment and bolstering resilience.
- Feed information from this study into the STIB tool kit and dashboard.

1.2 Objectives of the study

Specifically, the baseline objectives were to:

1. Establish the status of use of STIBs across agro-ecologies in Kenya.
2. Identify key indicators for monitoring and evaluation.
3. Inform the design and implementation of socio-technical innovation bundles, ensuring that they are tailored to actual needs and conditions of farmers.

1.3 Scope of the work undertaken

The baseline study was conducted in three counties in Kenya, namely Nakuru, Embu and Makueni. The three counties are the learning labs of the UU initiative in Kenya. The UU initiative is implementing on-farm demonstrations of conservation agriculture through mother and baby trial designs. The design has two levels: mother trials which are the learning sites and baby trials which are farmer experimentation. The experiments are designed to enable co-designing of climate smart risk management strategies and co-designing of technologies needed for specific demographic groups such as women

farmers. The baseline study focused on collecting demographic characteristics, farmer participation in UU activities, effectiveness of UU activities, adoption, and effectiveness of STIBS and implication of these information on monitoring and evaluation.

1.4 Structure of the report

This report is divided into 10 main chapters, which include an introduction, methodology, results and discussion, and finally conclusions and recommendations. The introductory section gives the project background and context, objectives and research questions. The second section of the report describes the methods used to address the objectives and the research questions. The methodology presents the study approach detailing the data collection methods/tools, sample size determination, data collection and analysis, quality assurance measures and limitation. Chapter three to nine presents study findings based on the themes of respondents characterization, and land utilization, mechanization of farm operations, participation in the uu initiative activities, adoption of socio-technical innovation bundles, effectiveness of UU and HER+ initiatives, farmer empowerment, contribution of UU and HER+ to resilient food systems. The final section highlights the conclusions and provides recommendations generated from the study finding.

> “WP2 contributes to filling the gap by providing evidence about the reasons for women’s limited uptake of innovations and developing decision-support tools to guide the design and implementation of Socio-Technical Innovation Bundles (STIBs)

CHAPTER TWO: METHODOLOGY

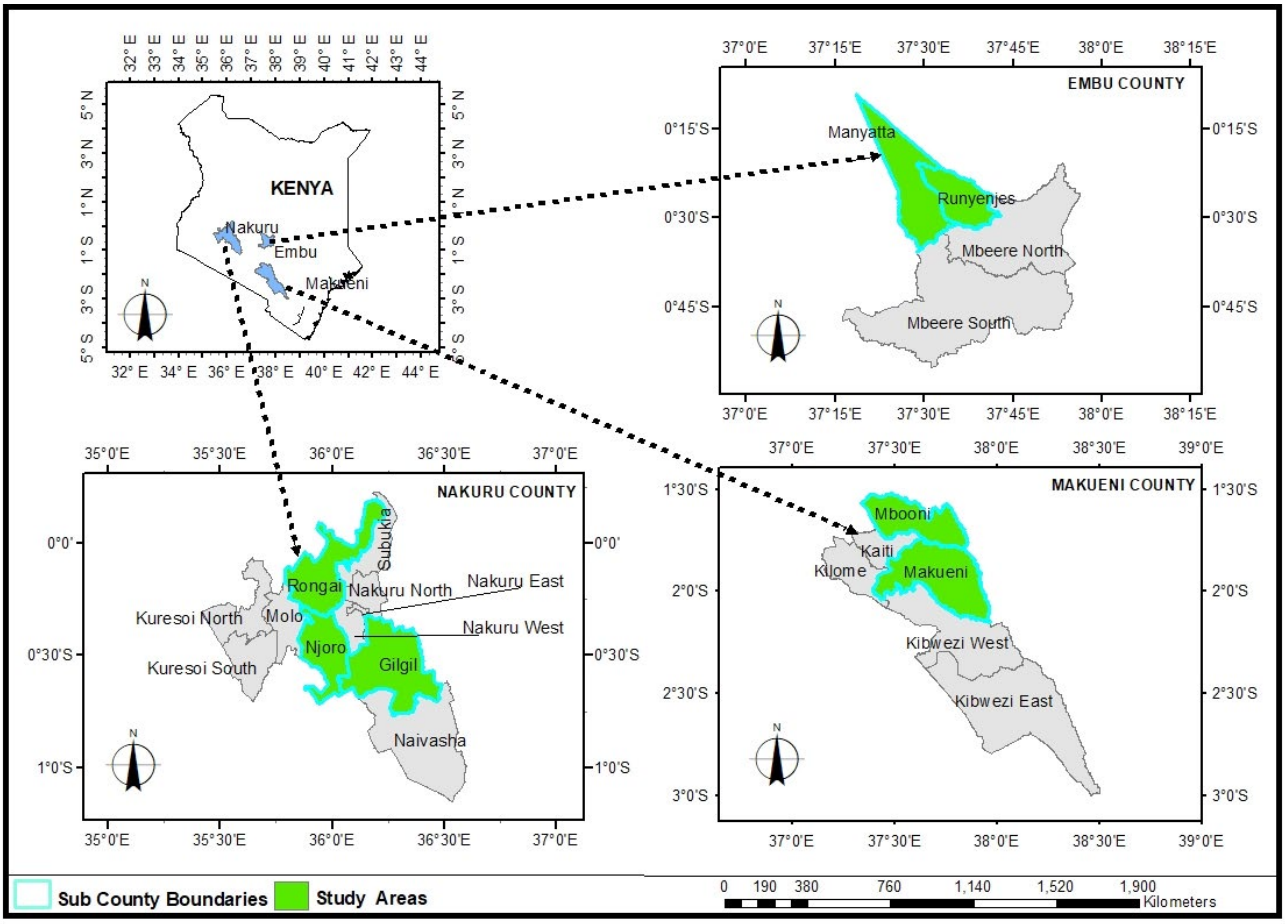
2.1 Study area and proposed approach

The quantitative data collection was conducted in Embu (Runyenjes and Manyatta sub counties) Makueni (Makueni and Mbooni Sub counties) and Nakuru (Rongai, Njoro and Gilgil sub counties) counties in Kenya (Figure 2), that is targeted under the UU and HER+ initiative. In all the three regions, agriculture is predominantly rainfed, with localized areas undertaking minimal irrigation. Recently, the areas have experienced erratic rainfall and extended dry spells that has increased production risks.

Nakuru County is located in Kenya in latitude 0° 29′ 59.99″ N and longitude: 36° 00′ 0.00″ E. Nakuru has an average elevation of 1871 meters above sea level and environmental conditions is characterized by generally temperate and warm conditions. The County has a wide range of agro-ecological and socio-economic characteristics, spanning from regions with limited agricultural potential to highly productive areas that serve as the breadbasket of Kenya. The annual rainfall pattern exhibits a bimodal distribution, with altitudinal variations resulting in a range of 800 to 1400 mm. The primary food crops grown in the county consist of various cereals such as maize and wheat, legumes like common beans, and root crops and tubers such as Irish potatoes. Fruits and vegetables, including tomatoes, peas, carrots, onions, French beans, citrus fruits, peaches, apples, cabbages, strawberries, asparagus, and leeks, are also crops grown in the county.

Makueni county on the other hand is classified as one of Kenya's dry and semi-arid counties, characterized by an annual precipitation range of 500 to 1,500 mm in the low-moorland parts and the sub-humid hilltops, respectively. The variability and unpredictability of seasonal rainfall patterns result in frequent occurrences of water scarcity, crop failure, and limited ability to adapt to climate change. The predominant agricultural crops cultivated in Makueni consist of drought-tolerant types,

Figure 2: Map of the study areas



specifically legumes such as cowpeas, pigeon peas, and green grammes, as well as cereals like short-duration maize varieties that exhibit resilience in the face of drought conditions.

Embu County is situated between latitude 0° 8′ and 0° 50′ South and longitude 37° 3′ and 37° 9′ East. The county is located within the Upper Midland semi-humid zone, with an elevation ranging from around 1,200 to 2,070 meters above sea level. The average annual temperature fluctuates between 12 °C and °C. The distribution of rainfall exhibits a bimodal pattern, characterized by two distinct peaks. The long rainy season typically spans from mid-March to May, while the short rainy season occurs between October and December. On average, the annual rainfall ranges from 1,000 to 2,000 mm. The farming systems in the county consists of intricate smallholder farms that are meticulously managed, characterized by intercropping of various crops, trees, and livestock. The primary subsistence crops encompass maize, beans, yams, cassava, millet, sorghum, and bananas. The primary cash crops encompass tea, coffee, and macadamia nuts.

2.2 Study process

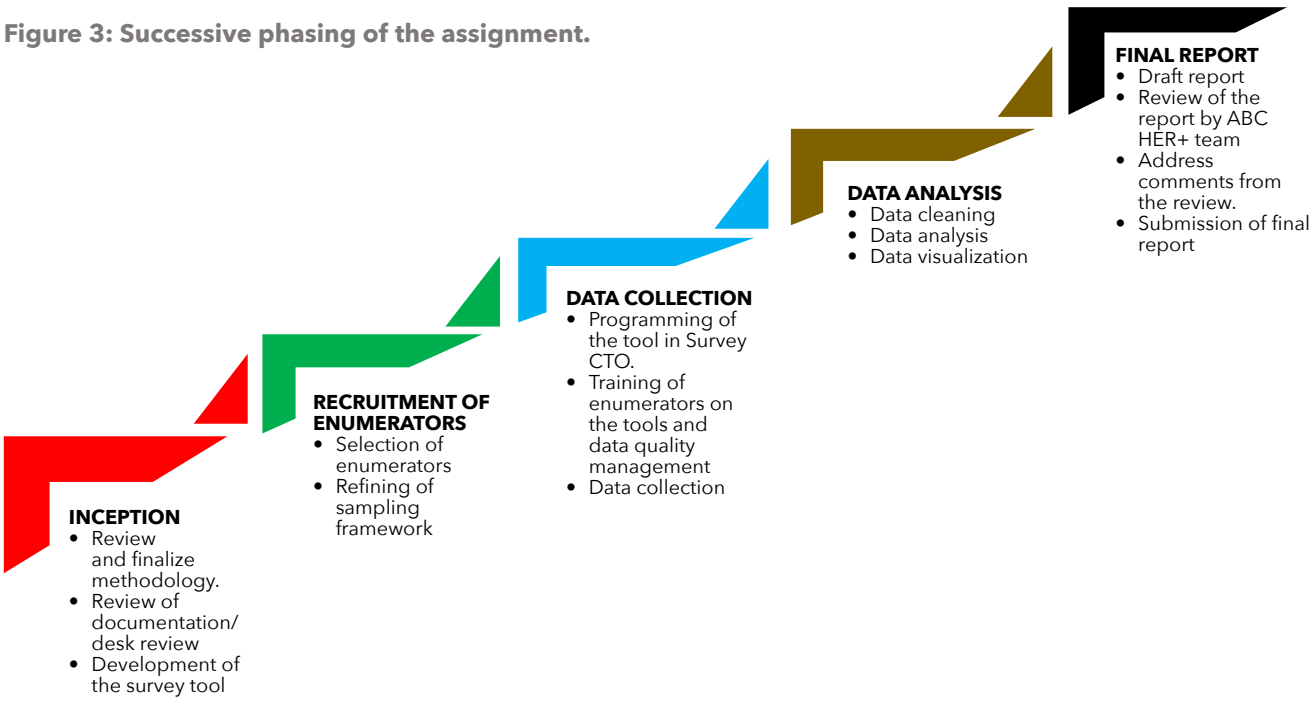
The baseline study was implemented in five phases as presented in Figure 3.

2.3 Data collection method

The study was implemented using mixed methods, combining both quantitative and qualitative data collection techniques. This facilitated the triangulation of the information from the different sources to provide baseline data to inform programming. Specifically, the data collection methods included:

- **Desktop review:** The consultant performed content analysis drawn from available project documents and online sources. It also involved reviewing the relevant project background documents provided by the ABC HER+ focal person for Kenya.
- **Observations and photography:** Besides conducting face-to-face interviews, the data collection team also relied on observations and photographs of mother and baby demo farms and activities during project implementation. These observations and photos validated some of the information collected from other sources and provided a better understanding of the current situation.
- **Survey of farmers:** This involved a survey of farmers involved in the project and those not involved in the project. Data from surveyed UU farmers were used to derive the quantitative information that will be used to guide monitoring and evaluation. A total of 806 farmers across

Figure 3: Successive phasing of the assignment.



the three countries learning were surveyed. A semi-structured questionnaire was developed by the ABC HER+ team with input from AECL. Thematically, the questionnaire was grouped into 12 modules of: household identification, household demographic characteristics, land ownership and livestock keeping, participation in initiative/project activities, mechanization of farm operations, crop production, gender gaps, socio-technical innovation bundling, food security, institutional and organizational support, household income and resources, climate change and resilience and Ukama Ustawi engagements.

The semi-structured questionnaire was programmed in Survey CTO digital data collection and management platform. A four-day enumerator training workshop for enumerators was organized by AECL at KALRO. The training focused on two days of understanding the survey questions and how to administer the questions to farmers using Computer-Assisted Personal Interviews (CAPI). The training also involved a series of role-plays to ensure the enumerators comprehended the survey tool. The tool was pre-tested on the third of training, where enumerators had the opportunity to interact with tool with by asking questions to farmers that were selected one of non-UU wards in Njoro sub-county. Feedback from pilot exercise was collected during a recap session to further improve the logic and flow of survey questions in CAPI.. The enumerators were briefed by ABC HER+ team and consultant on the study and expectations and data quality.

2.4 Sampling frame and technique

The target population in this study were Ukama Ustawi initiative beneficiaries/farmers in the HER+ learning in Kenya. These farmers are dubbed "UU farmers herein. The survey's primary sampling unit was the list of farmers implementing STIBs. According to project documents, 150 farmers were onboarded into the UU initiative in each county. Therefore, the sampling frame for UU farmers was 450. The study also selected a control group of farmers for the purpose of analysis of the effectiveness of innovations being tested by UU and HER+ initiatives. The local government agricultural extension officers supported the selection of a control group of farmers – farmers not participating in UU activities herein dubbed "non-UU farmers" – from

"The survey's primary sampling unit was the list of farmers implementing STIBs. According to project documents, 150 farmers were onboarded into the UU initiative in each county.

sub-counties within the three learning labs that were not participating in UU activities. The selection of control wards in non-UU sub-counties ensured that ward had similar agro-ecological conditions as those in UU intervention wards and sub-counties. A transect sampling procedure was then used to select the non-UU farmers.

2.5 Sample size determination

According to the project documents, the population of UU farmers in the counties was 450 men and women farmers. Therefore, to select a representative sample for the study (n), the formula by Kothari (2004) of a known sample was used to generate a sample size. Assuming a 95% confidence interval, a margin error (e) of 5%, and a design effect of 1.85 to reduce the loss of precision arising from the clustering, the sampling formular was specified as follows:

$$n = \frac{N}{1 + N(e)^2} * deff$$

where n is the desired sample size, N is the population size, e is the acceptable error (0.05) and *deff* is the design effect. Therefore, the final sample was generated as follows;

$$n = \frac{450}{1+450(0.05)^2} * 1.75 = 371 \text{ respondents}$$

The sample was then distributed proportionately to the population of beneficiaries supported by the initiative in the three counties. The sample for the target group (UU farmers) was then matched with the control group that resulted to a final target sample of 742 respondents. This sample size maintained the balance between the treated group and control

> Of the farmers interviewed, 65% were women, while 35% were men. About 75% of the surveyed UU farmers were women, compared to 58% of the non-UU farmers (Table 2). Makueni had the highest proportion of women farmers (72%), while Nakuru had the highest number of men farmers (41%).

group to enhance the validity of the comparable analysis by minimizing the chances of results being skewed due to inherent differences in the groups that are unrelated to the intervention. Having a balanced sample of UU and non-UU farmers was also necessary to increase the statistical power of the study allow generalizability of the study's findings and enhance the understanding of differential effects. However, the targeted sample size was surpassed during data collection to account for potential dropouts or incomplete responses and the expectation of unwillingness to participate. Therefore, a total of 806 farmers were interviewed, consisting of 376 UU farmers from 17 groups (men, women and joint) hosting mother and baby demos and 430 non-UU farmers. This implied that 5 UU and 59 of non-UU farmers were oversampled for replacement for future monitoring activities. Table 1 presents a summary of the data collection by county and type of farmer.

Table 1: Summary of sampled farmers by county and type of farmer

County	Type of Farmer		TOTAL
	UU farmer	Non-UU farmer	
Nakuru	147	165	312
Embu	114	136	250
Makueni	115	129	244
Total	376	430	806

Of the farmers interviewed, 65% were women, while 35% were men. About 75% of the surveyed UU farmers were women, compared to 58% of the non-UU farmers (Table 2). Makueni had the highest proportion of women farmers (72%), while Nakuru had the highest number of men farmers (41%).

Table 2: Gender disaggregation of the farmers interviewed (%)

Variable		Women	Men
County	Embu	67	33
	Makueni	72	28
	Nakuru	59	41
Farmer type	Non-UU	75	25
	UU	58	42
Pooled	**Pooled**	**65**	**35**

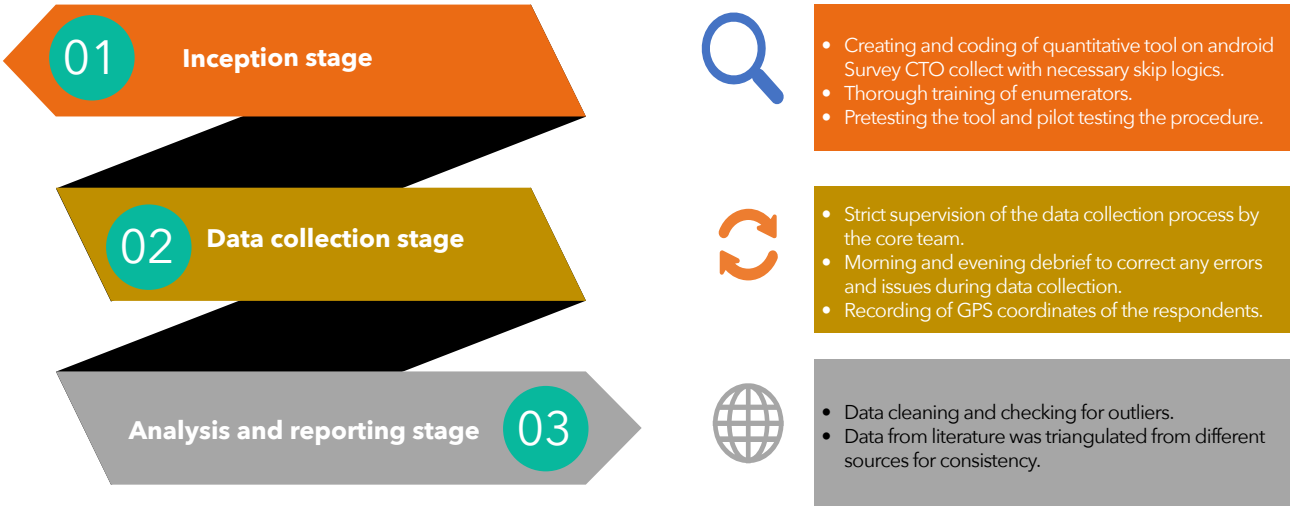
2.6 Data processing and analysis

The collected data were cleaned after the field work to remove any outliers, discrepancies, and filling our filling in missing values where appropriate. This ensures accurate, consistent, and relevant data for subsequent analyses. Data cleaning generated a non- Personally Identifiable Information (PII) survey dataset. The data analysts proceeded with the analysis of all the variables of interest. Quantitative analysis included descriptive statistics (cross-tabulations, mean, and percentages) and test of significance (Fisher's exact test, chi-square test of independence, and analysis of variance) on variables of interest was performed in Stata and Excel. Tabulation and data visualization techniques were used to present findings. The statistical methods employed are summarised in Table 3.

Table 3: Summary of data analysis methods employed.

Data analytical methods	Description of the method
Descriptive analysis	It described key variables and provided the basis for further statistical analysis.
Comparative analysis	Cross-tabulation of variables of interest (e.g., resilience, empowerment, STIBs, and food security) by farmer type (UU and non-UU), gender, and learning lab. This involved cross-tabulation and tests of significance

Figure 4: Data quality measures employed in the study



2.7 Data quality assurance

Strict quality control measures were followed throughout the assignment. The research assistant checked the data daily to ensure consistency and identification of anomalies that were corrected during field work. The specific quality control measures are highlighted in Figure 4.

2.8 Ethical considerations

The following ethical considerations were deployed in the study:

1. **Seeking verbal informed consent** from the selected respondents.
2. **Maintenance of strict confidentiality** and that all personal identifiers were delinked by coding. The unique identifiers only appeared in the consent form, which was stored separately. The codes were kept securely in a password-protected computer.
3. **An ethical review of the data collection protocols and instruments was sought from the ABC internal ethics review board.**
4. The study team was **trained in ethical procedures** and measures to protect confidentiality and needed to sign confidentiality agreements.
5. The consultant committed to the ABC Safeguarding Programme Participant Policy and Code of Conduct.
6. The survey team implemented the following procedures for data security:
   - Passwords were used to restrict access to the data collection tablets and the server used for data storage.
   - Enumerators were well-trained in data security.
   - **All data collected were kept secure**, in locked storage spaces for the written notes or password-protected files and computers for the digital files.
   - Strict adherence to the data protection and privacy policy of ABC and AECL.

2.9 Limitation of the study

The study was limited by the following:

1. Unavailability of some farmers for interviews: They were available past 5 pm due to off-farm job-related activities and other personal commitments. The team had to fit into their program and interview them past 5 pm to minimize non-response bias.
2. Group dynamics affected the functioning of the groups thus leading to some farmers dropping out of the project. This challenge was mainly experienced in Embu and Makueni Counties where farmers dropped out of the groups because they were not hosting mother demos due to the perceived premium benefits. This affected the proportional distribution of the sample size across the target counties.
3. The baseline data was collected after implementing the UU and HER+ initiatives. Thus, there is a need for caution and careful interpretation of the baseline data.

CHAPTER THREE
FARMER CHARACTERISTICS AND LAND ACCESS AND UTILIZATION

This chapter presents the demographic characteristics of the sampled farmers as well as their land ownership and utilization status.

3.1 Demographic profile of the surveyed farmers

Table 4 presents the socioeconomic characteristics of farmers disaggregated by farmer type and gender. Disaggregation of these results by county and gender is presented in Annex 1,2 and 3. Farmers in Nakuru were older and more experienced in farming, while farmers in Embu were relatively younger. The household size was five members, with an almost uniform number across county, gender, and farmer. Non-UU farmers were slightly more experienced in farming than UU members. A higher proportion of UU farmers than non-UU farmers was married but with higher than among non-UU farmers. Higher proportions of widowhood were reported among women UU farmers, while non-UU farmer widowhood and separation are also high. These characteristics indicate intersectional elements that may influence varying adoption of innovations. For instance, these characteristics could influence farmers' openness to new techniques and innovations.

In terms of education level, most of the farmers had primary and secondary levels of education, and the trend was similar across genders. Moreover, pooled results showed that more women had no formal education and less higher education attainment (college and university) than men. Higher education levels can accelerate the adoption of innovations as it enables farmers to discern promising innovations and inform assessment of the opportunity cost of the technologies. In the current circumstances, the reported disparities in education level in favor of men may have implications on gender disparities in use of STIBs.

Table 4: Socio-economic characteristics of the sampled households

Variable	Category	Farmer type		Gender		Pooled
		Non-UU	UU	Women	Men	
Age (Years)		53.57	52.86	52.20	55.22	53.24
Farming experience (Years)		25.89	23.68	24.76	25.11	24.88
Household size (number)		4.47	4.67	4.55	4.58	4.56
Marital status (%)	Married	69.53	74.86	64.09	86.86	71.97
	Never married/single	6.98	7.18	9.27	2.92	7.07
	Widowed	17.67	14.92	22.39	5.11	16.41
	Separated/Divorced	5.81	3.04	4.25	5.11	4.55
Education level (%)	No formal education	6.98	3.59	7.14	2.19	5.43
	Primary education	53.72	52.21	56.18	47.08	53.03
	Secondary (O level)	26.51	30.66	26.64	31.75	28.41
	Secondary (A level)	5.58	4.70	3.86	7.66	5.18
	College	5.81	8.56	5.98	9.12	7.07
	University	1.40	0.28	0.19	2.19	0.88

The sources of household income are presented in Table 5. Sale of crop produce was the dominant economic activity across county and gender type. However, UU farmers relied more on crop farming (86%) than non-UU farmers (80%). This finding shows the alignment of the UU and HER+ initiatives interventions to the farmers' priority areas, as they were mainly engaged in crop farming. Similar findings are evident when disaggregated by gender and county (Annex 4). Besides selling crop produce, UU farmers had more diverse sources compared to non-UU farmers.

Table 5: Sources of household income in the last 12 months (%)

Sources of Income	County			Farmer type		Pooled
	Embu	Makueni	Nakuru	UU	Non-UU	
Sale of crop products	86.18	71.55	89.58	86.19	80.47	83.08
Wages	47.97	40.59	31.27	38.67	39.77	39.27
Sale of livestock	32.52	35.15	25.73	35.36	26.74	30.68
Sale of livestock products	25.61	18.83	33.22	30.94	22.79	26.52
Business	17.07	25.52	9.12	18.23	15.12	16.54
Remittances	8.54	18.41	19.54	19.06	13.02	15.78
Salary	4.07	14.64	6.51	11.6	5.35	8.21
Social transfer payments	2.03	4.18	5.86	2.49	5.58	4.17
Pension	4.47	3.77	2.61	4.14	3.02	3.54
Rented out asset	0.41	0.42	1.95	0.83	1.16	1.01

The average income earned from income sources stated in Table 5 are presented in Table 6. Household income was higher among the UU farmers (KES 229,213) compared non-UU farmers (KES 180,480), among men (KES194,240) compared to women (KES 170,382) and higher for farmers in Makueni (KES 189,295) and lower for farmers in Embu (KES165,709)) The differences in income across counties, gender, and farmer type suggest possible variability in economic resilience. Households or groups with higher income could possibly cope with economic shocks.

Table 6: Amount of money earned by the household in the last 12 months (KES)

Farmer type	County						Pooled	
	Embu		Makueni		Nakuru			
	Women	Men	Women	Men	Women	Men	Women	Men
UU	255,853	279,964	237,890	213,248	200,209	203,721	230,699	224,853
Overall Income	**260,894**		**233,410**		**201,421**		**229.213**	
Non-UU	146,403	192,467	202,461	167,077	162,382	212,484	170,382	194,240
Overall Income	**165,709**		**189,295**		**185,763**		**180,480**	

3.2 Land ownership and utilization

Regardless of gender, farmer type, and county, land in the study area was majorly owned by men, especially among male-targeted farmers, as indicated by 82% of UU farmers and 90% of non-UU farmers (Table 7). The plausible explanation for this trend is the traditional patriarchal norms that have infiltrated land titling or registration that typically designate land ownership to "head of household," who coincidentally are mostly men. These situations possibly give men greater control over land than women.

Table 7: Land ownership in the household by farmer type

Farmer type		County						Pooled	
		Embu		Makueni		Nakuru			
		Women	Men	Women	Men	Women	Men	Women	Men
UU	Man	58.62	91.30	72.22	90.00	34.41	73.47	54.81	81.52
	Woman	24.14	0.00	13.33	5.00	44.09	0.00	27.41	1.09
	Jointly	17.24	4.35	13.33	5.00	19.35	22.45	16.67	14.13
	Other HH members (men)	0.00	0.00	0.00	0.00	2.15	4.08	0.74	2.17
	Other HH members (women)	0.00	4.35	1.11	0.00	0.00	0.00	0.37	1.09
Non-UU	Man	40.79	89.47	60.49	91.49	44.71	89.47	48.76	90.00
	Woman	46.05	0.00	23.46	0.00	44.71	2.63	38.02	1.11
	Jointly	10.53	8.77	12.35	6.38	10.59	6.58	11.16	7.22
	Other HH members (men)	1.32	0.00	2.47	2.13	0.00	1.32	1.24	1.11
	Other HH members (women)	1.32	1.75	1.23	0.00	0.00	0.00	0.83	0.56

Findings presented in Table 8 show that the land owned ranged between 1.75 acres in Embu and 3.37 acres in Makueni, reflecting differential land endowments across the counties. UU farmers owned larger pieces (2.54 acres) of land than non-UU farmers (1.93 acres). There were gender differences in land ownership and access across the counties where men UU farmers owned larger parcels (2.67 acres) than women UU farmers (2.50 acres). A similar trend was observed among the non-UU farmers. This finding has implication for adoption practices promoted by UU initiative. Larger land size can facilitate mechanization and allows farmers to experiment with and potentially scale up innovations.

Table 8: Total land owned by farmers in the last 12 months (Acres)

Farmer type		County						Pooled	
		Embu		Makueni		Nakuru			
		Women	Men	Women	Men	Women	Men	Women	Men
UU	Land owned	1.89	1.24	3.33	3.54	2.27	2.98	2.50	2.67
	Overall total land owned		**1.75**		**3.37**		**2.52**		**2.54**
	Land owned under crop production	1.41	0.87	2.14	2.68	1.44	2.00	1.66	1.87
	Land rented	0.26	0.44	0.09	0.03	0.59	0.62	0.32	0.45
	Land borrowed	0.05	0.09	0.08	0.30	0.08	0.18	0.07	0.18
	Total land accessed	1.72	1.39	2.31	3.01	2.11	2.80	2.05	2.49
	Overall total land accessed		**1.65**		**2.43**		**2.35**		**2.16**
Non-UU	Land owned	1.73	1.78	2.12	2.61	1.65	1.95	1.83	2.07
	Overall total land owned		**1.75**		**2.30**		**1.79**		**193**
	Land owned under crop production	1.19	1.34	1.58	1.81	1.05	1.44	1.27	1.51
	Land rented	0.27	0.34	0.07	0.24	0.36	0.64	0.24	0.44
	Land borrowed	0.05	0.05	0.03	0.01	0.12	0.04	0.07	0.04
	Total land accessed	1.51	1.73	1.68	2.07	1.53	2.12	1.57	1.98
	Overall total land accessed		**1.60**		**1.82**		**1.80**		**1.74**

CHAPTER FOUR MECHANIZATION OF FARM OPERATIONS

This chapter presents findings on the status of mechanization of farm operations and potential impact of mechanization on adoption of conservation agriculture practices among the sampled farmers.

4.1 Primary means of farming operations.

Mechanization is a key aspect in conservation agriculture, helping to reduce soil disturbance (e.g., ripping), improving soil health over time by maintaining organic matter, limiting soil disturbance, and supporting diverse crop rotation (Alemayehu et al., 2020; Wulanningtyas et al., 2021). It is the core of the UU initiative that targets to diversify maize-mixed systems. The results presented in Figure 5 provide the status of mechanization in the UU learning labs. Adoption of mechanization varied across different counties and farmer types. There was a lower level of mechanization, with 99% of farmers in Embu relying on manual labour compared to 68% in Nakuru and 64% in Makueni. Low mechanization could be a barrier to the adoption and scaling of CA practices among farmers.

Modes of accessing mechanization services were also asked. About 26% and 31% of farmers in Makueni and Nakuru rented mechanization services, respectively. The result in Figure 5 also showed that about 25% and 31% of farmers in Makueni and Nakuru rented mechanizations (respectively), suggesting the potential role of the rental model for the delivery of mechanization services in adoption (beyond the baby demo) and scaling of CA practices Therefore, there is a need to explore different models of accessing mechanization services or emphasize adoption of alternative CA practices, such as residue retention, that are currently demonstrated on the mother demo but least preferred by farmers.

Disaggregated findings by gender (Table 9) indicated that more men farmers (34% of UU farmers and 21% of non-UU farmers) mechanized farm operation than women farmers (27% of UU farmers and 18% of non-UU farmers). The cross-county comparison revealed that more men farmers had adopted mechanization compared to women farmers among both UU and non-UU farmers.

Figure 5: Primary means of farming operations by farmers (%)

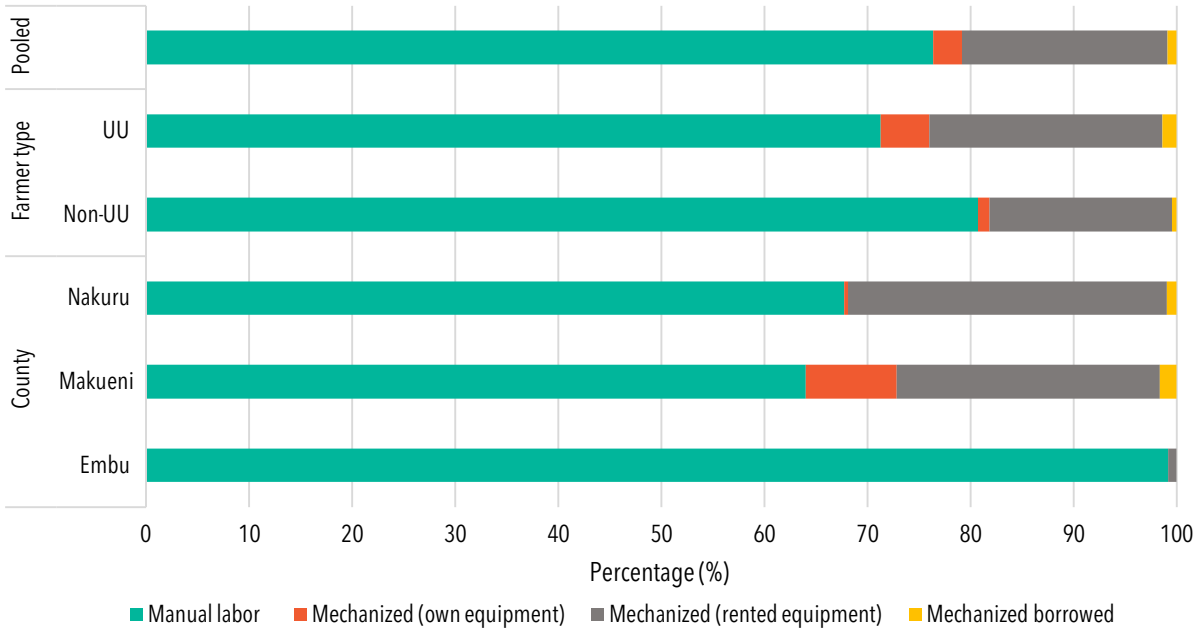


Table 9: Primary means of farming operation by gender of farmer (%)

Farmer type	Farming operations	County						Pooled	
		Embu		Makueni		Nakuru			
		Women	Men	Women	Men	Women	Men	Women	Men
UU	Manual labor	98.85	95.65	52.22	40.00	68.82	63.27	72.96	66.30
	Mechanized (owned equipment)	0.00	0.00	14.44	15.00	1.08	0.00	5.19	3.26
	Mechanized (rented equipment)	1.15	4.35	31.11	40.00	30.11	32.65	21.11	27.17
	Mechanized borrowed equipment	0.00	0.00	2.22	5.00	0.00	4.08	0.74	3.26
Non-UU	Manual labor	100.00	100.00	80.25	68.75	68.18	68.83	82.26	78.57
	Mechanized (owned equipment)	0.00	0.00	1.23	8.33	0.00	0.00	0.40	2.20
	Mechanized (rented equipment)	0.00	0.00	17.28	22.91	30.68	31.17	16.54	19.23
	Mechanized borrowed equipment	0.00	0.00	1.23	0.00	1.14	0.00	0.81	0.00

The results presented in Table 10 showed low ownership of mechanization equipment, with ox-plough being the most owned equipment, indicating that either farmers are not or are slow in modernizing farming operations. Most farmers mechanizing farming operations hired the equipment. Tractors and disc ploughs were the most hired machinery by both men and women farmers regardless of gender and farmer type. Disproportionately high percentages of UU men farmers than UU women farmer who mechanized farm operations borrowed equipment. In contrast, non-UU men farmers compared to 50% of non-UU farmers borrowed the equipment. Hiring machinery rather than ownership and borrowing could be explained by limited capital requirement to own equipment and diseconomies of scale associated with relatively small land sizes. The high ownership of ox-ploughs may also undermine the purpose of CA, countering/limiting some of the benefits of mechanization in CA.

Table 10: Means of agricultural equipment/machinery acquisition by gender and farmer type (%)

Farmer type	Equipment	Owned		Hire		Borrow	
		Women	Men	Women	Men	Women	Men
UU	Tractor	0.37	1.09	71.74	73.91	0.00	66.67
	Ox-plough	4.81	2.17	32.61	26.09	100.00	33.33
	Disc Plough	0.37	0.00	45.65	52.17	0.00	66.67
	Harrow	0.00	0.00	6.52	17.39	0.00	66.67
	Seeder	0.00	0.00	4.35	4.35	0.00	33.33
	Sprayer	0.37	0.00	17.39	13.04	0.00	0.00
	Thresher	0.37	0.00	34.78	52.17	0.00	66.67
	Chaff cutter	0.00	0.00	4.35	0.00	0.00	0.00
	Ripper	1.11	0.09	13.04	13.04	0.00	33.33
Non-UU	Tractor	0.00	0.00	69.23	70.59	50.00	0.00
	Ox-plough	0.40	2.20	28.21	29.41	50.00	0.00
	Disc plough	0.00	0.00	51.28	47.06	0.00	0.00
	Harrow	0.00	0.00	10.26	11.76	0.00	0.00
	Sprayer	0.00	0.00	12.82	5.88	0.00	0.00
	Thresher	0.00	0.00	15.38	26.47	0.00	0.00
	Ripper	0.00	0.00	5.13	5.88	0.00	0.00

Photo 1: A farmer ripping using an ox-plough in Makueni Sub-County

4.2 Perceptions of importance of mechanization

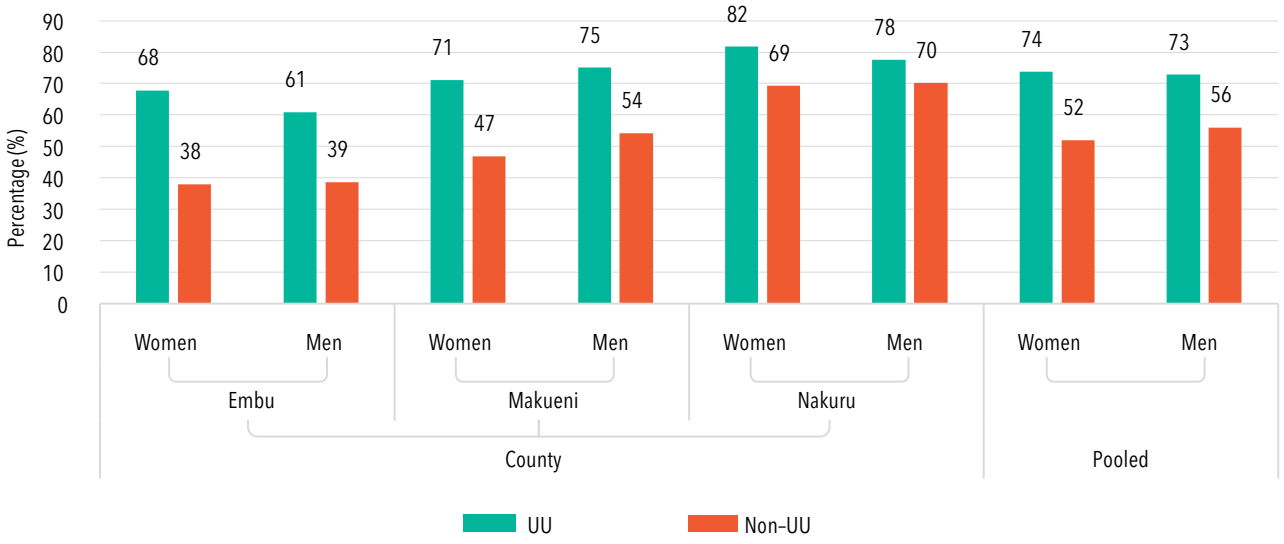
The results in Table 11 show that most farmers, regardless of farmer type and gender, perceived that access mechanization services would positively influence their decision to adopt CA practices. However, more UU women farmers than UU men farmer indicated that mechanization would greatly encourage CA adoption. In contrast, higher a percentage of non-UU men farmers than women farmers perceived mechanization as being crucial for CA adoption. None of non-UU farmers and non-UU men farmers in Embu County considered mechanization as critical to CA adoption, while all UU women farmers perceived it somewhat discouraging adoption of CA. This is mainly attributed to relatively smaller land sizes and the slopy topography in Embu County.

Table 11: Farmers' perception of the influence mechanization on adoption of CA(%)

Farmer type		County						Pooled	
		Embu		Makueni		Nakuru			
		Women	Men	Women	Men	Women	Men	Women	Men
UU	Greatly discourages	0.00	0.00	0.00	0.00	0.00	6.25	0.00	3.85
	Somewhat discourages	100.00	0.00	0.00	0.00	0.00	12.50	1.67	7.69
	Does not influence	0.00	0.00	16.13	10.00	7.14	6.25	11.67	7.69
	Somewhat encourages	0.00	0.00	29.03	50.00	42.86	31.25	35.00	38.46
	Greatly encourages	0.00	0.00	54.84	40.00	50.00	43.75	51.67	42.31
Non-UU	Greatly discourages	0.00	0.00	0.00	0.00	3.70	4.17	2.50	2.63
	Somewhat discourages	0.00	0.00	0.00	0.00	11.11	16.67	7.50	10.53
	Does not influence	0.00	0.00	15.38	7.14	25.93	25.00	22.5	18.42
	Somewhat encourages	0.00	0.00	30.77	28.57	40.74	8.33	37.50	15.79
	Greatly encourages	0.00	0.00	53.85	64.29	18.52	45.83	30.00	52.63

The study also collected information on the potential role of increased access to mechanization in changing farming practices. Most farmers affirmed that increased access to mechanization would change their current farming practices. This observation was more prominent among UU farmers than non-UU farmers. About 73% of men and 74% of women UU farmers asserted that increased access to mechanization would change their current farming practices compared to 56% of men and 52% of women non-UU farmers. A higher percentage of UU and non-UU farmers in Nakuru County indicated that they would change their current farming practices due to increased access to mechanization. These findings highlight farmers' readiness to embrace mechanization in transforming their farming practices. There is need to explore options for enhancing cost-effective access to agricultural mechanization for transformation of farming systems.

Figure 6: Farmer perception of the influence of increased access to mechanization on the current farming practices (%)



> Most farmers, regardless of farmer type and gender, perceived that access mechanization services would positively influence their decision to adopt CA practices. However, more UU women farmers than UU men farmer indicated that mechanization would greatly encourage CA adoption.

CHAPTER FIVE
PARTICIPATION IN THE UU INITIATIVE ACTIVITIES

The UU initiative aims to intensify, diversify, and de-risk maize-based farming systems for climate-resilience and socially inclusive outcomes. The initiative uses farm demonstrations to allow men and women farmers to experiment and adopt climate-smart, conservation agriculture, and sustainable intensification practices. The approach involves participation in the different activities in the mother trials in three learning in Kenya. Farmers are expected to randomly select the practices and trial them on their farms before adoption. This section presents the survey findings on the different UU initiative activities that farmers participated in since inception of the project.

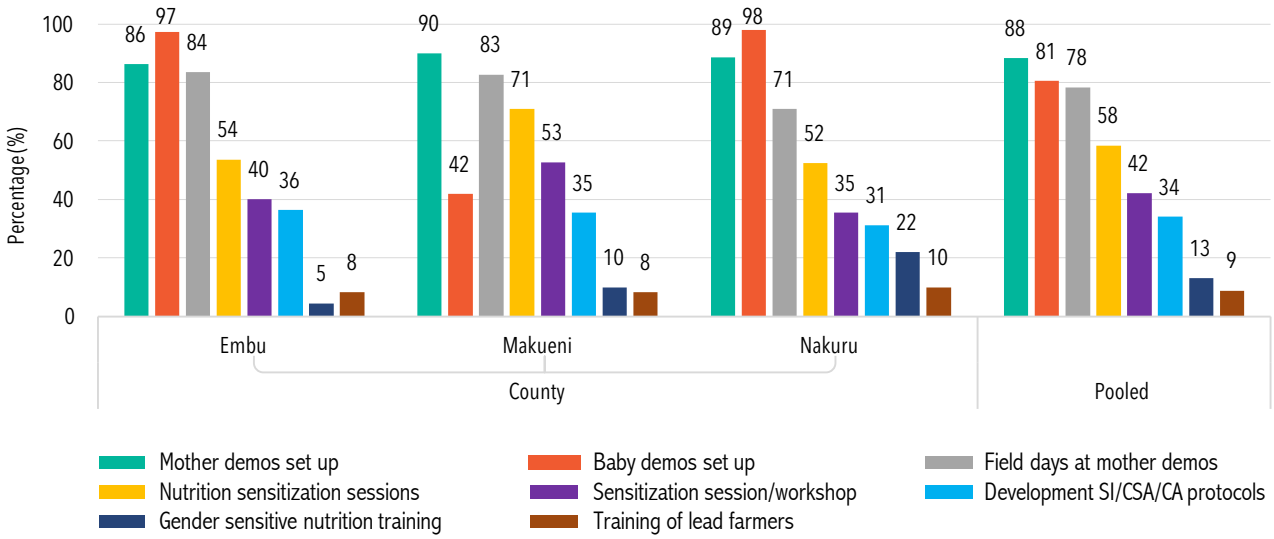
5.1: Farmer participation in the UU initiative activities

Figure 7 presents the different activities that UU farmers were involved. Farmers' participation in designing processes was low in Embu (36%), Makueni (35%), and Nakuru (31%) Farmer participation in designing SI/CSA/CA protocols is crucial in increasing engagement and adoption. Nine per cent of the UU farmers were trained as lead farmers to support farmer mobilization and to assist the technical field staff to set up farm demonstrations and implementation of baby demos on farmers' fields. This demonstrates UU's commitment to developing local leadership for sustainable knowledge transfer.

There were high levels of participation in mother (88%) and baby (78%) demonstrations across the counties. Makueni County had the lowest participation rate (42%) in baby demonstrations despite reporting the highest of rate (53%) of participation in sensitization sessions that onboarded and exposed farmers to the UU objectives and activities in the learning labs. The technical team attributed this to the late distribution of startup kits to farmers. The high participation levels in mother and baby demonstrations indicate strong interest and engagement in learning and trials of CA practices in the three counties. Field days at mother demonstrations – crucial for peer-to-peer learning and community engagement – were well-attended in all counties (ranging from 71% in Nakuru to 84% in Embu).

Figure 7 also shows that although 58% of UU farmers across the counties attended nutrition sensitization training, only 13% attended gender-sensitive nutrition sessions. Participation in gender-sensitive nutrition training is low in Embu (5%) and Makueni (10%) compared to 22% in Nakuru. At the time of the baseline survey, HER+ and UU initiatives had conducted gender-sensitive nutrition training in Nakuru and Makueni. This could reflect differences in the sequencing of the activities and differing programmatic focuses by implementing partners to reflect local contexts. However, the overall low participations rates in gender-sensitive nutrition training indicates the need for training of trainers (TOT) on gender and nutrition to cascade the knowledge and skills to local communities. This will enhance the effectiveness of integration of social innovations in UU activities, a target of the HER+ initiative.

Figure 7: General participation of farmers in UU activities (%)



The results men and women farmers participation in UU project activities are presented in Table 12. Overall, 89% and 88% of women and men farmers participated in setting up mother demonstration plots, respectively. More women farmers compared to men participated in field days at baby demos (79% vs 76%) and nutrition sensitization sessions (60% vs 56%). In contrast, more men than women UU farmers reported to have participated in baby demos set up (84% vs. 80%) and gender-sensitive nutrition training (16% vs 12%). Participation in mother and baby demonstration plots setups was lower in Makueni compared to other counties. This was attributed to the prolonged dry spell at the beginning of the main planting season and the delayed delivery of starter inputs. Participation in baby demo set up was higher than in mother demos set up in Embu and Nakuru which is counterintuitive based on the expectation that farmers learned from the mother demos before replicating the practices in baby demonstration plots. This could be explained by a sense of ownership of baby demos. It could also be attributed to structures and incentives for setting up baby demos, such as lead farmers, inputs, and technical assistance. Analysis by county further revealed that men farmers had higher participation in UU activities than women in Nakuru. In contrast, in Embu and Makueni, women's participation rates in UU activities were higher than those of men. The participation index affirmed these findings.

Table 12: Farmer participation in UU activities by county and gender (%)

UU activities	County						Pooled	
	Embu		Makueni		Nakuru			
	Women	**Men**	**Women**	**Men**	**Women**	**Men**	**Women**	**Men**
Mother demos set up	86.21	86.96	92.22	80.00	87.10	91.67	88.52	87.91
Baby demos set up	96.55	100.00	44.44	30.00	97.85	97.92	79.63	83.52
Field days at mother demos	86.21	73.91	84.44	75.00	67.74	77.08	79.26	75.82
Nutrition sensitization sessions	55.17	47.83	72.22	65.00	51.61	54.17	59.63	54.95
Sensitization session/workshop	40.23	39.13	55.56	40.00	31.18	43.75	42.22	41.76
Development SI/CSA/CA protocols	35.63	39.13	37.78	25.00	29.03	35.42	34.07	34.07
Gender-sensitive nutrition training	5.75	0.00	10.00	10.00	19.35	27.08	11.85	16.48
Training of lead farmers	10.34	0.00	7.78	10.00	9.68	10.42	9.26	7.69
Average number of UU activities attended	**4.16**	**3.87**	**4.04**	**3.35**	**3.94**	**4.38**	**4.04**	**4.02**
Participation index*	**0.52**	**0.48**	**0.51**	**0.42**	**0.49**	**0.55**	**0.51**	**0.50**

**Computed as a fraction of the areas farmers participated in divided by the total number of UU activities*

5.2: Farmer training in farming practices

The UU initiative held several training courses in climate-smart agriculture practices to enhance farmers' resilience capacity against climate change (Table 13). About 90% and 82% of UU farmers across the counties received training in CA techniques and the proper use of inputs, respectively. Training in crop diversification in maize production systems (61%), agronomic practices (54%), and selection and integration of nutritious crops in cropping systems (50%) were also reported by farmers. Training on CA techniques was mainly reported in Nakuru (94%), whereas proper use of inputs was reported by most UU farmers in Makueni (87%). Makueni County had the highest training attendance index (4.96), followed by Embu County (4.30) and Nakuru County (4.22). The gap in participation in agricultural/farming practices training was evident, with men farmers having higher attendance in most training sessions than women. This may result in gender disparities in the acquisition of technical skills and adoption of farming practices implemented by UU initiative, agricultural productivity, resilience to climate change, household food security and nutrition, and women's empowerment.

Table 13: Agricultural/farming practices covered during farmer training (%)

Agricultural training area	County			Gender		Pooled
	Embu	Makueni	Nakuru	Women	Men	
Conservation agriculture (CA) techniques	83.64	92.73	93.62	90.74	89.01	90.30
Proper use of inputs	81.82	87.27	77.30	80.74	84.62	81.72
Crop diversification of the maize system	62.73	61.82	59.57	58.89	68.13	61.22
Agronomic practices	50.91	65.45	47.52	52.96	57.14	54.02
Selecting and integrating nutritious crops in cropping systems	50.91	52.73	46.10	48.89	51.65	49.58
Sustainable intensification and climate-smart agriculture practices	44.55	47.27	51.06	47.04	50.55	47.92
Use of early maturing crop varieties	50.00	50.00	41.13	45.19	50.55	46.54
Water management practices	4.55	39.09	4.96	16.67	10.99	15.24
Average number of agricultural/farming practices received	**4.30**	**4.96**	**4.22**	**4.42**	**4.64**	**4.47**
Agricultural/farming practices attendance index*	**0.54**	**0.62**	**0.53**	**0.55**	**0.58**	**0.56**

**Computed as a fraction of the number of training sessions attended divided by the total number of agricultural training areas*

Table 14 presents gender disaggregated results of farmer participation in different training by county. The training attendance index results show that more men farmers in Embu and Nakuru counties received training in farming practices. Notable gender gaps in use of CA techniques, proper use of inputs, crop diversification and agronomic practices among UU farmers in Embu and Nakuru counties were reported. However, in Makueni County, more women UU farmers received training on CA techniques, crop diversification and agronomic practices than men.

> 89% and 88% of women and men farmers participated in setting up mother demonstration plots, respectively. More women farmers compared to men participated in field days at baby demos (79% vs 76%) and nutrition sensitization sessions (60% vs 56%).

Table 14: Farmer participation in agricultural/farming practices training by gender (%)

Type of training in agricultural practices/farming	County					
	Embu		Makueni		Nakuru	
	Women	Men	Women	Men	Women	Men
Conservation agriculture (CA) techniques	81.61	91.30	95.56	80.00	94.62	91.67
Proper use of inputs	79.31	91.30	87.78	85.00	75.27	81.25
Crop diversification of the maize system	59.77	73.91	61.11	65.00	55.91	66.67
Agronomic practices	48.28	60.87	66.67	60.00	44.09	54.17
Selecting and integrating nutritious crops in cropping systems	51.72	47.83	53.33	50.00	41.94	54.17
Sustainable intensification and climate-smart agriculture practices	44.83	43.48	47.78	45.00	48.39	56.25
Use of early maturing crop varieties	49.43	52.17	48.89	55.00	37.63	47.92
Water management practices	5.75	0.00	37.78	45.00	6.45	2.08
Average number of agricultural/farming practices received	**4.22**	**4.61**	**4.99**	**4.85**	**4.05**	**4.56**
Agricultural/farming practices attendance index*	**0.53**	**0.58**	**0.62**	**0.61**	**0.51**	**0.57**

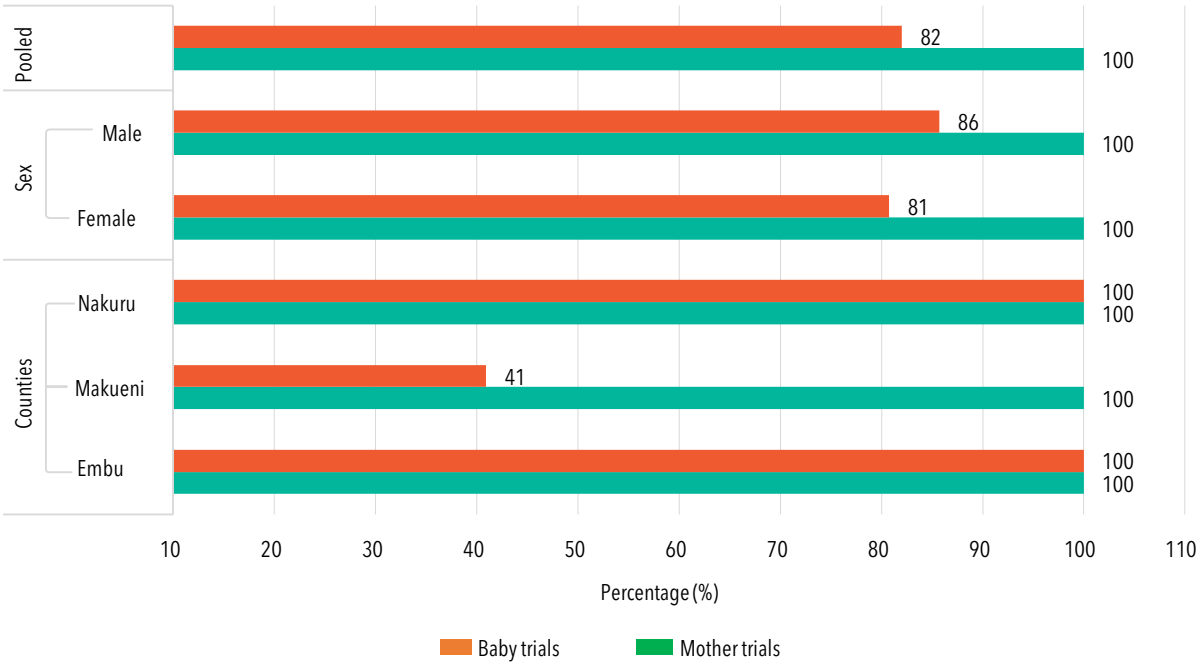
**Computed as a fraction of the number of training sessions attended divided by the total number of agricultural training areas*

Photo 2: Dr. Ooro takes farmers through a session during training at KALRO Njoro

5.3: Participation in mother and baby demos

The UU initiative established 17 mother demonstration plots across the counties. The mother demos serve as educational tools, technology, CA, and CSA practices demonstration, testing, and adaptation sites, a, and an extension, social learning, and collaboration platform. Farmers are expected to randomly select the practices and trial them on their farms before adoption. Survey findings in Figure 8 revealed that all (100%) farmers surveyed participated in mother demos, with 81% participating in baby demos. Replication of mother demo practices on baby demos was notably lower (42%) in Makueni County compared to 100% of farmers in Embu and Nakuru counties. The low proportion farmers trialing the practices and technologies on baby demos in Makueni was mainly attributed to late distribution of startup kits. By gender, more men (86%) UU farmers participated in baby trials than women farmers (81%).

Figure 8: Farmer participation in mother and baby trials/demonstrations.



Further inquiry was made into the specific CSA and CSA practices demonstrated in the mother demos, and the findings are presented in Table 15. Intercropping (94%), strip cropping (82%), crop rotation (81%) and minimum tillage (73%) were the major practices demonstrated in mother demos across the three counties. A similar trend was observed across genders. Ripping was common in Makueni (88%) and Nakuru (83%), whereas furrowing and ridging were dominant in Embu (40%). This is attributed to the heterogeneous promotion of the SI/CSA/CA practices across the counties by the UU initiative. Makueni County had the highest number of demonstrated CA practices (5.01) than Embu (4.21) and Nakuru (4.82) counties, possibly due to Makueni being more adversely affected by regular, prolonged, and severe droughts.

Table 15: Farmer reporting of CSA practices demonstrated in mother demos (%)

CA practices	County			Pooled
	Embu	Makueni	Nakuru	
Intercropping	90.00	92.73	97.87	93.91
Strip cropping	77.27	70.91	92.91	81.44
Crop rotation	83.64	84.55	74.47	80.33
Minimal tillage	57.27	69.09	88.65	73.13
Ripping	7.27	89.09	82.27	61.50
Mulching	36.36	26.36	19.15	26.59
Cover cropping	20.91	20.00	24.11	21.88
Furrows	39.09	16.36	0.00	16.90
Planting basins	0.91	26.36	0.00	8.31
Agroforestry	8.18	0.91	2.13	3.60
Zai pits	0.00	4.55	0.00	1.39
Average number of demonstrated CA practices	**4.21**	**5.01**	**4.82**	**4.69**
Demonstrated CA practices index*	**0.38**	**0.46**	**0.44**	**0.43**

**Computed as a fraction of the number of demonstrated CA practices to farmers in the mother demo divided by the total number of CA practices*

Table 16 presents technologies that are applied/demonstrated in mother demos. Bean seeds (99%), maize seeds (98%) and fertilizer application (96%) were the main technologies used in the mother demos regardless of county. These patterns in adoption of technologies reveal a high adoption for externally sourced inputs and low adoption of local inputs, providing opportunity for HER+ and UU initiative to increasingly bundle local solutions to soil health challenges for sustainability.

Table 16: Farmer reporting of technologies used in mother demos (%)

Technologies	County			Pooled
	Embu	Makueni	Nakuru	
Seed (beans)	100.00	96.36	99.29	98.61
Seed (maize)	97.27	95.45	100.00	97.78
Fertilizer	96.36	93.64	97.87	96.12
Herbicides	61.82	60.91	82.27	69.53
Manure	2.73	12.73	2.84	5.82

Common beans and maize were the most planted crops on baby demonstration by farmers in all counties and across genders (Table 17). Common bean is the most integrated crop in maize demonstrations by UU initiative as it is considered an important crop for diversified diets and gender equality. Vegetables and pigeon peas were minimally integrated in mother demos in Embu and Makueni counties, possibly the importance of these crops in the two geographies.

Table 17: Crops planted by farmers on the baby demo plot.

Crops	County			Pooled
	Embu	Makueni	Nakuru	
Maize	90.91	93.33	97.87	94.59
Common bean	88.18	91.11	97.16	92.91
Pigeon pea	0.00	2.22	0.00	0.34
Potato	0.91	0.00	0.00	0.34
Kale	0.91	0.00	0.00	0.34
Other vegetables	0.91	0.00	0.00	0.34

Farmers were expected trial technologies and practices demonstrates in mother demos on their baby demos. About 50%, 42% and 41% of UU farmers surveyed experimented with intercropping, minimum tillage, and ripping on their baby demos, respectively (Table 18). Other CSA practices applied in mother demos experimented on baby demos were strip cropping (35%) and crop rotation (20%). More men than women farmers experimented intercropping (53% vs 49), minimum tillage (47% vs. 40%), ripping (51% vs 38%), and strip cropping (37% vs 35%). This finding can be attributed to higher percentage of men participation in different types of training as earlier shown in Table 16. The CA application index indicate experimenting of mother demo technologies and practices on baby demos was higher in Makueni (0.3) and among men (0.27).

> Common beans and maize were the most planted crops on baby demonstration by farmers in all counties and across genders

Table 18: CA practices demonstrated on mother demos used on baby demos (%)

CSA practices	County			Gender		Pooled
	Embu	Makueni	Nakuru	Women	Men	
Intercropping	40.00	31.11	63.83	48.62	53.85	50.00
Minimal tillage	28.18	40.00	53.90	40.83	46.15	42.23
Ripping	3.64	66.67	62.41	37.61	51.28	41.22
Strip cropping	27.27	28.89	41.13	33.03	37.18	34.12
Crop rotation	28.18	33.33	7.80	22.02	11.54	19.26
Mulching	10.91	8.89	0.00	5.96	3.85	5.41
Cover cropping	6.36	8.89	0.71	4.59	2.56	4.05
Planting basins	0.00	15.56	0.00	3.21	0.00	2.36
Average number of practices applied	**1.75**	**2.40**	**2.33**	**2.11**	**2.17**	**2.13**
CA application index*	**0.22**	**0.30**	**0.29**	**0.26**	**0.27**	**0.27**

**Computed as a fraction of the number of CA practices demonstrated in the mother demo and have been used in the baby demo divided by the total number of CA practices*

Comparison of UU practices experimented on baby demos by county and gender is presented in Table 19. The average number of practices experimented by farmers was slightly higher among men than women. Men in Makueni had the highest average number of practices applied (2.57) and the highest CA application index (0.32). Ripping was more common in Makueni and Nakuru than in Embu and among men farmers than women farmers. The results also show regional and gender preferences for practices, possibly due to varying farmers' experiences of climate change.

Table 19: CSA practices demonstrated on mother demo used on baby demo by county and gender (%)

CSA practices	County						Pooled	
	Embu		Makueni		Nakuru			
	Women	Men	Women	Men	Women	Men	Women	Men
Intercropping	43.68	26.09	28.95	42.86	61.29	68.75	48.62	53.85
Ripping	2.30	8.70	65.79	71.43	59.14	68.75	37.61	51.28
Minimal tillage	26.44	34.78	36.84	57.14	55.91	50.00	40.83	46.15
Strip cropping	26.44	30.43	28.95	28.57	40.86	41.67	33.03	37.18
Crop rotation	28.74	26.09	31.58	42.86	11.83	0.00	22.02	11.54
Mulching	10.34	13.04	10.53	0.00	0.00	0.00	5.96	3.85
Cover cropping	5.75	8.70	10.53	0.00	1.08	0.00	4.59	2.56
Planting basins	0.00	0.00	18.42	0.00	0.00	0.00	3.21	0.00
Average number of practices applied	**1.74**	**1.78**	**2.37**	**2.57**	**2.35**	**2.29**	**2.11**	**2.17**
CSA application index*	**0.22**	**0.22**	**0.30**	**0.32**	**0.29**	**0.29**	**0.26**	**0.27**

**Computed as a fraction of the number of CA practices demonstrated in the mother demo and have been used in the baby demo divided by the total number of CA practices*

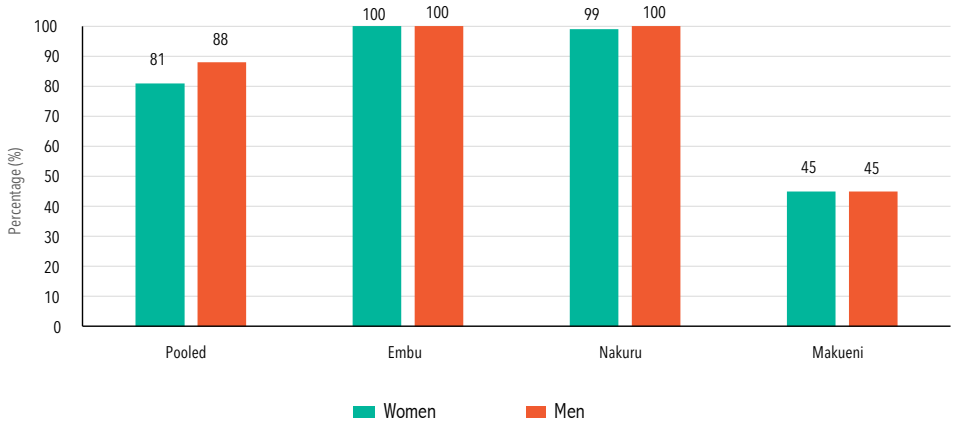
Table 20 shows that maize seeds (79%), bean seeds (78%), and fertilizer (74%) are the major technologies demonstrated in mother demonstrations that were experimented on baby demos (Table 20). Adoption of maize seeds (43%), bean seeds (43%) and fertilizer (36%) were lowest in Makueni and highest in Nakuru (maize seeds (100%), bean seeds (96%) and fertilizer application (92%). Delayed input supply was cited as reason for low experimentation of these technologies on baby demonstration plots.

Table 20: Technologies demonstrated in the mother demos that have been used in baby demos (%)

	County			Gender		Pooled
	Embu	Makueni	Nakuru	Female	Male	
Seed (maize)	90.00	42.73	100.00	78.52	82.42	79.50
Seed (beans)	89.09	42.73	97.16	76.30	83.52	78.12
Fertilizer	90.00	34.55	93.62	70.74	85.71	74.52
Herbicides	22.73	2.73	65.96	28.15	49.45	33.52
Manure	10.91	10.91	1.42	8.89	2.20	7.20
None	0.00	54.55	0.00	17.78	13.19	16.62

The UU initiative supported farmers with starter inputs to establish baby demos. About 81% of the surveyed women farmers and 88% of men farmers received starter inputs (Figure 9). Almost all men and women UU farmers (99%) in Embu and Nakuru received starter inputs compared to 45% in Makueni county.

Figure 9: Farmers reporting on access to starter-up kits as part of the UU and HER+ initiatives.



Almost all UU women (99%) and men (100%) farmers received seeds of maize and beans across the counties (Table 21). About (88%) and 95% of women and men farmers receive fertilizer, respectively. Additionally, in Embu and Nakuru counties, more men farmers received seeds, fertilizer, herbicides, and plant protection products than women farmers. Similar findings were observed in Makueni except for fertilizer, where more women farmers (78%) received fertilizer than men farmers (67%).

Table 21: Starter inputs received by farmers by county (%)

Starter inputs	County						Pooled	
	Embu		Makueni		Nakuru			
	Women	Men	Women	Men	Women	Men	Women	Men
Seeds	100.00	100.00	95.00	100.00	98.91	100.00	98.63	100.00
Fertilizer	83.91	95.65	77.50	66.67	97.83	100.00	88.58	95.00
Herbicides	19.54	21.74	2.50	11.11	57.61	73.47	32.42	51.85
Plant Protection Products	10.34	26.09	0.00	0.00	25.00	30.61	14.61	25.93
Seedling	0.00	0.00	0.00	0.00	4.35	2.04	1.83	1.23
Tools	1.15	0.00	0.00	0.00	4.35	0.00	2.28	0.00
Equipment	0.00	0.00	0.00	0.00	3.26	0.00	1.37	0.00
Training Materials	0.00	0.00	0.00	0.00	4.35	0.00	1.83	0.00

5.4: Challenges and opportunities associated with participating in the project activities

Surveyed UU farmers reported several challenges related to climate, economic, logistical, workload, and infrastructural constraints in relation to their participation in UU activities. Unpredictable weather conditions, limited access to equipment, and time and workload were the top three challenges faced by farmers in their participation in UU activities regardless of gender and county (Table 22). Other challenges reported by farmers were the high cost of inputs, land and resource constraints, and inadequate training and knowledge of practices.

Table 22: Challenges faced by farmers while participating in the project activities (%)

Challenges	Country						Pooled	
	Embu		Makueni		Nakuru			
	Women	Men	Women	Men	Women	Men	Women	Men
Unpredictable weather/climate challenges	57.47	56.52	64.44	65.00	69.89	71.43	64.07	66.30
Limited access to inputs or equipment	33.33	34.78	43.33	40.00	36.56	12.24	37.78	23.91
Time constraints or workload	36.78	43.48	30.00	30.00	38.71	44.90	35.19	41.30
High input costs	35.63	43.48	24.44	20.00	16.13	10.20	25.19	20.65
Land or resource constraints	21.84	34.78	8.89	5.00	12.90	20.41	14.44	20.65
Lack of adequate training or knowledge	14.94	8.70	18.89	15.00	13.98	12.24	15.93	11.96
Difficulty in accessing markets or marketing produce	4.60	0.00	2.22	5.00	1.08	8.16	2.59	5.43

The collaboration of UU and HER+ initiatives aim to enhance crop diversification for resilient agri-food systems while addressing the gender-related gaps in the food systems. Consequently, farmers were asked to assess opportunities for participating in the activities implemented by the two initiatives. Survey presented in Table 23 show that most farmers envisioned their participation in the two initiatives would improve their knowledge in agricultural practices, increase crop yields and food security, enhance resilience to climate change, and improve household nutrition and health status. However, these opportunities varied by gender, with higher proportions of men farmers across counties identifying opportunities from their participation UU and HER+ activities compared to women. These findings are aligned with objectives of the two initiatives, reflecting their relevance to the needs of men and women farmers.

Table 23: Farmers reporting on opportunities associated with participating in UU and HER+ initiative (%)

Opportunities	County						Pooled	
	Embu		Makueni		Nakuru			
	Women	Men	Women	Men	Women	Men	Women	Men
Improved agricultural practices and knowledge	91.95	95.65	93.33	85.00	87.10	91.84	90.74	91.30
Increased crop yields and food security	72.41	95.65	52.22	45.00	44.09	63.27	55.93	67.39
Enhanced resilience to climate change	37.93	39.13	33.33	35.00	41.94	42.86	37.78	40.22
Improved household nutrition and health	41.38	30.43	37.78	55.00	33.33	36.73	37.41	39.13
Strengthened connections with other farmers or organizations	29.89	30.43	23.33	45.00	23.66	30.61	25.56	33.70
Better access to inputs, equipment, or services	16.09	21.74	11.11	15.00	20.43	32.65	15.93	26.09
Opportunities for income diversification	18.39	26.09	12.22	15.00	15.05	18.37	15.19	19.57
Empowerment of women or youth	13.79	26.09	12.22	10.00	13.98	4.08	13.33	10.87
Access to new markets or marketing opportunities	0.00	8.70	0.00	0.00	2.15	2.04	0.74	3.26

CHAPTER SIX
ADOPTION OF SOCIO-TECHNICAL INNOVATION BUNDLES

Technological innovations (e.g., improved seed, fertilizer, good agricultural practices, farm chemicals, mechanization, etc.) have contributed to increased agricultural productivity and socioeconomic development for decades. However, the devastating effects of climate change and other social and economic crises continue to impede progress towards resilient agri-food systems, revealing that technological innovations alone cannot safeguard agri-food systems transformations. The STIBs (Socio-technical innovation bundles) – context-specific combination or combinations of technological (e.g., seed and fertilizer), technical (e.g., training and capacity building and development), and social (e.g., institutions, policy, social organizations, financial mechanisms, etc.) innovations have the potential to transform agri-food systems, improve farmers' resilience to climate change and contribute to women's empowerment. Hence, it is imperative for agri-food systems stakeholders to collaborate and co-design STIBs that would counteract obstacles to agri-food systems transformations. The socio-technical innovations bundling approach aims to positively impact multiple economic and social development outcomes. The HER+ initiative WP 2 contributes to climate resilience and women's empowerment through co-designing of STIBs with farmers, NGOs, private sector, NARS, and other CGIAR initiatives. This chapter presents findings on the level of adoption of STIBs in HER+ learning labs in Kenya.

6.1: General adoption of STIBs

Results in Table 24 reveal that about 63% of the surveyed farmers adopted and used STIBs at baseline. Inter-county variation in STIBs adoption and use were observed, with Embu and Makueni having the highest (69%) and lowest (54%) adoption rates, respectively. Disaggregated findings by farmer type revealed that about 98% of UU farmers compared to 33% of non-UU farmers used STIBs, respectively. Another salient finding is that adoption of STIBs among UU farmers was almost even across counties (98%) but varied among non-UU farmers, ranging from 16% in Makueni to 45% in Embu. The gaps in STIBs adoption between UU and non-UU farmers could largely be attributed to participation in the UU and HER+ initiatives that are intentionally co-designing and promoting STIBs with farmers as major partners in the bundling approaches. The near-universal adoption of STIBs among UU farmers reflects the effectiveness of HER+ and UU initiatives in driving inclusive adoption of STIBs.

There was a gender gap in STIBs adoption, with 66% of women adopting compared to 57% of men. However, deeper analysis by farmer group type and county revealed that 100% and 53% of men UU and non-UU farmers in Embu, respectively, compared to 98% of UU and 39% of non-UU women farmers

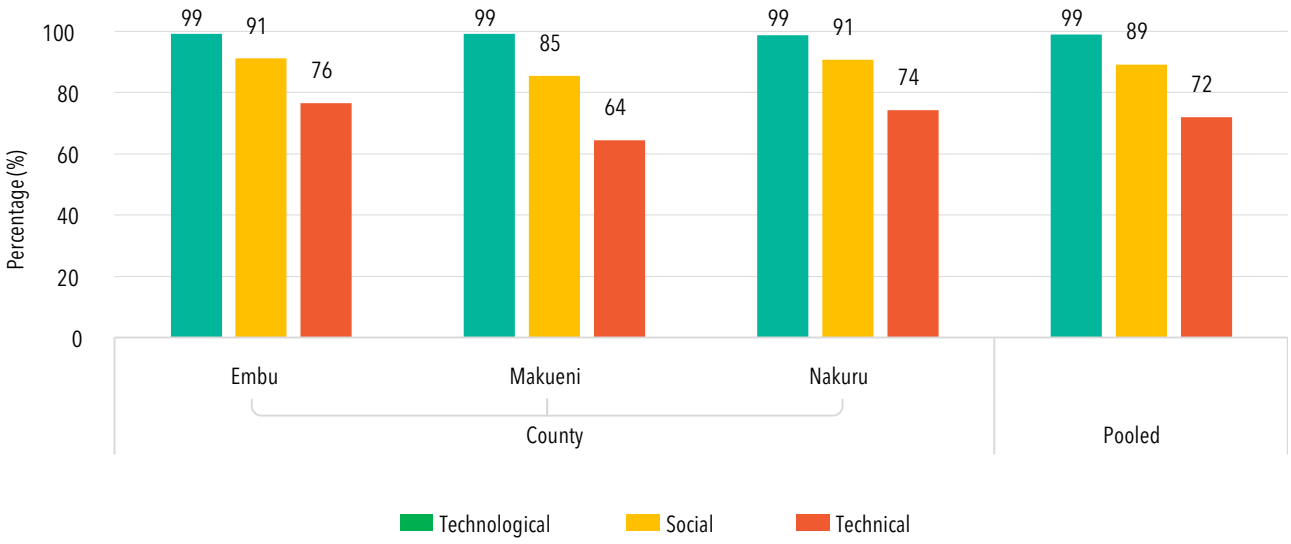
adopted STIBs. In Makueni, 100% and 98% of men and women UU farmers and 8% and 21% of men and women non-UU farmers adopted STIBs, respectively. Equal proportions of men and women UU farmers in Nakuru (98%) adopted to STIBs in Nakuru compared to 36% women and 39% men non-UU farmers, respectively. The near-universal adoption of STIBs among UU farmers regardless of gender and county reflects effectiveness of HER+ and UU initiatives in driving inclusive adoption of STIBs. On the other hand, the narrow gap between men and women UU farmers adopting STIBs in Makueni and Embu counties and equal adoption rates among men and women UU farmers in Nakuru county reveals that the two initiatives are also contributing to gender equality in STIBs adoption.

Table 24: Adoption of STIBs by county, gender, and type of farmer (%)

County	Gender	Farmer type		Overall
		Non-UU	UU	
Embu	Women	39.24	97.70	69.88
	Men	52.63	100.00	66.25
	Overall	**44.85**	**98.18**	**68.70**
Makueni	Women	20.99	97.78	61.40
	Men	8.33	100.00	35.29
	Overall	**16.28**	**98.18**	**53.97**
Nakuru	Women	**36.36**	97.85	67.96
	Men	38.96	97.96	61.90
	Overall	**37.58**	**97.89**	**65.47**
Pooled	Women	32.26	97.78	66.41
	Men	35.16	98.91	56.57
	Overall	**33.49**	**98.07**	**63.01**

Further analysis was conducted to identify technological, technical, and social innovations used by STIBs adopters, which is critical to informing future bundling. Findings in Figure 10 show that there was a high adoption of technological innovations (99%) compared to social innovations (89%) and technical innovations (72%). Notably, there was low adoption of social innovations (85%) and technical innovations (64%) in Makueni compared to Embu and Nakuru counties that had a similar adoption rate of 91%. The low usage of technical and social innovations has implications for farmers' capacities to effectively utilize and integrate technologies and practices into their existing farming systems.

Figure 10: Adoption of different innovation types by county (%)



An in-depth analysis of STIBs components by gender and farmer type is presented in Table 25. Generally, UU farmers had higher adoption rates of the different innovation components of STIBs than non-UU farmers. Among non-UU farmers, low use of technical innovations was evident, and men farmers reported higher adoption rates in most innovation components compared to women farmers. The disparities in the use of STIBs components between UU and non-UU farmers could be attributed to better access to information and support provided through the UU initiative, Men's higher adoption rates of STIBs innovation components point to gender-specific barriers in access to information or resources or socio-cultural constraints that prevent women from effectively participating in innovation processes.

Table 25: Adoption of different innovation types by county and gender (%)

Farmer type	Types of innovations	County					
		Embu		Makueni		Nakuru	
		Women	Men	Women	Men	Women	Men
Non-UU	Technological	98.73	100.00	98.77	100.00	96.59	100.00
	Technical	53.16	63.16	32.10	39.58	51.14	54.55
	Social	81.01	89.47	77.78	64.58	82.95	83.12
UU	Technological	98.85	100.00	98.89	100.00	100.00	97.96
	Technical	100.00	100.00	98.89	100.00	98.92	100.00
	Social	98.85	100.00	100.00	100.00	98.92	100.00

Furthermore, a detailed analysis beyond the percentages of farmers adopting STIBs components was performed to reveal the extent of adoption of technological, technical, and social innovations. These results, including detailed results of the sources of these innovations are presented in Annexes 5 through 19.

The results presented in Table 26 show noticeable increase in adoption of technological innovations from between 2018 to 2021 and 2022 to 2023, with highest percentage change occurring among UU farmers compared to non-UU farmers. The increase in use of technologies and practices ranged from 19% to 21% for men and women UU farmers, respectively, compared to and 3% among women to 6% among men non-UU farmers. This indicates the possible effectiveness of the UU and HER+ initiatives in increasing adoption through socio-technical innovation bundling approach. The highest increase in technological innovation usage by farmers occurred in Embu learning lab, with about 22% of women and 26% of men UU farmers reporting rise in adoption between the two periods. This compares to about 12% of women in Embu and 11% of men in Makueni, groups of farmers that reported the highest increase in number of technological innovations among non-UU farmers from between 2018 to 2021 and 2022 to 2023.

The adoption of technical innovations showed a significant increase, especially among UU farmers. Both men and women UU farmers experienced substantial growth in adoption rates. The percentage changes in use of technical innovations ranged from 64% among men UU farmers in Embu to 94% among men UU farmers in Makueni. This observation is based on an increase in the number of technical innovations by 72% from between 2018 to 2021 and 2022 to 2023 among both men and women farmers that participated in UU and HER+ collaborative activities in the across the learning labs. In contrast, there was a decrease (-1%) in number of technical innovations adopted by men non-UU farmers over the five years, while women non-UU farmers increased adoption by only 5% in the same period. Increase in number of technical innovations used by non-UU farmers was highest among women farmers in Nakuru (23%) and least among men farmers in Nakuru (-17%). The results, as shown by stark contrast in adoption rates between UU and non-UU farmers, underscore the importance of targeted, collaborative efforts between HER+ and UU initiatives in driving access to technical innovations and importance of localized or contextualized approaches.

The analysis in Table 26 also reveals an increase in the number of social innovations accessed or used by farmers. There was an increase in the number of social innovations used by UU farmers by 30-32% from between 2018-2021 and between 2022 and 2023 compared to an increase of 6-11% among women and men non-UU farmers. The largest percentage (40%) increase was among men UU farmers in Nakuru county. The percentage increase in number of social innovations adopted among men UU farmers was 19% in Embu and 31% in Makueni. Equal proportion increase (32%) in number of social innovations was reported among women UU farmers in Embu and Makueni compared to 27% increase among women UU farmers in Nakuru. The highest increase in the number of social innovations used by non-UU farmers was 23% among men non-UU farmers in Embu and least (7%) among male non-UU farmers in Makueni county. These results suggest that the learning labs concept is effective in fostering sharing of knowledge and community engagements that are essential for encouraging use of social innovations. The results also reveal the need for HER+ and UU to focus more on gender-specific and regional factors to ensure inclusive adoption of social innovations.

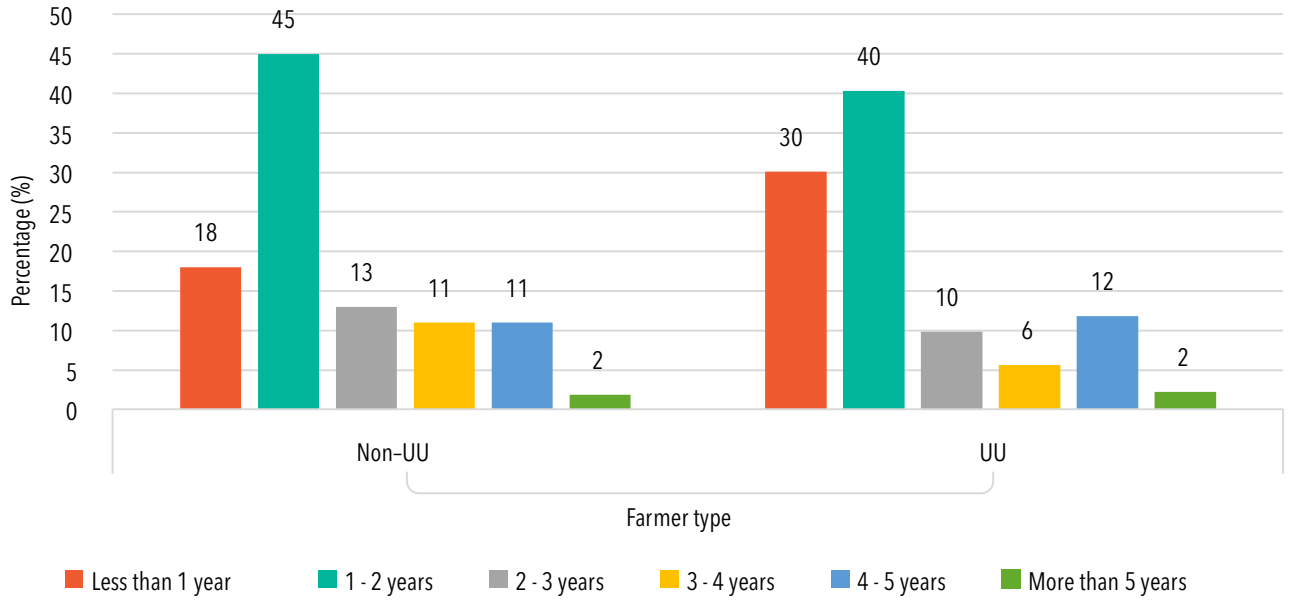
Table 26: Number of technological, technical, and social innovations bundles used by farmers.

Inno	Farmer type		County						Pooled	
			Embu		Makueni		Nakuru			
			Women	Men	Women	Men	Women	Men	Women	Men
Technological	UU	2018 to 2021	4.45	5.04	4.61	5.20	4.74	5.90	4.61	5.54
		2022 to 2023	5.43	6.35	5.52	6.10	5.75	6.95	5.58	6.60
		Percentage change	**22%**	**26%**	**20%**	**17%**	**21%**	**18%**	**21%**	**19%**
	Non-UU	2018 to 2021	3.40	4.33	4.12	4.17	4.06	4.83	4.32	4.92
		2022 to 2023	3.81	4.72	4.30	4.63	4.16	4.88	4.45	5.23
		Percentage change	**12%**	**9%**	**4%**	**11%**	**2%**	**1%**	**3%**	**6%**
Technical	UU	2018 to 2021	2.00	1.96	1.87	1.60	2.18	2.20	2.03	2.02
		2022 to 2023	3.41	3.22	3.40	3.10	3.66	3.78	3.50	3.48
		Percentage change	**71%**	**64%**	**82%**	**94%**	**68%**	**72%**	**72%**	**72%**
	Non-UU	2018 to 2021	0.84	1.22	0.52	0.88	1.24	1.53	1.47	1.97
		2022 to 2023	0.85	1.19	0.56	0.94	1.52	1.27	1.55	1.96
		Percentage change	**1%**	**-2%**	**8%**	**7%**	**23%**	**-17%**	**5%**	**-1%**
Social	UU	2018 to 2021	2.17	2.70	2.17	2.10	2.42	2.35	2.28	2.38
		2022 to 2023	2.87	3.22	2.87	2.75	3.08	3.29	2.97	3.13
		Percentage change	**32%**	**19%**	**32%**	**31%**	**27%**	**40%**	**30%**	**32%**
	Non-UU	2018 to 2021	1.34	1.68	1.63	1.15	1.72	1.73	1.89	2.11
		2022 to 2023	1.47	2.07	1.77	1.23	1.88	1.87	2.01	2.34
		Percentage change	**10%**	**23%**	**9%**	**7%**	**9%**	**8%**	**6%**	**11%**

6.2: Farmers' years of experience in using STIBs

Figure 11 presents results on the duration that farmers have been using STIBs. About 63% of non-UU farmers and 70% of the UU farmers had used STIBs for less than 2 years. However, during the period of HER+ implementation (within the past year), the usage of STIBs within one year was 30% for UU farmers and 18% for non-UU farmers. This finding reflects the combined effectiveness of the UU and HER+ interventions in influencing the adoption of STIBs in the past two years.

Figure 11: Experience in using STIBs by farmer type and gender of farmer (%)



County disaggregated findings indicate that most farmers across the three counties have used STIBs within the last two years (Table 27). Most UU farmers in Embu and Nakuru counties have used STIBs for 1 to 2 years, whereas in Makueni, most of the UU farmers have used STIBs for less than one year. In Nakuru county, about 20% of women farmers and 25% of men farmers reported to have used STIBs for more than four years. Moreover, the usage of STIBs for more than four years was higher in Nakuru county compared to other counties across the gender. The results reveal widespread recent adoption of STIBs and variations in duration of usage. Longer/long-term usage of STIBs is reported in Nakuru – 25% of men and 20% of women have used STIBs for more than four years – and Makueni with the shortest duration of usage. These results suggest the need for differentiated support in socio-technical innovation bundling approaches and considering local context in agricultural interventions.

Table 27: Farmer experience in using STIBs in years (%)

	Categorization	Embu		Makueni		Nakuru	
Non-UU		Women	Men	Women	Men	Women	Men
	Less than one year	19.35	16.67	29.41	25.00	12.50	16.67
	1-2 years	48.39	43.33	52.94	75.00	37.50	43.33
	2-3 years	12.90	23.33	0.00	0.00	15.62	10.00
	3-4 years	12.90	10.00	17.65	0.00	12.50	3.33
	4-5 years	6.45	6.67	0.00	0.00	15.62	23.33
	More than five years	0.00	0.00	0.00	0.00	6.25	3.33
UU	Less than one year	24.71	17.39	50.00	50.00	19.78	20.83
	1-2 years	50.59	52.17	34.09	20.00	40.66	35.42
	2-3 years	12.94	17.39	4.55	15.00	9.89	8.33
	3-4 years	3.53	4.35	1.14	5.00	9.89	10.42
	4-5 years	8.24	8.70	10.23	10.00	15.38	16.67
	More than five years	0.00	0.00	0.00	0.00	4.40	8.33

6.3 Patterns of STIB Adoption

There are a total of 485 unique socio-technical innovations bundles (STIBs) in the dataset. Table 28 presents the distribution of the STIBs by county, farmer type, and gender. Majority of the STIBs were reported women (69%) and UU farmers (71%). About 40% of the STIBs were reported in Nakuru County.

Table 28: Distribution of STIBs by county, farmer type and gender

County	Farmer type		Gender		Pooled
	Non-UU	UU	Women	Men	
Embu	61	108	116	53	169
	36.09%	63.09%	68.64%	31.36%	33.87%
Makueni	21	108	105	24	129
	16.28%	83.72%	81.40%	18.60%	25.85%
Nakuru	62	139	123	78	201
	30.85%	69.15%	61.19%	38.81%	40.28%
Total	**144**	**355**	**344**	**155**	**485**
	28.86%	**71.14%**	**68.94%**	**31.06%**	

Table 29 presents the 5 most used STIBs by farmers disaggregated by county, farmer type and gender. Nine (9) out of 499 STIBs adopting farmers across the learning labs combined improved seed, farmer training, and group membership. A combination of inorganic, nutrition education, group membership and intercropping, farmer training and group membership were used by three farmers each. On the other hand, organic, farmer training, and group membership and intercropping, nutrition education and group membership were used by two farmers each. The other bundles of innovations are complex, and farmer centered. Annex 20 presents 25 example of examples of complex STIBs used by farmers in the learning labs.

Table 29: Distribution of the most used STIBs by county, farmer type and gender

STIBs	County			Farmer type		Gender		Pooled
	Embu	Makueni	Nakuru	Non-UU	UU	Women	Men	
Improved seed, farmer training, and group membership	4	2	3	6	3	6	3	9
Inorganic, Nutrition Education, Group	0	0	3	0	3	2	1	3
Intercropping, Farmer Training, Group	1	2	0	1	2	3	0	3
Organic, Farmer training, Group membership	1	0	1	2	0	1	1	2
Intercropping, Nutrition Education, Group membership	0	1	1	0	2	1	1	2

> Most UU farmers in Embu and Nakuru counties have used STIBs for 1 to 2 years, whereas in Makueni, most of the UU farmers have used STIBs for less than one year. In Nakuru county, about 20% of women farmers and 25% of men farmers reported to have used STIBs for more than four years.

CHAPTER SEVEN
EFFECTIVENESS OF UU AND HER+ INITIATIVES

This chapter presents the findings on effectiveness of UU and HER+ initiatives activities and gendered implication of CA practices.

7.1: Maize and beans production and productivity

Table 30 present types of seeds used by farmers in the general plots – farmers' non-experimental plots for typical agricultural activities. Findings indicate a high use of certified maize (89% of women and 90% of men) seed and local bean varieties (70% of women and 69% of men). The low use of improved common bean seeds indicates a technological gap in access to improved bean varieties among farmers. This is more pronounced among non-UU farmers than UU farmers. 18% and 15% women and men UU farmers used improved bean seeds compared to 7% and 6% of women and men non-UU farmers respectively. Integration of Nyota bean seed in UU mother demonstration plots was meant to catalyze adoption of improved common bean varieties beyond farmers' trials on baby demonstration plots. This possibly explains the differences in adoption of improved common bean seeds between UU and non-UU farmers.

Table 30: Type of seed planted by farmer in the general plot (%)

Crop	Farmer type	Seed type	County						Pooled	
			Embu		Makueni		Nakuru			
			Women	Men	Women	Men	Women	Men	Women	Men
Maize	UU	Local	1.15	5.00	18.18	15.00	5.62	2.04	8.33	5.62
		Recycled improved	3.45	0.00	4.55	10.00	1.12	4.08	3.03	4.49
		Improved/ certified	95.40	95.00	77.27	75.00	93.26	93.88	88.64	89.89
	Non-UU	Local	16.67	14.04	27.16	12.50	1.22	4.17	14.94	9.60
		Recycled improved	8.97	1.75	3.70	6.25	0.00	1.39	4.15	2.82
		Improved/ certified	74.36	84.21	69.14	81.25	98.78	94.44	80.91	87.57

Crop	Farmer type	Seed type	County						Pooled	
			Embu		Makueni		Nakuru			
			Women	Men	Women	Men	Women	Men	Women	Men
Beans	UU	Local	77.11	76.19	60.49	83.33	72.37	59.52	70.00	69.14
		Recycled improved	8.43	0.00	17.28	11.11	9.21	26.19	11.67	16.05
		Improved/ certified	14.46	23.81	22.22	5.56	18.42	14.29	18.33	14.81
	Non-UU	Local	90.79	94.23	80.00	79.17	83.54	82.35	84.68	85.12
		Recycled improved	6.58	5.77	8.75	16.67	12.66	10.29	9.36	10.71
		Improved/ certified	2.63	0.00	11.25	4.17	3.80	7.35	5.96	4.17

Table 31 presents productivity of maize and bean on general plot, baby demo plots, and conventional plots. Maize and bean productivity from baby demonstration plots (treated plots) were 1,865 kg/acre and 678 kg/acre, respectively, compared to 1,097 kg/acre of maize and 307 kg/acre of beans harvested from conventional control trial plots. Among UU farmers, 420 kg/acre of maize and 246 kg/acre of beans harvested from general plots were significantly lower than those harvested from baby demonstration plots. Comparison of maize and bean productivity on general plots by farmer type revealed higher productivity among UU farmers than non-UU farmers, with non-UU farmers producing 204 kg/acre of bean and 355 kg/acre of maize. These results indicate that technologies and practices demonstrated on mother demos and replicated on baby demonstration plots (e.g., CA practices, intercropping, strip cropping, and improved seeds), are effective in increasing crop productivity.

The results in Table 31 also show gender and regional variations in maize and bean productivity. The average productivity of beans (753 kg/acre) and maize (2,213 kg/acre) from baby demonstration plots were higher among men UU farmers than women UU farmers (beans: 652 kg/acre and maize:1,760 kg/acre). Bean productivity on baby plots was higher among men UU farmers in Embu and Nakuru, but higher among women UU farmers in Makueni county. Except for women UU farmers in Nakuru, women in Makueni and Embu recorded higher maize productivity from baby demonstration plots than men. Maize productivity among UU farmers in Nakuru (2,363 kg/acre) surpassed the productivity of baby demonstration plots in Embu (1,823 kg/acre) and Makueni (901 kg/acre). These results indicate the complexity of agricultural productivity dynamics, where both gender and regional factors play a significant role in determining the outcomes of interventions. This has implication for HER+ and UU initiatives to continuously design and re-design STIBs that address specific needs and constraints of different groups of farmers for equitable maximization of agricultural productivity.

Table 31: Overall productivity for maize and beans in kg/acre

Crop	Farmer type	County						Pooled		
		Embu		Makueni		Nakuru				
		Women	Men	Women	Men	Women	Men	Women	Men	% difference
General plot										
Beans	UU	206	254	165	89	440	309	224	315	29%
	Overall	**215**		**152**		**356**		**246**		
	Non-UU	204	224	135	122	249	274	204	204	0%
	Overall	**212**		**130**		**262**		**204**		

Crop	Farmer type	County						Pooled		
		Embu		Makueni		Nakuru				
		Women	Men	Women	Men	Women	Men	Women	Men	% difference
Maize	UU	472	544	308	280	484	652	404	482	16%
	Overall	**485**		**303**		**537**		**420**		
	Non-UU	390	373	258	263	409	492	343	373	8%
	Overall	**383**		**260**		**450**		**355**		
Baby demo conventional										
Beans	UU	374	434	240	92	180	280	289	334	14%
	Overall	**399**		**166**		**216**		**307**		
Maize	UU	1,190	1,328	337	600	1,109	1,200	1,056	1,182	11%
	Overall	**1,226**		**403**		**1,141**		**1,097**		
Baby demo treated										
Beans	UU	679	761	685	627	613	758	652	753	13%
	Overall	**694**		**680**		**666**		**678**		
Maize	UU	1,856	1,681	908	780	2,211	2,633	1,760	2,213	20%
	Overall	**1,823**		**901**		**2,363**		**1,865**		

7.2 Relationship between adoption of STIBs and productivity

Analysis was conducted to determine the relationship between maize and bean productivity and the adoption of STIBs in the general plot. Results in Table 32 show that regardless of farmer type and gender, farmers who adopted STIBs reported higher maize and bean productivity than non-adopters. Higher maize and bean productivity among were harvested by UU farmers who adopted STIBs compared to UU non-STIBs adopters. These findings further reinstate the importance of adopting STIBs in increasing crop productivity by effectively addressing multifaceted challenges that farmers confront in agricultural production. Disaggregated findings by gender indicated a notable gender gap among UU farmers who adopted STIBs. Among the UU adopter of STIBs, women farmers harvested 215 kg/acre of beans and 407 kg/acre of maize from the general plot compared to 302 kg/acre of beans and 488 kg/acre of maize harvested by men farmers. The gender disparity in productivity among UU STIBs adopters suggests that while STIBs are effective, there may be differential access to benefits they offer due to several factors that maximize benefits among men than women. Therefore, monitoring and evaluation would be critical in identifying and addressing sources of gender disparities that prevent women from utilizing STIBs to their full potential and benefits.

Table 32: Disaggregated overall productivity for maize and beans in kg/acre by STIBs adoption

Adoption of STIBs	Farmer type		Bean	Overall	Maize	Overall
With STIBs	UU	Women	215.26	236.90	407.06	424.11
		Men	302.69		488.13	
	Non-UU	Women	233.99	230.70	347.33	376.23
		Men	226.50		413.39	
Without STIBs	UU	Women	91.67	91.39	296.67	286.43
		Men	90.00		225.00	
	Non-UU	Women	188.14	188.99	341.23	345.02
		Men	190.24		350.55	

7.3: Application of CA practices on baby demonstration plots among UU farmers

The results in Table 33 present CA practices implemented by UU farmers on baby demo plots. Four out of the six CA no-till (NT) ripping practices were experimented on farmers' fields. The most selected CA practice from mother demo to baby demo was the standard maize-common bean intercrop as reported by 49% of the UU farmers. Strip cropping common bean and maize, common bean-maize intercrop double-row configuration, and continuous maize were experimented by 32%, 13%, and 2% of the UU farmers in Nakuru, respectively. More women (51%) than men (45%) experimented standard maize-common bean intercrop in Nakuru. In contrast, more men (36%) implemented strip cropping of common bean-maize than women (30%).

There was equal experimentation of common bean-maize intercrop double row configuration and continuous maize among men and women. Maize-common bean rotation with residue and continuous beans were the least experimented CA practices in Nakuru and Embu counties, respectively. In Makueni County, the least adopted CA practice was strip-cropping with two rows of beans-one row of maize, 4 rows of beans-3 rows of maize, ripping continuous beans, ridges and furrows continuous beans, CA furrows (maize-bean intercrop) and CA furrows. In addition, three more practices not demonstrated in mother demos were implemented by women farmers: tilling standard common maize bean intercrop, tilling stripping 2-row maize three rows' beans, and tilling strip common bean-maize strip. Although the modifications are against the no-till principle emphasized by the UU initiative, the results indicate women farmers' willingness to adapt or innovate practices beyond those demonstrated in mother demos, possibly to suit their contexts.

Table 33: CA practices implemented in the baby demonstration plots.

Counties	CA practices	Gender		Pooled
		Women	Men	
Nakuru	Standard maize- common bean intercrops	50.63	45.45	48.78
	Strip cropping common bean-maize strips	30.38	36.36	32.52
	Bean-maize intercrop double-row	12.66	13.64	13.01
	Continuous maize	2.53	2.27	2.44
	Tilling standard common maize bean intercrop	1.27	2.27	1.63
	Maize- common bean rotation with residue	1.27	0.00	0.81
	Tilling stripping two rows of maize three rows of beans	1.27	0.00	0.81
	Tilling strip common bean-maize strip	1.27	0.00	0.81
Embu	Continuous maize	7.81	6.67	7.59
	Standard maize-bean intercrops	32.81	33.33	32.91
	Common bean-maize rotation	14.06	26.67	16.46
	Maize-common bean rotation	6.25	13.33	7.59
	Bean-maize intercrop double-row	12.50	20.00	13.92
	Strip cropping common bean-maize strips	25.00	6.67	21.52
	Continuous beans	4.69	0.00	3.80
Makueni	Continuous maize	5.56	25.00	7.50
	Standard maize-legume intercrops	27.78	0.00	25.00
	Maize- legume rotation	19.44	25.00	20.00
	Legume-maize rotation	5.56	0.00	5.00
	Legume-maize intercrop double row configuration	5.56	50.00	10.00
	Legume -maize strips (4 rows maize & rows legume)	16.67	0.00	15.00
	Maize-legume strip cropping	16.67	0.00	15.00
	Strips two row of beans one raw maize	2.78	0.00	2.50
	4 rows Beans 3 rows maize	2.78	0.00	2.50
	CA ripping continuous beans	2.78	0.00	2.50
	Ridges and furrows continuous beans	2.78	0.00	2.50
	CA furrows (maize-bean intercrop)	2.78	0.00	2.50
	CA furrows	2.78	0.00	2.50

Photo 3: Farmers strategy meeting in establishing mother demonstration in Makueni Sub-County

7.4: Effectiveness of different CA practices on maize and bean productivity

The results in Table 34 measure the effectiveness of no-till (NT) ripping CA practices in Nakuru county regarding maize and bean productivity, focusing on CA experimented by both men and women. Common bean-maize intercrop double row configuration had the highest maize productivity (2,338 kg/acre), with six women farmers recording an average of 2,980 kg/acre against 1,375 kg/acre reported by four men farmers. The 23 farmers (10 men and 13 women) that experimented with strip cropping of common bean-maize harvested almost equal productivity of 1,700 kg/acre by men and 1,720 kg/acre by women. Ten farmers who experimented with standard maize-common bean intercrop harvested 2,084 kg/acre of maize, with women farmers harvesting an average yield of 2,107 kg/acre compared to 2,000 kg/acre harvested by men farmers. Only one men farmer established no-till CA with continuous maize, harvesting 2,600 kg/acre. Maize productivity in women plots under common bean-maize intercrop double row configuration and standard maize-common bean intercrop plots were superior to productivity in men plots, suggesting that they might be more effective or have better adapted to certain CA practices.

Table 34: Maize and bean productivity by no till (NT) ripping CA practices in Nakuru County by gender.

CA practices	Maize			Bean		
	Women	Men	Pooled	Women	Men	Pooled
Continuous maize	0	2,600	2,600	0	0	0
Standard maize-bean intercrop	2,107	2,000	2,084	343	328	339
Bean-maize intercrop double row	2,980	1,375	2,338	435	279	368
Strip cropping bean-maize strips	1,720	1,700	1,711	398	458	424

The results in Table 34 above also revealed that forty-three (30 women and 13 men), 14 (8 women and six men), and 30 (17 women and 13 men) farmers had harvested beans from the standard maize-common bean intercrops, common bean-maize intercrop double row configuration, and strip cropping common bean-maize strips experimental baby demos by the time of baseline survey, respectively. In Nakuru, strip cropping (common bean-maize strips) was the most effective CA practice for bean production (424 kg/acre), followed by common bean-maize intercrop double row configuration (368 kg/acre), and standard maize-common bean intercrop (339 kg/acre). The average bean yields obtained from the standard maize-common bean intercrops plots were 343 kg/acre for women and 328 kg/acre for men. Women harvested 435 kg/acre of beans from common bean-maize intercrop double-row configuration plots against 279 kg/acre harvested by men. In contrast, men (458 kg/acre) outperformed women (398 kg/acre) in bean grain produced on strip cropping common bean-maize strips experimental baby demo plots. The results suggest that women may have specific strengths or better adoption in certain CA practices, especially in intercropping systems.

Table 35 provides performance of furrow and ridge variations of CA practices implemented in farmers' baby demonstration plots in Embu County. The results are obtained from an analysis of 60 and 69 UU farmers who had harvested beans and maize at the time of the survey, respectively. Notable variations in maize productivity were reported. Maize-common bean rotation produced the highest maize yields (2,700 kg/acre (women: 3,600 kg/acre, men: 1,800 kg/acre) followed by strip cropping common bean-maize strips with an average harvest of 1,654 kg/acre (women: 1,705 kg/acre, men: 898 kg/acre). Maize yields were least in CA furrow and ridges continuous maize (702 kg/acre: women (609 kg/acre) and men (1,171 kg/acre)) and bean-maize rotation (770 kg/acre: women (738) and men (900 kg/acre)). Average yields on common bean-maize intercrop double row configuration were 1,081 kg/acre, with women and men producing 1,133 kg/acre and 944 kg/acre, respectively.

Table 35: Maize and bean productivity by CA Furrow and ridges practices in Embu County by gender

Variable	Maize			Bean		
	Women	Men	Pooled	Women	Men	Pooled
Continuous maize	609	1,171	702	0	0	0
Standard maize-bean intercrops	1,352	1,550	1,385	421	890	506
Bean-maize rotation	738	900	770	381	373	379
Maize-bean rotation	3,600	1,800	2,700	416	0	416
Bean-maize intercrop double row	1,133	944	1,081	530	426	499
Strip bean -maize	1,705	898	1,654	510	364	498
Continuous beans	0	0	0	252	0	252

Table 35 also shows that the most effective CA practices for bean production in Embu County were the standard maize-common intercrop with furrows and ridges with 506 kg/acre of grain harvested. Men farmer's plots recorded an average of 890 kg/acre, outperforming yield obtained from women's plots (506 kg/acre) under CA furrow and ridges standard maize-common bean intercrops. Yields obtained from common bean-maize intercrop double row configuration and strip cropping common bean-maize strips were equal: 499 kgs/acre (women (30 kg/acre), men (426 kg/acre)) and 498 kgs/acre (men (364 kg/acre) and women (510 kg/acre)). The third most effective CA practice in Embu was maize-common bean rotation (416 kg/acre), as reported by women farmers. Bean yields from bean-maize rotation (378 kg/acre) were almost the same for men (373 kg/acre) and women (381 kg/acre) farmers. CA furrows and ridges continuous beans, a farmer-modified CA protocol, was the least effective CA practice, with an average yield of 252 kg/acre. These results indicate varying gender-specific effectiveness across different CA practices.

The results of predominantly women's engagement in baby trials of CA ripping practices in Makueni are presented in Table 36. The most effective CA practice was maize-legume rotation with an average of 1,583 kg/acre

of maize reported by women farmers. Strip cropping legume-maize strips (four rows maize four rows legume) with productivity of1,054 kg/acre of maize and strips of 4 rows beans 3 rows maize with productivity of 1000 kg/acre of maize were the second and third most effective CA ripping practices. The legume-maize intercrop double-row configuration was the only practice in which men engaged, harvesting 780 kgs/acre of maize compared to 1,080 kg/acre harvested by women. The least effective CA practices in terms of maize production were maize-bean intercrop (400 kg/acre), standard maize-legume intercrops (545 kg/acre), and strips two row of beans one row of maize (556 kg/acre).

Table 36: Maize and bean productivity by CA ripping practices in Makueni County by gender

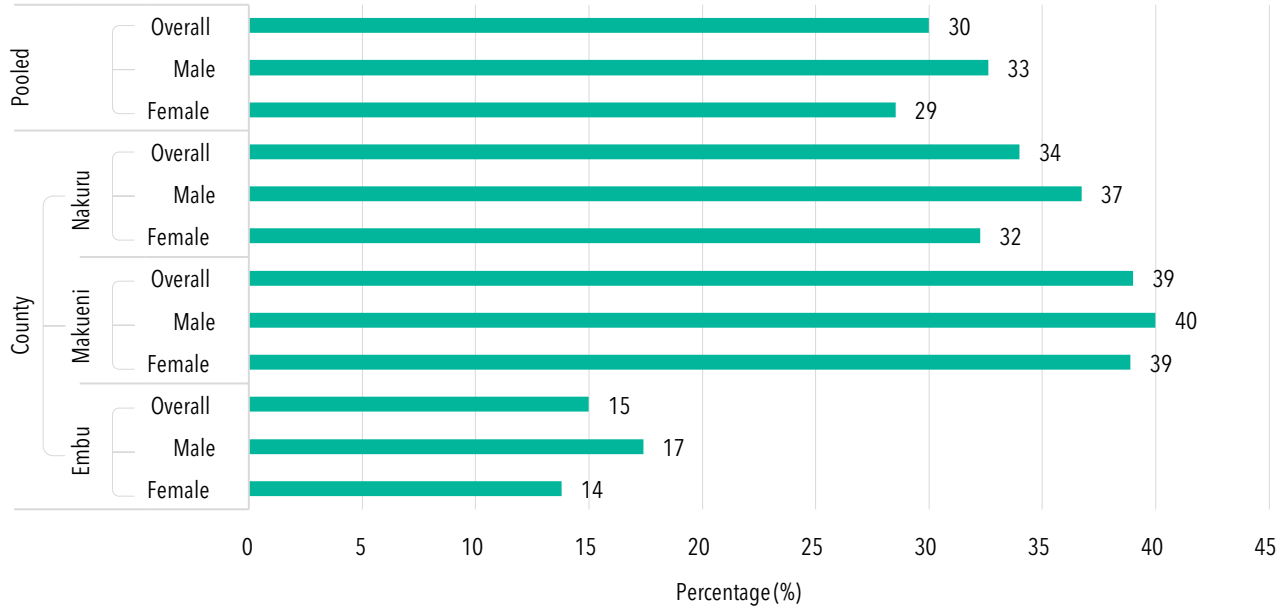
Variable	Maize			Bean		
	Women	Men	Pooled	Women	Men	Pooled
Continuous maize	700	0	700	0	0	0
Standard maize-legume intercrops	545	0	545	393	0	393
Maize-legume rotation	1,583	0	1,583	567	0	567
Legume-maize intercrop double row	1,080	780	930	600	220	410
Legume-maize strips (each 4 rows)	1,054	0	1,054	429	0	429
Planting basins (maize-legume strip)	600	0	600	460	0	460
Strips two rows of beans, one raw maize	556	0	556	167	0	167
4 rows beans 3 rows maize	1,000	0	1,000	533	0	533
CA furrows (maize-bean intercrop)	400	0	400	800	0	800
Continuous beans	0	0	0	80	0	80
Ridges and furrows continuous beans	0	0	0	183	0	183

In terms of bean yields, maize-bean intercrop was the most effective CA practice (800 kg/acre) in Makueni followed by maize-legume rotation (567 kg/acre) and four rows of beans and three rows of maize (533 kg/acre) (Table 36). The least effective CA practices in Makueni were continuous beans (80 kg/acre) and ridges and furrows continuous beans (183 kg/acre), which are farmers' modifications on farmers' plots. All CA practices in Table 36 were only practiced by women except legume-maize intercrop double row configuration. Women outperformed men with an average of 600 kg/acre of beans harvested from legume-maize intercrop double row configuration baby demos against 220 kg/acre harvested by men farmers.

Replication of CA practices in in general plots

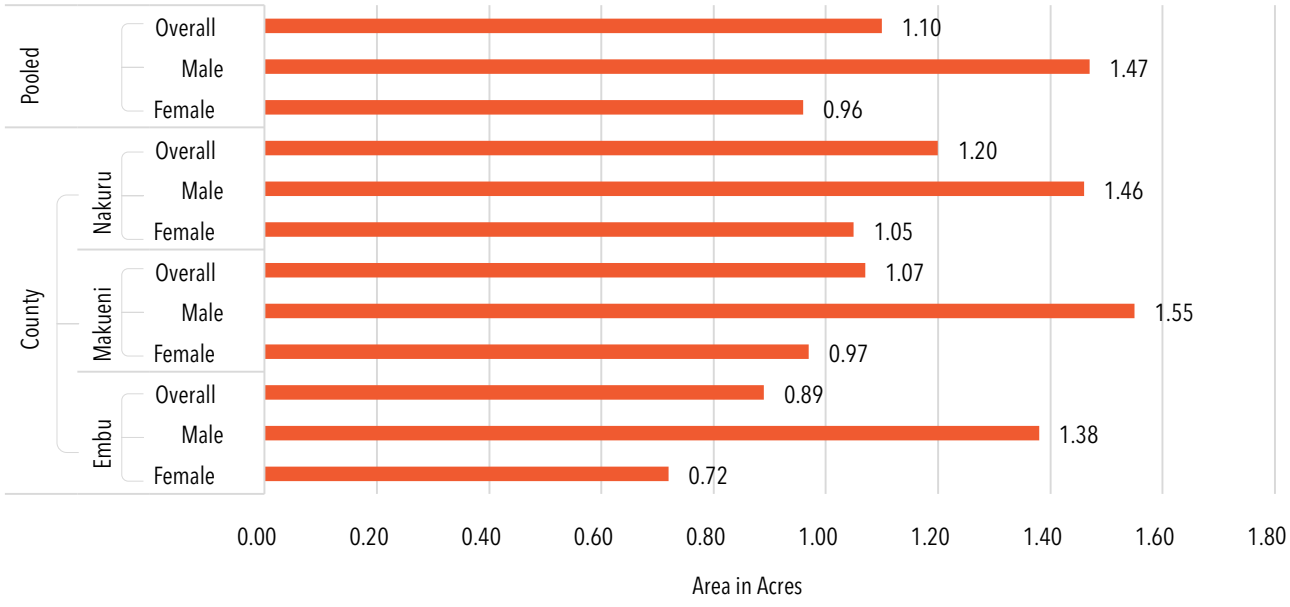
About 30% of the sampled UU farmers replicated the CA practices experimented in the mother demonstration plots on general plots. Figure 12 Shows that most of the replications (39%) were in Makueni and the least (15%) in Embu County reflecting regional contextual factors in the transition of the practices. The high replication of mother demonstration technologies and practices on general plots in Makueni County could be a result of the prevalence of climate-related shocks compared to other HER+ learning labs as shown in Figure 15 and the application of more CA practices experimented in the baby demos. These results reflect regional differences in intensity of implementation of the CA practices as shown in Table 37. On the other hand, the low replication in Embu County could be attributed to land constraints as shown earlier in Table 8. The results in Figure 12 also shows that more men farmers replicated CA practices than female farmers, suggesting the possibility of women farmers lacking resources to implement the CA practices or social norms that grant men decision-making power on adoption of farming practices.

Figure 12: Proportion of UU farmers who have transitioned the CA practices from the mother and baby demo to the general plots (%)



There were differences in scale of replication of mother demonstration practices and technologies on general plots. In general, men UU farmers had a higher average land size (1.47 acres) under the replicated CA practices compared to women (0.96 acres). Gender disparities in land area under replicated practices ranged from 0.41 acres in Nakuru to 0.66 acres in Embu in favour of men UU farmers. (Figure 13). Nakuru had the highest scale of replication of the practices on the general plot (1.20 acre) compared while Embu had the lowest scale of replication (0.89 acres). These results suggest several underlying issues, such as access to land and resources and the influence of gender norms that constraints women from implementing changes on a larger scale. Redesigning STIBs to create greater access to social innovations could ensure that women replicate CA practices on an equitable scale.

Figure 13: Scale of transition of CA practices from the mother and baby demos to the general plot.



The specific CA practices replicated on the general plot are presented in Table 37. Farmers in Makueni replicated more practices (9) on the general plot compared to their counterparts in Nakuru (7) and Embu (6), possibly because of the large number of CA protocol identified and demonstrated on the mother demo or the severe climatic conditions. The standard maize-bean intercrop was the most replicated CA practice in Nakuru County (49%) and Makueni County (47%), whereas standard maize-common bean intercrop was the most replicated CA practice in Embu County (40%). This finding indicates differences in regional preferences of co-designed CA practices and the appropriateness to context specific consideration in designing of the CA protocols.

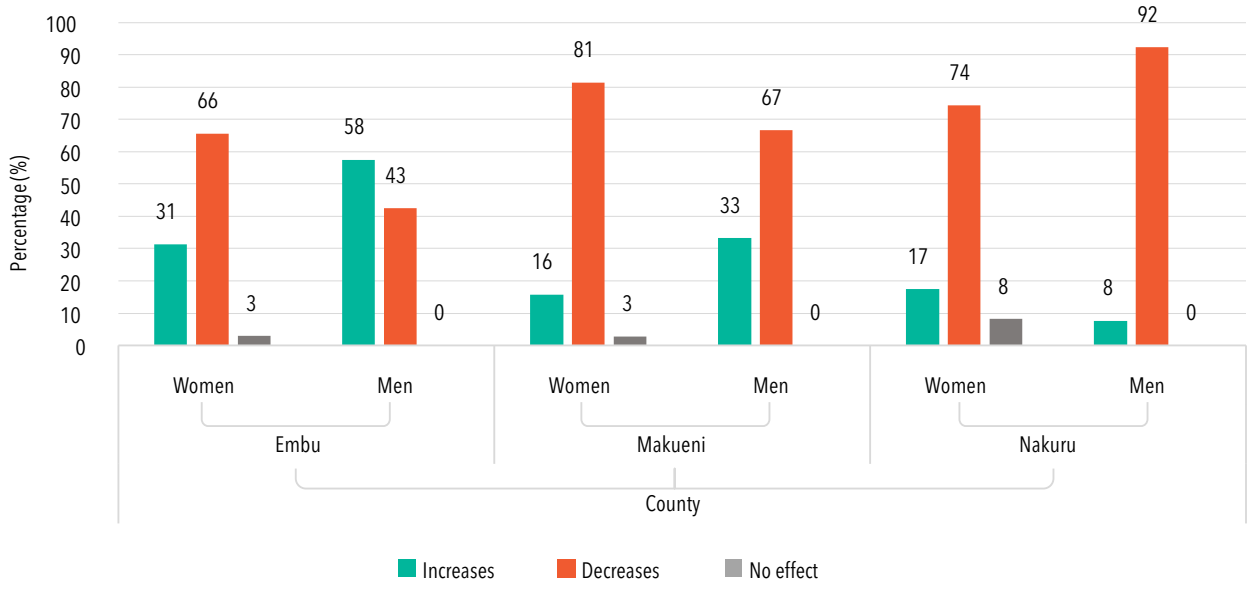
Table 37: CA practices transitioned from the mother and baby demos to the general plot (%)

Counties	CA practices	Percentage (%)
Nakuru	Standard maize-bean intercrops	48.89
	Continuous maize	33.33
	Bean-maize rotation without residue	6.67
	Maize-bean rotation with residue	6.67
	Strip bean-maize strips	6.67
	Ripping continuous beans	2.22
	Tilling strip maize-beans double	2.22
Makueni	Standard maize-legume intercrops	46.51
	Maize-legume rotation	23.26
	Continuous maize	18.6
	Legume-maize rotation	2.33
	Legume-maize intercrop double row configuration	2.33
	CA furrows continuous maize	2.33
	Continuous green gram	2.33
	Strip maize-2 rows beans configuration	2.33
	CA Zai pits: maize-legume strip cropping	2.33
Embu	Standard maize-common bean intercrops	40.00
	Continuous maize	20.00
	Strip cropping Common bean-maize strips	20.00
	Common bean-maize rotation	13.33
	Maize-Common bean rotation	6.67
	Common bean-maize intercrop double row configuration	6.67

7.5: Implication of CA practices on workload

Figure 14 shows farmers' perceptions of the implication of CA practices demonstrated on the mother demo and experimented on their farms. While a higher percentage of men (58%) in Embu perceived an increased workload, 66% of women reported a decreased workload. About 81% of women and 67% of men in Makueni and 74% of women and 92% of men in Nakuru reported decreased workload from experimented CA practices. These results reveal possible regional variation in gender-specific roles in agriculture, reflecting possible trade-offs in tasks typically undertaken by men and women that may result from adoption of the CA practices.

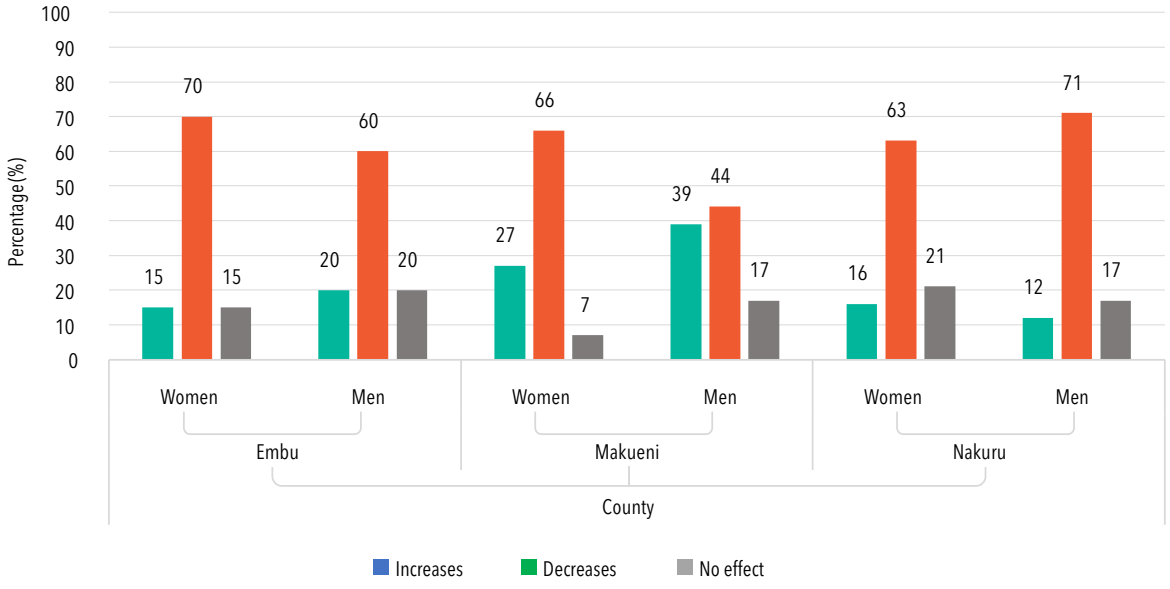
Figure 14: Implication of CA practices on workload.



7.6: Implication of CA practices on need of farm inputs

Results of farmers' perceptions of the impact of CA on the need for farming inputs are presented in Figure 15. The percentage of women farmers that reported a decreased need for farm inputs (e.g., fertilizer, labour, irrigation water, manure etc.) was highest in Embu (70%), followed by Makueni (66%) and Nakuru (66%). In comparison, 60% of men in Embu, 44% in Makueni, and 71% in Nakuru indicated a decrease in the need for inputs. The salient finding is that CA practices decreased the need for farm inputs across gender and regions, suggesting that farmers generally viewed CA as beneficial in reducing input requirements or costs. Notwithstanding the decrease in need for inputs as the most common perception, the varying perceptions by gender suggest possibly differences in men and women's roles in input acquisition or provision.

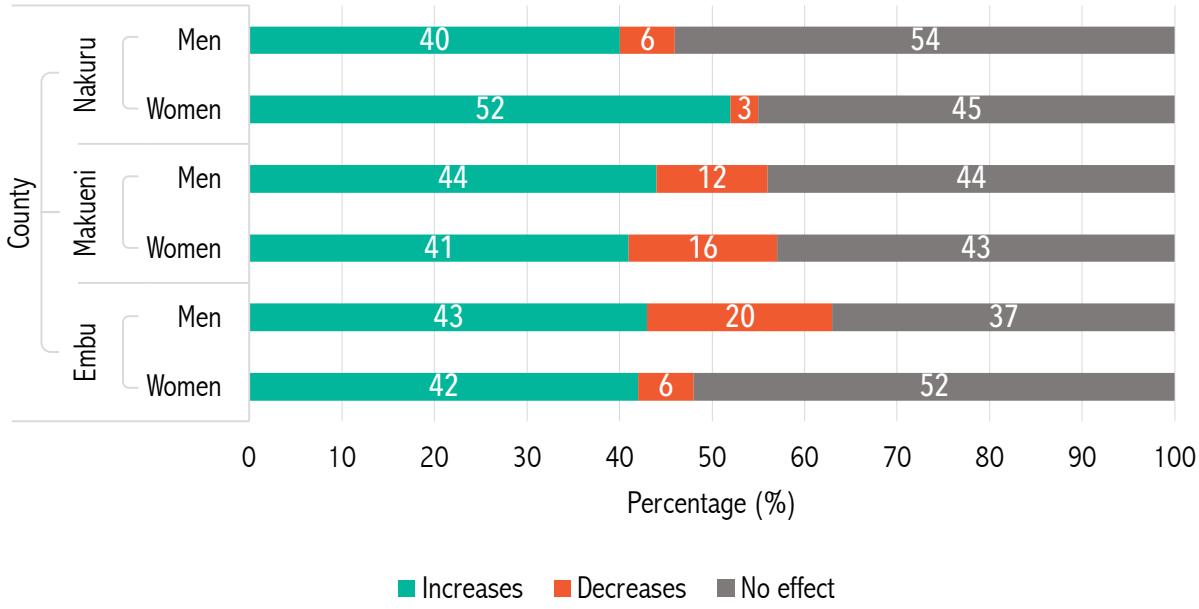
Figure 15: Implication of CA practices on the need for farm inputs.



7.7: Implication of CA practices on control over benefits/income

Respondents' perceptions of the impact of CA practices on their control over benefits or income derived from crop production are presented in Figure 16. The percentage of women that reported increased control over benefits/income was highest in Embu (52%) than in Nakuru (45%) and Makueni (43%). About 38%, 44%, and 54% of men in Embu, Makueni, and Nakuru reported increased control over benefits/income, respectively. Most women (51%) in Nakuru perceived that CA did not affect control over benefits/income compared to 40% of men. The perception of no effect on control over benefits/income was almost balanced between women (41%) and men (44%) in Makueni and in Embu (women (42%) and men (43%)). These results reveal varying gender perceptions of sense of control over agricultural income and benefits which necessitates further evaluation of gendered socio-economic impacts of CA across regions.

Figure 16: Implication of CA practices on control of benefits/income.



> Most UU farmers in Embu and Nakuru counties have used STIBs for 1 to 2 years, whereas in Makueni, most of the UU farmers have used STIBs for less than one year. In Nakuru county, about 20% of women farmers and 25% of men farmers reported to have used STIBs for more than four years.

CHAPTER EIGHT
FARMER EMPOWERMENT

Intra-household dynamics and socio-economic factors have implications on empowerment in terms of men and women involvement in decision-making. These factors can also influence the configuration of the farming systems and the nature of outcomes that emanate from farming. This section presents the findings on farmers' decision-making in key agricultural activities and the relationship between adoption of STIBs and empowerment.

8.1 Farmer participation in decision-making on key agricultural resources and activities

Survey findings presented in Table 38 show that decisions to use of own land for farming are mostly made jointly (man and woman) among both UU and non-UU farmers. Among the UU farmers, joint decision-making was reported by 59% of the men in Nakuru and 64% of women in Makueni County. Further, decision-making by men was majorly reported by male-targeted farmers. Women's decision-making was highly reported by 57% of the UU women farmers in Nakuru County. Higher proportions of men are primary decision-makers on the use of land. Notably, a higher percentage of women in Nakuru than in other counties are primary decision-makers on use of own land. Men never indicated that women were the primary decision-makers regarding the use of own land. Albeit the evidence of collaborative decision-making, the findings indicate a prevailing dominance of men in the decision-making process. Although the involvement of women and men in decision-making processes may suggest a shift towards more collaborative approaches in decision-making on productive resources , men continue to hold the dominant decision-making role. This observation highlights the persistent influence of socio-cultural practices on decision-making dynamics.

Table 38: Decision maker on use of owned land (%)

Farmer type	Decision maker	County						Pooled	
		Embu		Makueni		Nakuru			
		Women	Men	Women	Men	Women	Men	Women	Men
UU	Man	17.24	43.48	15.56	45.00	9.68	40.82	14.07	42.39
	Woman	31.03	0.00	18.89	0.00	56.99	0.00	35.93	0.00
	Jointly	49.43	52.17	64.44	55.00	32.26	59.18	48.52	56.52
	Other HH member (man)	1.15	0.00	0.00	0.00	1.08	0.00	0.74	0.00
	Other HH members (women)	1.15	4.35	1.11	0.00	0.00	0.00	0.74	1.09
Non-UU	Man	13.16	50.88	16.05	36.17	21.18	59.21	16.94	50.56
	Woman	53.95	0.00	27.16	0.00	47.06	1.32	42.56	0.56
	Jointly	30.26	47.37	54.32	61.7	29.41	38.16	38.02	47.22
	Other HH member (man)	1.32	0.00	1.23	2.13	0.00	1.32	0.83	1.11
	Other HH members (women)	1.32	1.75	1.23	0.00	2.35	0.00	1.65	0.56

Decision making on the borrowing/renting land.

Findings presented in Table 39 show that the decision to borrow or rent land was jointly made by both men and women, especially among male targeted farmers. This is evident across counties and farmer types. The findings point to women's empowerment in decisions involving access to borrowed or rented land for crop production. Women dominated decision making among female targeted farmers while men dominated decision making among male targeted farmers.

Table 39: Decision maker on borrowing/renting in land (%)

Farmer type	Decision maker	County						Pooled	
		Embu		Makueni		Nakuru			
		Women	Men	Women	Men	Women	Men	Women	Men
UU	Man	12.50	60.00	31.25	50.00	5.41	38.10	12.94	45.45
	Woman	25.00	0.00	18.75	0.00	67.57	4.76	42.35	3.03
	Jointly	59.38	40.00	50.00	50.00	27.03	57.14	43.53	51.52
	Other HH member (man)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Other HH members (women)	3.12	0.00	0.00	0.00	0.00	0.00	1.18	0.00
Non-UU	Man	9.38	46.86	0.00	12.50	20.00	33.33	13.33	33.87
	Woman	46.88	4.76	25.00	0.00	34.29	3.03	38.67	3.23
	Jointly	40.62	52.38	75.00	87.50	45.71	60.61	46.67	61.29
	Other HH member (man)	0.00	0.00	0.00	0.00	0.00	3.03	0.00	1.61
	Other HH members (women)	3.12	0.00	0.00	0.00	0.00	0.00	1.33	0.00

Decision making on agricultural equipment/machinery acquisition.

Findings in Table 40 indicate that most of the decisions on agricultural equipment/machinery acquisition or hiring were made jointly at the household level by both UU and non-UU farmers. While a relative trend of the inclusion of both women and men in decision-making processes may indicate a move towards more cooperative approaches in agricultural resource decisions, it is crucial to acknowledge that men still maintain the predominant decision-making position attributed to socio-cultural dynamics.

Table 40: Decision maker on agricultural equipment/machinery acquisition (%)

Farmer type	Equipment	Owned			Hire			borrow		
		Man	Woman	Jointly	Man	Woman	Jointly	Man	Woman	Jointly
UU	Tractor	0.00	50.00	50.00	14.00	32.00	54.00	0.00	0.00	100.00
	Ox-plough	20.00	13.33	66.67	9.52	14.29	76.19	33.33	0.00	66.67
	Disc plough	0.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Harrow	0.00	0.00	0.00	14.29	28.57	57.14	0.00	0.00	100.00
	Sprayer	100.00	0.00	0.00	18.18	45.45	36.36	0.00	0.00	0.00
	Thresher	0.00	100.00	0.00	17.86	25.00	57.14	0.00	0.00	100.00
	Ripper	0.00	50.00	50.00	0.00	22.22	77.78	100.00	0.00	0.00
Non-UU	Tractor	0.00	0.00	0.00	35.29	29.41	35.29	0.00	0.00	100.00
	Ox-plough	40.00	0.00	60.00	19.05	19.05	61.90	0.00	0.00	100.00
	Harrow	0.00	0.00	0.00	25.00	37.50	37.70	0.00	0.00	0.00
	Sprayer	0.00	0.00	0.00	28.57	14.29	57.14	0.00	0.00	0.00
	Thresher	0.00	0.00	0.00	33.33	20.00	46.67	0.00	0.00	0.00
	Ripper	0.00	0.00	0.00	25.00	50.00	25.00	0.00	0.00	0.00

Table 41 presents the survey findings on the decision maker on the mechanization of farm operations by county and farmer type. Regardless of the farmer type, the decision to mechanize farming operations was jointly made. About 85% of women in Makueni and 100% of women in Nakuru made decision regarding mechanization of farm operations.

Table 41: Decision maker on the mechanization of farm operations (%)

Farmer type	Decision maker	County						Pooled	
		Embu		Makueni		Nakuru			
		Women	Men	Women	Men	Women	Men	Women	Men
UU	Man	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Woman	0.00	0.00	15.38	0.00	0.00	0.00	14.29	0.00
	Jointly	0.00	0.00	84.62	100.00	100.00	0.00	85.71	100.00
Non-UU	Man	0.00	0.00	0.00	50.00	0.00	0.00	0.00	50.00
	Woman	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Jointly	0.00	0.00	100.00	50.00	0.00	0.00	100.00	50.00

Decision making on maize and bean production.

The findings on men's and women's involvement in production decisions in targeted crops (maize and beans) are presented in Table 42. Most of the decisions on production of maize and beans were jointly made. However, joint decision-making on mechanization was higher among UU farmers than non-UU farmers. This could be

attributed to capacity building through UU and HER+ initiatives. Additionally, women dominated decision-making among the targeted female farmers, whereas men dominated decision-making among male-targeted farmers. Like production decisions, findings in Annex 21 suggest that decision-making on the type of maize and bean seeds to plant is majorly done jointly. This pattern remains consistent across counties, genders, and farmer types.

Table 42: Farmer participation in decision-making on maize and bean production (%)

Crop	Farmer type	Decision maker	County						Pooled	
			Embu		Makueni		Nakuru			
			Women	Men	Women	Men	Women	Men	Women	Men
Maize	UU	Man	1.15	30.00	1.14	15.00	3.37	24.49	1.89	23.60
		Woman	44.83	0.00	30.68	0.00	61.80	2.04	45.83	1.12
		Jointly	52.87	70.00	68.18	85.00	34.83	73.47	51.89	75.28
		Other HH members (women)	1.15	0.00	0.00	0.00	0.00	0.00	0.38	0.00
	Non-UU	Man	2.56	31.58	1.23	18.75	2.44	33.33	2.07	28.81
		Woman	53.85	1.75	34.57	2.08	57.32	0.00	48.55	1.13
		Jointly	42.31	64.91	61.73	79.17	39.02	63.89	47.72	68.36
		Other HH member (man)	0.00	0.00	1.23	0.00	0.00	2.78	0.41	1.13
		Other HH members (women)	1.28	1.75	1.23	0.00	1.22	0.00	1.24	0.56
Beans	UU	Man	1.20	28.57	0.00	16.67	3.95	19.05	1.67	20.99
		Woman	38.55	9.52	34.57	0.00	56.58	2.38	42.92	3.70
		Jointly	57.83	61.90	65.43	83.33	39.47	78.57	54.58	75.31
		Other HH members (women)	2.41	0.00	0.00	0.00	0.00	0.00	0.83	0.00
	Non-UU	Man	1.32	21.15	1.25	18.75	1.27	23.53	1.28	21.43
		Woman	53.95	9.62	40.00	8.33	60.76	4.41	51.49	7.14
		Jointly	40.79	67.31	56.25	72.92	36.71	69.12	44.68	69.64
		Other HH member (man)	1.32	0.00	0.00	0.00	0.00	2.94	0.43	1.19
		Other HH members (women)	2.63	1.92	2.50	0.00	1.27	0.00	2.13	0.60

Decision making on the use of SI/CSA/CA practices.

Overall, decision-making on use of CA practices on the baby demonstration plots was majorly (67%) made by women (Table 43), especially among the female targeted farmers. Among the male targeted farmers, 50% men and 50% joint decision-making about the use of CA practices on the baby demonstration plots was reported. Analysis by county revealed that about 72% of the decision to use CA practices on baby demonstration plot was made by women in Embu, whereas in Nakuru the decision was made by men. Joint decision making was majorly (67%) reported in Makueni by men UU farmers.

Table 43: Decision maker on the use of SI/CSA/CA on baby demonstration plot (%)

Decision maker	County						Pooled	
	Embu		Makueni		Nakuru			
	Women	Men	Women	Men	Women	Men	Women	Men
Man	0.00	50.00	0.00	33.33	0.00	100.00	0.00	50.00
Woman	71.67	0.00	55.56	0.00	0.00	0.00	66.67	0.00
Jointly	28.33	50.00	44.44	66.67	0.00	0.00	33.33	50.00

Decision-making regarding replication of CA practices on the general plots is presented in Table 44. Overall, decision-making on the replication of CA practices on general plots was mainly made by women (69%), especially in Nakuru (74%) and Embu (73%). In Makueni county, all decisions to replicate CA practices on the general plots among the male targeted farmers were made by men. Joint decision making on replication of CA practices was majorly (54%) reported in Nakuru County.

Table 44: Decision maker on replication of SI/CSA/CA on general plot by UU farmers (%)

Decision maker	County						Pooled	
	Embu		Makueni		Nakuru			
	Women	Men	Women	Men	Women	Men	Women	Men
Man	0.00	66.67	0.00	100.00	0.00	30.77	0.00	41.18
Woman	72.73	0.00	57.14	0.00	74.07	15.38	69.23	11.76
Jointly	27.27	33.33	42.86	0.00	25.93	53.85	30.77	47.06

Farmers ability to voice their opinion and concerns at household level.

Farmers were further asked about their ability to voice opinions and concerns in household decisions even if they differ from others. Generally, over 98% of the surveyed farmers feel that they could voice their opinions and concerns in household decisions even if they differ from others (Table 45). All targeted male farmers confirmed that they voiced their opinions and concerns in household decisions.

Table 45: Farmers voicing their opinions and concerns in household decisions (%)

Farmer type	County						Pooled	
	Embu		Makueni		Nakuru			
	Women	Men	Women	Men	Women	Men	Women	Men
UU	98.85	100.00	98.89	100.00	100.00	100.00	99.26	100.00
Non-UU	97.47	100.00	98.77	100.00	98.86	98.70	98.39	99.45

Decision making on credit and savings.

Among the UU farmers, male targeted farmers jointly made decisions (60%) to use credit whereas most women (60%) spearheaded the decision on how to use the credit received among the female targeted farmers (Table 46). About 74% of male targeted farmers in Nakuru jointly decided how to use credit whereas in Embu (60%) and Nakuru (68%), women decided how to use the credit received.

Table 46: Decision maker on how to use the credit received (%)

Farmer type	Decision maker	County						Pooled	
		Embu		Makueni		Nakuru			
		Women	Men	Women	Men	Women	Men	Women	Men
UU	Man	1.92	60.00	5.26	16.67	0.00	26.32	2.34	34.29
	Woman	59.62	0.00	52.63	33.33	68.42	0.00	60.16	5.71
	Jointly	34.62	40.00	42.11	50.00	31.58	73.68	35.94	60.00
	Other HH member (man)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Other HH members (women)	3.85	0.00	0.00	0.00	0.00	0.00	1.56	0.00
Non-UU	Man	0.00	68.75	4.76	56.25	5.00	70.83	2.99	66.07
	Woman	69.23	12.50	85.71	12.50	85.00	12.50	79.10	12.50
	Jointly	30.77	18.75	9.52	31.25	10.00	16.67	17.91	21.43
	Other HH member (man)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Other HH members (women)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Results on decision-making on savings are presented in Table 47. The results show that regardless of the farmer type, women made most decision on savings among the female targeted farmers whereas among the male targeted farmers, decisions to save were made jointly. Disaggregated findings by county revealed that about 77% of UU male targeted farmers in Makueni reported joint decision making on savings. On the other hand, 65% of the saving decisions among the UU female targeted farmers were made by women. In Embu, 38% of the saving decisions among the UU targeted male farmers were made by men.

Table 47: Decision maker on saving (%)

Farmer type	Decision maker	County						Pooled	
		Embu		Makueni		Nakuru			
		Women	Men	Women	Men	Women	Men	Women	Men
UU	Man	3.80	38.10	2.67	7.69	0.00	26.19	2.14	26.32
	Woman	56.96	4.76	42.67	15.38	65.00	9.52	55.13	9.21
	Jointly	36.71	57.14	54.67	76.93	35.00	64.29	41.88	64.47
	Other HH member (man)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Other HH members (women)	2.53	0.00	0.00	0.00	0.00	0.00	0.85	0.00
Non-UU	Man	3.85	40.00	3.51	15.38	7.46	53.57	5.11	40.98
	Woman	71.15	12.50	54.39	15.38	62.69	7.14	62.50	10.66
	Jointly	25.00	47.50	40.35	69.23	28.36	35.71	31.25	46.72
	Other HH member (man)	0.00	0.00	1.75	0.00	0.00	3.57	0.57	1.64
	Other HH members (women)	0.00	0.00	0.00	0.00	1.49	0.00	0.57	0.00

Decision making on the use of owned and co-owned resources.

Results in Table 48 revealed that the majority of men and women UU farmers reported having decision-making power over use of all owned and co-owned resources, with men generally having a slightly higher percentage

in this category than women. 74% and 69% of men and women UU farmers in Embu indicated that they had decision-making power for all resources. The trend was similar in Nakuru, with 82% of men and 78% of women, and in Makueni, 80% of men compared to 68% of women. The absence of any UU farmers reporting no decision-making power suggests the effectiveness of HER+ and UU initiatives' collaborations in influencing gender relations and empowerment in the learning labs. Among the non-UU farmers, a higher percentage of both men and women report reported having decision-making power for all resources compared to their UU counterparts in Embu and Makueni, but the numbers are lower in Nakuru.

Table 48: Decision maker on the use of owned and co-owned resources (%)

Farmer type	Decision maker	County						Pooled	
		Embu		Makueni		Nakuru			
		Women	Men	Women	Men	Women	Men	Women	Men
UU	Yes, for all resources	67.82	73.91	67.78	80.00	78.02	81.63	71.27	79.35
	Yes, for some resources	32.18	26.09	30.00	20.00	20.88	18.37	27.61	20.65
	No	0.00	0.00	2.22	0.00	1.10	0.00	1.12	0.00
Non-UU	Yes, for all resources	73.42	80.70	66.67	87.50	70.45	77.92	70.16	81.32
	Yes, for some resources	25.32	19.30	32.10	12.50	28.41	22.08	28.63	18.68
	No	1.27	0.00	1.23	0.00	1.14	0.00	1.21	0.00

Survey findings in Table 49 revealed that regardless of the farmer type, decision on which livestock to raise in the household is made jointly and the trend is similar across gender and county. Among the UU farmers, joint decision making on the type of animal to keep was majorly observed in Makueni County as reported by about 77% of women and 78% of men. In addition, there was a considerable percentage of women making decisions among the female targeted farmers and men making decision among male targeted farmers.

Table 49: Decision maker on livestock to raise (%)

Farmer type	Decision maker	County						Pooled	
		Embu		Makueni		Nakuru			
		Women	Men	Women	Men	Women	Men	Women	Men
UU	Man	3.53	45.45	2.27	16.67	4.4	26.53	3.41	29.21
	Woman	31.76	4.55	20.45	5.56	57.14	0.00	36.74	2.25
	Jointly	63.53	50	77.27	77.78	37.36	73.47	59.09	68.54
	Other HH member (man)	0.00	0.00	0.00	0.00	1.10	0.00	0.38	0.00
	Other HH members (women)	1.18	0.00	0.00	0.00	0.00	0.00	0.38	0.00
Non-UU	Man	7.04	34.62	5.26	20.93	6.17	34.72	6.14	31.14
	Woman	42.25	0.00	23.68	0.00	48.15	2.78	38.16	1.20
	Jointly	47.89	63.46	68.42	79.07	43.21	56.94	53.07	64.67
	Other HH member (man)	1.41	0.00	1.32	0.00	1.23	5.56	1.32	2.40
	Other HH members (women)	1.41	1.92	1.32	0.00	1.23	0.00	1.32	0.60

Furthermore, the survey findings showed that decision on which crop to produce was made jointly and the trend was similar across farmer type, gender, and county (Table 50). UU farmers embraced joint decision making on crops to be planted which could be attributed to their participation in the UU activities. Disaggregated findings by county and gender further revealed that joint decision-making was mainly reported by 72% of female and 85% male UU farmers.

Table 50: Decision maker on which crops to plant (%)

Farmer type	Decision maker	County						Pooled	
		Embu		Makueni		Nakuru			
		Women	Men	Women	Men	Women	Men	Women	Men
UU	Man	3.45	30.43	0.00	15.00	2.15	18.37	1.85	20.65
	Woman	33.33	0.00	27.78	0.00	60.22	2.04	40.74	1.09
	Jointly	62.07	69.57	72.22	85.00	37.63	79.59	57.04	78.26
	Other HH member (man)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Other HH members (women)	1.15	0.00	0.00	0.00	0.00	0.00	0.37	0.00
Non-UU	Man	2.53	21.05	1.23	18.75	2.27	33.77	2.02	25.82
	Woman	51.9	3.51	32.1	2.08	55.68	3.90	46.77	3.30
	Jointly	44.3	73.68	64.2	79.17	40.91	61.04	49.60	69.78
	Other HH member (man)	0.00	0	1.23	0.00	0.00	1.30	0.40	0.55
	Other HH members (women)	1.27	1.75	1.23	0.00	1.14	0.00	1.21	0.55

Findings in Table 51 reveal that farmers mainly jointly decided on how to use the income derived from sale of crops and livestock, especially among UU farmers. Further, about 42% of the decision on how to spend the income derived from the sale of crops and livestock were made by women among the female targeted UU farmers. These findings implies that women were involved in decision making that benefits them.

Table 51: Decision maker on how to spend income derived from selling crops and livestock (%)

Farmer type	Decision maker	County						Pooled	
		Embu		Makueni		Nakuru			
		Women	Men	Women	Men	Women	Men	Women	Men
UU	Man	1.15	34.78	4.44	15.00	2.15	14.29	2.59	19.57
	Woman	35.63	4.35	31.11	0.00	58.06	2.04	41.85	2.17
	Jointly	62.07	60.87	64.44	85.00	38.71	83.67	54.81	78.26
	Other HH member (man)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Other HH members (women)	1.15	0.00	0.00	0.00	1.08	0.00	0.74	0.00
Non-UU	Man	7.59	29.82	8.64	25.00	3.41	32.47	6.45	29.67
	Woman	54.43	1.75	33.33	4.17	52.27	0.00	46.77	1.65
	Jointly	36.71	66.67	55.56	70.83	43.18	66.23	45.16	67.58
	Other HH member (man)	0.00	0.00	1.23	0.00	0.00	1.30	0.40	0.55
	Other HH members (women)	1.27	1.75	1.23	0.00	1.14	0.00	1.21	0.55

8.2: Relationship between adoption of STIBs and empowerment

Analysis was also performed to establish the relationship between adoption of STIBs and empowerment (Measured by an index described in annex 22). Findings presented in Table 52 indicate that regardless of county, gender and farmer type, farmers who adopted STIBs reported higher empowerment score (2.37) compared to their counterparts without STIBs (2.19). Findings by farmer type revealed that the UU farmers had a higher empowerment score (2.25) compared to non-UU farmers (2.21). However, disaggregated findings by gender indicated a notable gender gap among UU farmers where UU farmers adopters of STIBs registered lower empowerment score (2.25) compared to non-adopters (2.36). This difference could be attributed to the disproportionately small sample size among UU non-STIBs adopters. Among farmers with STIBs, Makueni county

reported the highest empowerment score whereas analysis by gender show that men with STIBs had higher empowerment score (2.38) compared to women (2.17). These findings imply that the project needs to implement strategic interventions to close the empowerment gap.

Table 52: Relationship between adoption of STIBs and empowerment by county, gender and farmer type

Variable	Disaggregation	Without STIBs	With SIBs
County	Embu	2.09 (n=58)	2.23 (n=163)
	Makueni	2.36 (n=98)	2.38 (n=123)
	Nakuru	2.06 (n=79)	2.15 (n=200)
Gender	Women	2.11 (n=141)	2.17 (n=333)
	Men	2.33 (n=94)	2.38 (n=153)
Farmer type	UU	2.36 (n=6)	2.25 (n=338)
	Non-UU	2.19 (n=229)	2.21 (n=148)

CHAPTER NINE
CONTRIBUTION OF UU AND HER+ TO RESILIENT FOOD SYSTEMS

HER+ work package 2 and Ukama Ustawi initiatives share a common objective of enhancing smallholder farmers' resilience to climate change and food and nutrition security by promoting gender equality and social inclusion in access and use of innovations. The HER+ pathway to achieving this objective is through the integration of technological, technical, and social innovations in Ukama Ustawi initiative's CA and crop diversification interventions in three learning labs in Kenya. The survey collected key baseline indicators that span various resilience capacities. This chapter reports a baseline comparison of resilience capacities and food and nutrition security of participants and non-participants in the Ukama Ustawi initiative.

9.1: Food and nutrition security

The Household Food Insecurity Access Prevalence (HFIAP) status indicator was used measure household food insecurity (access) at baseline. Findings in Table 53 indicated about 19%) of UU farmers and 10% of non-UU farmers were food secure. About to 12% of farmers in Embu and10% in Makueni were food secure. The food security situation in Nakuru was polarized, with the county having the highest percentage of food secure (19%) and severely food insecure households (23%).

Table 53: Prevalence of Household Food Insecurity based on HFIAS scores (%)

HFIAS categories	Counties			Farmer type		Pooled
	Embu	Makueni	Nakuru	Non-UU	UU	
Food secure	11.79	10.04	18.57	10.00	19.15	13.89
Mildly food insecure	19.92	16.74	15.31	15.58	19.68	17.17
Moderately food insecure	57.72	57.32	43.00	52.79	49.20	51.89
Severely food insecure	10.57	15.90	23.13	21.63	11.97	17.05

Further disaggregation of findings by gender (Table 54) indicated that more (13%) women UU farmers were severely food insecure compared to men (8%). Both men and women UU farmers had better food security status compared to non-UU counterparts. The results suggest gender and locational differences in food security status at baseline.

Table 54: Prevalence of Household Food Insecurity based on HFIAS scores by farmer type (%)

Farmer type		County						Pooled	
		Embu		Makueni		Nakuru			
		Women	Men	Women	Men	Women	Men	Women	Men
UU	Food secure	16.09	8.70	15.56	20.00	23.66	22.45	18.52	18.48
	Mildly food insecure	18.39	34.78	16.67	20.00	20.43	14.29	18.52	20.65
	Moderately food insecure	56.32	52.17	53.33	55.00	40.86	53.06	50.00	53.26
	Severely food insecure	9.20	4.35	14.44	5.00	15.05	10.20	12.96	7.61
Non-UU	Food secure	3.80	17.54	4.94	4.17	15.91	12.99	8.47	12.09
	Mildly food insecure	18.99	17.54	18.52	12.50	14.77	10.39	17.34	13.19
	Moderately food insecure	65.82	50.88	60.49	60.42	38.64	44.16	54.44	50.55
	Severely food insecure	11.39	14.04	16.05	22.92	30.68	32.47	19.76	24.18

The study also used food consumption score (FCS) to provide a more comprehensive understanding of household food situation at baseline in the three counties. Findings in Table 55 revealed that 69% of the sampled farmers achieved acceptable FCS. More UU farmers (82%) compared to non-UU farmers (58%) achieved acceptable food consumption score, suggesting possible differences in access to diverse and nutritious food between the two groups. These results are consistent with the HFIAP findings that showed higher food security status among UU farmers than non-UU farmers (Table 39). Farmers with acceptable FCS category ranged from 65% in Makueni to 72% in Embu, reflecting a relatively high level of food consumption and nutritional quality at baseline across the countries. Farmers in the poor and borderline possibly highlight challenges that undermine crop productivity and food consumption, including constraints in accessing markets or agricultural inputs and economic or climate-related shocks.

Table 55: Food Consumption Score status by county and gender (%)

FCS Category	Counties			Farmer type		Pooled
	Embu	Makueni	Nakuru	Non-UU	UU	
Poor	4.88	4.60	5.54	6.51	3.31	5.05
Borderline	23.17	29.71	25.73	35.35	15.19	26.14
Acceptable	71.95	65.69	68.73	58.14	81.49	68.81

Further disaggregation of findings by farmer type and gender revealed that more men UU farmers (85%) achieved acceptable FCS compared to women (80%) (Table 56). There was nearly equal percentages of men (57%) and women (59%) non-UU farmers in acceptable FCS category. The noticeable gender gap in FCS within and across farmer types and counties requires a more nuanced understanding of the socio-economic and other contextual factors to effectively enhance food security and dietary diversity outcomes.

Table 56: Food Consumption Score status by farmer type (%)

		County						Pooled	
		Embu		Makueni		Nakuru			
		Women	Men	Women	Men	Women	Men	Women	Men
UU	Poor	2.30	0.00	4.44	0.00	4.30	4.08	3.70	2.17
	Borderline	10.34	4.35	22.22	15.00	15.05	16.33	15.93	13.04
	Acceptable	87.36	95.65	73.33	85.00	80.65	79.59	80.37	84.78
Non-UU	Poor	8.86	5.26	7.41	2.08	7.95	5.19	8.06	4.40
	Borderline	35.44	33.33	34.57	41.67	29.55	40.26	33.06	38.46
	Acceptable	55.70	61.40	58.02	56.25	62.50	54.55	58.87	57.14

Participants in UU activities were asked to report learnings from nutritional sessions and gender-nutrition sensitive training they attended. The purpose of this information was to synthesize the differences in food security status among UU and non-UU farmers based on FCS and HFIAS results presented in Table 53 through Table 56. Results shown in Table 57 revealed that UU farmers who attended the nutrition and gender sensitization sessions increased their of understanding of nutritious diets (89%), the importance of nutrient-dense foods (82%), food categories (59%), role of biofortification (58%) and local crops & micronutrients (50%). The understanding of these nutritional concepts is expected to encourage farming and behavioral changes, including crop diversification and dietary changes to meet households' nutritional requirements.

Additionally, results in Table 57 show that Makueni and Nakuru had comparatively greater levels of learning areas in comparison to Embu. This observation could be explained by the fact that HER+ had not conducted gender-sensitive nutrition training in Embu by the time of the survey. Nevertheless, men have acquired knowledge in more areas of food and nutrition than women. Thus, targeted interventions, such as continuation of gender sensitive nutrition training are needed to bridge the gender gap in nutritional knowledge.

Table 57: Learning from the nutrition sessions/gender nutrition sensitive training (%)

Learning areas	County			Gender		Pooled
	Embu	Makueni	Nakuru	Women	Men	
Understanding of nutrition/diet	88.33	93.59	85.14	88.89	90.00	89.15
Importance of nutrient-dense foods	90.00	82.05	75.68	80.25	88.00	82.08
Understanding food categories	50.00	66.67	59.46	59.26	60.00	59.43
Role of biofortification	61.67	57.69	54.05	57.41	58.00	57.55
Local crops & micronutrients	36.67	57.69	54.05	51.23	48.00	50.47
Nutrition during life stages	21.67	50.00	44.59	41.98	34.00	40.09
Household food timetable	18.33	44.87	47.30	35.8	46.00	38.21
Women's role in household nutrition	21.67	34.62	40.54	33.95	30.00	33.02
Gender's role in nutrition	11.67	26.92	37.84	24.69	32.00	26.42
Post-harvest nutrient preservation	10.00	21.79	24.32	17.28	26.00	19.34

The within county comparison of men and women farmers' learning from nutrition sessions and gender-sensitive trainings are presented in Table 58. The findings show that there were notable gaps in learnings derived by farmers from nutrition sensitization and gender sensitive nutrition training between men and women, especially in Embu and Makueni. There was noticeably lower number of farmers across the counties who reported learning about gender (women's) roles in household nutrition despite being a major highlight during the sensitization and training sessions. Therefore, strategic actions are needed to trigger a shift in gender norms that may undermine women's from participating in food and nutrition decisions.

> The UU farmers who participated in nutrition sensitization sessions and gender sensitive nutrition trainings were asked to highlight changes made to household food consumption

Table 58: Learning from the nutrition sessions/gender-sensitive training (%)

Learning areas	County					
	Embu		Makueni		Nakuru	
	Women	Men	Women	Men	Women	Men
Understanding of nutrition/diet	87.76	90.91	92.31	100.00	85.42	84.62
Importance of nutrient-dense foods	89.8	90.91	80.00	92.31	70.83	84.62
Understanding food categories	46.94	63.64	67.69	61.54	60.42	57.69
Role of biofortification	59.18	72.73	56.92	61.54	56.25	50.00
Local crops & micronutrients	38.78	27.27	58.46	53.85	54.17	53.85
Household food timetable	18.37	18.18	44.62	46.15	41.67	57.69
Nutrition during life stages	24.49	9.09	50.77	46.15	47.92	38.46
Gender's role in nutrition	12.24	9.09	23.08	46.15	39.58	34.62
Women's role in household nutrition	26.53	0.00	32.31	46.15	43.75	34.62
Post-harvest nutrient preservation	10.20	9.09	18.46	38.46	22.92	26.92

The UU farmers who participated in nutrition sensitization sessions and gender sensitive nutrition trainings were asked to highlight changes made to household food consumption. Findings in Table 59 showed that farmers have mainly modified household dietary practices (79%) and increased consumption of biofortified foods (64%). Modification of dietary practices was reported primarily on Makueni (91%), whereas an increase in consumption of biofortified foods was mainly reported in Embu (73%). Other changes in household consumption because of participating in UU activities included changes in food timing (55%), reduced consumption of unhealthy foods (53%) and cultivating nutrient-dense crops (40%). Notable gender gaps were observed in reducing unhealthy foods, cultivating nutrient-dense crops favoring men, and changing food timing favoring women.

Table 59: Changes in household consumption by participating in nutrition sessions/gender-sensitive training (%)

Changes in household consumption	County			Gender		Pooled
	Embu	Makueni	Nakuru	Women	Men	
Modified dietary practices	81.67	91.03	64.86	79.63	78.00	79.25
Increased biofortified foods	73.33	62.82	58.11	64.81	62.00	64.15
Changed food timing	43.33	67.95	52.70	57.41	50.00	55.66
Reduced unhealthy foods	56.67	58.97	43.24	50.62	60.00	52.83
Cultivating nutrient-dense crops	40.00	35.90	41.89	36.42	48.00	39.15
Adopted meal plans	10.00	21.79	24.32	19.75	18.00	19.34
Improved infant feeding	6.67	25.64	16.22	16.67	18.00	16.98
Nutrition for pregnant/lactating mothers	5.00	16.67	9.46	11.73	8.00	10.85
No change	0.00	1.28	8.11	2.47	6.00	3.30
Index	**3.17**	**3.83**	**3.20**	**3.41**	**3.48**	**3.42**

9.2: Relationship between adoption of STIBs and food security

The study explored the relationship between STIBs and food security across counties, farmer type, and gender. Pooled results in Table 60 show that STIBs adoption was associated with higher percentages of farmers in acceptable food consumption category. About 77% of STIBs adopters compared to 55% of non-STIBs adopters had acceptable food consumption level. However, these relationships varied by county, farmer type, and gender. Percentages of STIBs adopters with acceptable FCS ranged from 74% in Makueni to 79% in Nakuru county compared to 49% in Nakuru and 61% in Embu among non-STIBs adopters. Equal proportions (77%) of men and women STIBs adopters had acceptable levels of food consumption, while among non-adopters, 56% of women

compared to 52% of men had acceptable FCS. Mixed relationships were observed with respect to farmer type. Whereas a higher proportion (81%) of UU STIBs adopters than non-UU STIBs adopters (67%) achieved acceptable FCS, 100% of non-UU non-STIBs adopters were in acceptable FCS category. These results indicate STIBs is associated with increased food consumption and reduction in gender disparities, especially among participants in UU activities.

Table 60: Relationship between adoption of STIBs and FCS by county, gender, and farmer type (%)

Variable	Disaggregation	Without STIBs			With STIBs		
		Poor	Borderline	Acceptable	Poor	Borderline	Acceptable
County	Embu	5.19	33.77	61.04	4.73	18.34	76.92
	Makueni	5.45	39.09	55.45	3.88	21.71	74.42
	Nakuru	7.55	43.40	49.06	4.48	16.42	79.10
Gender	Women	7.47	36.21	56.32	4.94	18.02	77.03
	Men	4.20	43.70	52.10	3.23	19.35	77.42
Farmer type	Non-UU	6.29	40.21	53.50	6.94	25.69	67.36
	UU	0.00	0.00	100.00	3.38	15.49	81.13
Pooled		6.14	39.25	54.61	4.41	18.44	77.15

Comparison of household access to food categories between STIBs and non-STIBs adopters based on the HFIAP revealed that majority of farmers who adopted18% of STIBs adopters and 7% of non-STIBs adopters were food secure (18%Table 16). For instance, the percentage of STIBs adopters in Nakuru (22%), Makueni (15%), and Embu (16%) were food secure compared to 3%, 5%, and 12% of non-STIBs adopters, respectively. About 17% and 22% of women and men STIBs adopter were food secure compared to 8% and 5% of non-STIBs adopters. In terms of farmer type, 17% of non-UU STIBs adopters and19% of UU STIBs adopters were food secure compared to 7% of non-STIBs adopters and 14% of STIBs adopters. These results reinforce the strong link between STIBs adoption and higher levels of food security among farmers. The nearly equal percentages of men (17%) and women (19%) UU STIBs adopters indicates that HER+ and UU collaborations in co-designing of STIBs could results in higher gender-neutral impacts among smallholder farmers.

Table 61: Relationship between adoption of STIBs and HFIAS by county, gender, and farmer type

		County			Gender		Farmer type		Pooled
		Embu	Makueni	Nakuru	Women	Men	Non-UU	UU	
Without STIBs	Food Secure	2.60	4.55	12.26	8.05	5.04	6.64	14.29	6.83
	Mildly Food Insecure	18.18	16.36	12.26	17.82	11.76	15.38	14.29	15.36
	Moderately Food Insecurity	64.94	59.09	42.45	52.3	57.98	54.55	57.14	54.61
	Severely Food Insecurity	14.29	20.00	33.02	21.84	25.21	23.43	14.29	23.21
With STIBs	Food Secure	15.98	14.73	21.89	16.57	21.29	16.67	18.59	18.04
	Mildly Food Insecure	20.71	17.05	16.92	18.02	18.71	15.97	19.15	18.24
	Moderately Food Insecurity	54.44	55.81	43.28	52.03	46.45	49.31	50.7	50.30
	Severely Food Insecurity	8.88	12.4	17.91	13.37	13.55	18.06	11.55	13.43

9.3: Climate change and resilience

This sub-section presents the proportion of farmers who experienced shocks, types of shocks experienced and the mitigation strategies. In addition, it presents how participating in UU contributed to enhancing farmers' resilience to shocks.

Overall, about 96% of farmers surveyed experienced climate related shocks in the last 12 months (Figure 17). indicating that the HER+ and UU interventions in the three counties were timely. About 97% and 95% of women and men experienced climate related shocks. County disaggregated results indicate that more (98%) farmers in Makueni county faced shocks compared to 95% in Embu and Nakuru.

Figure 17: Proportion of farmers who experienced climate-related shocks (%)

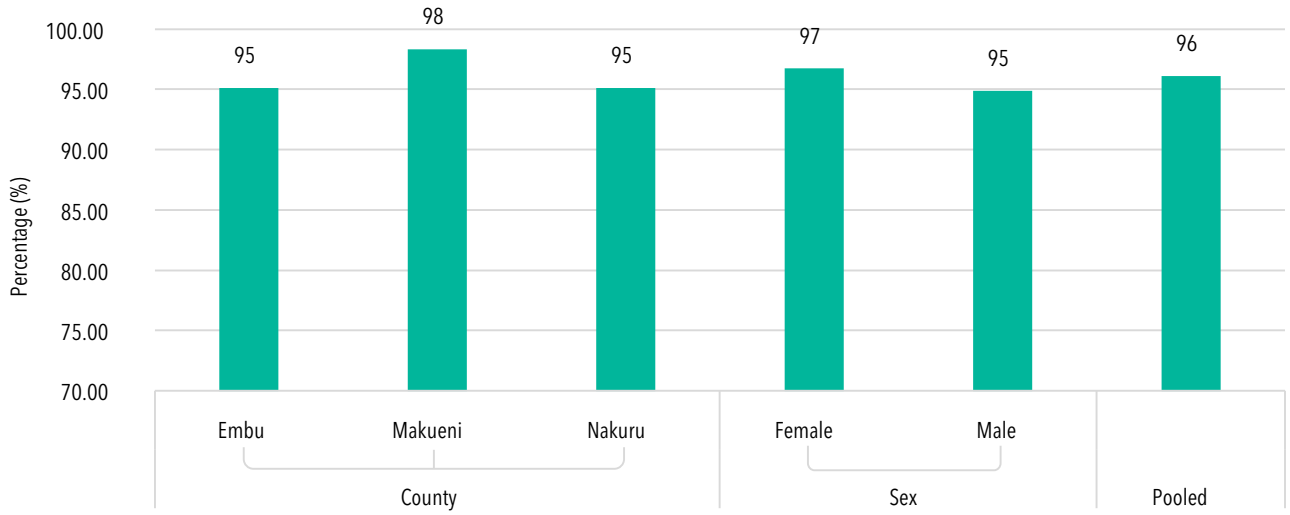


Table 62 reveals drought and crop diseases and pests as the most experienced climate-related shocks regardless of gender, county, and farmer type. Other types of climate-related shocks experienced by farm were frost, excessive rains or flooding, soil erosion or degradation, strong winds, and hailstorm. The distribution of these shocks varied by county, with farmers in Nakuru reporting several shocks than farmers in Embu and Makueni.

> The percentage of STIBs adopters in Nakuru (22%), Makueni (15%), and Embu (16%) were food secure compared to 3%, 5%, and 12% of non-STIBs adopters, respectively. About 17% and 22% of women and men STIBs adopter were food secure compared to 8% and 5% of non-STIBs adopters

Table 62: Types of climate-related shocks experienced by the household in the last 12 months (%)

Farmer type	Climate related shocks	County						Pooled	
		Embu		Makueni		Nakuru			
		Women	Men	Women	Men	Women	Men	Women	Men
UU	Unreliable rain/ drought	91.25	90.91	98.86	100.00	98.91	89.13	96.54	92.05
	Crop disease/pests	42.50	50.00	46.59	55.00	48.91	26.09	46.15	38.64
	Frost	2.50	0.00	4.55	5.00	14.13	13.04	7.31	7.95
	Soil erosion/ degradation	0.00	0.00	0.00	5.00	2.17	4.35	0.77	3.41
	Excessive rain/ Flooding	6.25	4.55	0.00	0.00	2.17	2.17	2.69	2.27
	Strong wind	0.00	4.55	0.00	5.00	2.17	2.17	0.77	3.41
	Hailstorm	1.25	0.00	0.00	0.00	0.00	0.00	0.38	0.00
Non-UU	Unreliable rain/drought	98.70	94.55	96.25	100.00	91.67	95.71	95.44	96.51
	Crop disease/pests	33.70	54.55	36.25	44.68	60.71	42.86	43.98	47.09
	Frost	0.00	0.00	6.25	0.00	10.71	14.29	5.81	5.81
	Strong wind	2.60	5.45	0.00	0.00	4.76	4.29	2.49	3.49
	Excessive rain/flooding	0.00	0.00	2.50	0.00	2.38	4.29	1.66	1.74
	Hailstorm	0.00	0.00	0.00	0.00	2.38	4.29	0.83	1.74
	Soil erosion/ degradation	0.00	1.82	0.00	0.00	2.38	2.86	0.83	1.74

The comparison of farmers resilience – computed as an average composite score of the five resilience capacities – based on their STIBs adoption status is shown in Table 63. Overall, the results demonstrate that farmers had higher anticipative and absorptive capacities but low preventive, adaptive, and transformational capacities. This reflects that while farmers could foresee and prepare for future climate-related risks, they did not make fundamental long-term changes to mitigate against potential shocks. The results further show that UU farmers higher score in all the five resilience capacities than non-UU farmers. There are no variations in farmers' resilience capacities across the three counties. The average score for all sampled farmers was 19 indicating a relatively lower climate resilience. However, disaggregated findings by farmer type demonstrated that UU farmers had higher climate resilience (score of 24) than non-UU farmers (15). This indicates that UU farmers exhibited higher resilience capacities than non-UU farmers.

Table 63: Overall climate resilience scores by county and type of farmer

	County			Farmer type		Pooled
	Embu	Makueni	Nakuru	Non-UU	UU	
Anticipative	4.46	4.49	4.30	3.65	5.42	4.46
Absorptive	4.36	4.15	4.15	3.43	5.15	4.22
Preventive	3.55	3.77	3.53	2.87	4.48	3.61
Adaptive	3.50	3.60	3.15	2.57	4.37	3.40
Transformative	3.17	3.30	3.20	2.40	4.20	3.22
Overall, for UU farmers	**24.21**	**23.68**	**23.11**			
Overall, for non-UU farmers	**14.87**	**15.57**	**14.47**			
Overall, for all farmers	**19.04**	**19.31**	**18.47**	**14.92**	**23.62**	**18.90**

Table 64 show that men (25) and women (23) UU farmers exhibited higher resilience capacity than their men (15) and women (15) non-UU counterparts. Men had slightly higher resilience capacity score than women across the

counties. The results suggest the effectiveness of the UU initiative in enhancing the ability of farmers to withstand environmental, economic, and social shocks and STIBs in closing gender gaps in resilience capacities.

Table 64: Scores for different domains of climate resilience by farmer type

Farmer type	Variable	Embu		Makueni		Nakuru		Pooled	
		Women	Men	Women	Men	Women	Men	Women	Men
UU	Anticipative	5.44	5.57	5.24	5.85	5.23	5.84	5.30	5.77
	Absorptive	5.37	5.13	4.84	5.45	5.04	5.39	5.08	5.34
	Preventive	4.57	4.52	4.51	4.90	4.05	4.88	4.37	4.79
	Transformative	4.10	4.74	4.09	4.70	4.05	4.41	4.08	4.55
	Adaptive	4.53	5.00	4.61	4.50	3.98	4.04	4.37	4.38
	Overall	**24.01**	**24.96**	**23.30**	**25.40**	**22.35**	**24.55**	**23.20**	**24.84**
Non-UU	Anticipative	3.58	3.75	3.62	3.96	3.83	3.26	3.68	3.60
	Absorptive	3.41	3.84	3.26	3.79	3.55	2.99	3.41	3.47
	Preventive	2.57	2.95	2.88	3.44	2.94	2.70	2.80	2.97
	Adaptive	2.38	2.86	2.59	3.04	2.61	2.21	2.53	2.63
	Transformative	2.12	2.58	2.42	2.71	2.49	2.22	2.35	2.46
	Overall	**14.06**	**15.98**	**14.77**	**16.94**	**15.42**	**13.38**	**14.77**	**15.13**

The difference between the UU farmers and non-UU farmers in the resilience scores was further explored by inquiry among UU farmers on how the initiatives have impacted their resilience. Most UU farmers attributed their status of climate resilience to knowledge exchange and capacity building, training in agricultural practices and crop production, access to improved inputs and technologies and climate-smart agriculture adoption (Table 65). Men than women were reported that their participation in UU activities, as demonstrated by the pooled results. However, higher proportion of women (89%) reported knowledge exchange and capacity building from the initiatives than men (82%).

Table 65: Impact of partnering with other stakeholders on farmers' resilience through the UU and HER+ initiative (%)

Impact pathways	County						Pooled	
	Embu		Makueni		Nakuru			
	Women	Men	Women	Men	Women	Men	Women	Men
Knowledge exchange and capacity building	91.95	91.30	93.33	80.00	80.65	77.55	88.52	81.52
Training in agricultural practices and crop production	59.77	73.91	67.78	75.00	54.84	61.22	60.74	67.39
Access to improved inputs and technologies	63.22	78.26	36.67	35.00	56.99	63.27	52.22	60.87
Climate-smart agriculture adoption	36.78	52.17	28.89	30.00	38.71	59.18	34.81	51.09
Disaster risk reduction and preparedness	2.30	8.70	5.56	5.00	2.15	14.29	3.33	10.87
Enhanced collective action and community support	5.75	4.35	7.78	10.00	4.30	12.24	5.93	9.78
Strengthened market linkages and value addition	3.45	0.00	0.00	0.00	6.45	4.08	3.33	2.17
Financial support and insurance schemes	3.45	0.00	1.11	5.00	6.45	2.04	3.70	2.17

9.4: Relationship between adoption of STIBs and climate resilience

Table 66 compares resilience capacities of farmers based on STIBs adoption status at baseline. STIBs adoption was associated with high resilience capacities (21) than non-adoption (15). Resilience capacities scores were consistently higher for farmers adopting STIBs than those without STIBs across counties, farmer type, and gender. Noticeably, UU farmers without STIBs reported a higher climate resilience index (25.71) compared to UU farmers with STIBs (23.58). This could be attributed to the disproportionate low sample size of non-STIBs adopting UU farmers - 7 UU farmers were non-adopters against 355 adopters.

Table 66: Relationship between adoption of STIBs and climate resilience by county, gender, and farmer type

STIBS	Variable	County			Gender		Farmer type		Pooled
		Embu	Makueni	Nakuru	Women	Men	Non-UU	UU	
Without STIBs	Transformative	2.43	2.67	2.11	2.47	2.31	2.36	4.28	2.41
	Preventive	2.71	3.10	2.83	2.86	2.97	2.86	4.43	2.90
	Anticipative	3.88	3.89	3.59	3.79	3.76	3.73	5.86	3.78
	Absorptive	3.73	3.48	3.15	3.44	3.41	3.36	6.14	3.43
	Adaptive	2.77	2.84	2.36	2.66	2.63	2.59	5.00	2.65
	Overall	**15.52**	**15.98**	**14.05**	**15.21**	**15.08**	**14.90**	**25.71**	**15.16**
With STIBs	Transformative	3.51	3.83	3.78	3.65	3.82	2.47	4.20	3.70
	Preventive	3.93	4.35	3.90	4.01	4.06	2.90	4.48	4.02
	Anticipative	4.73	4.99	4.87	4.89	4.76	3.48	5.41	4.85
	Absorptive	4.65	4.71	4.68	4.71	4.62	3.58	5.13	4.68
	Adaptive	3.83	4.26	3.57	3.91	3.67	2.55	4.36	3.84
	Overall	**20.65**	**22.14**	**20.80**	**21.17**	**20.93**	**14.97**	**23.58**	**21.09**

CHAPTER TEN CONCLUSION AND RECOMMENDATIONS

10.1 Conclusion

The UU and HER+ initiatives are on track to enhance smallholder farmers' resilience to climate change, empower women, and improve food and nutritional security through the bundling of socio-technical innovations. Collaborations between the two initiatives in co-designing social innovations and integrating them in farm demonstration experiments has increased adoption of CA among UU farmers across learning labs. The bundling approach has been effective enabling farmers to replicate technologies demonstrated on mother demonstration farms on their farms. d The STIBs have been widely adopted by farmers but with varying intensity. Evidence generated by this study demonstrates that STIBs were associated with higher productivity, improved food and nutrition security, women's empowerment, and increase resilience capacities. However, while UU and HER+ interventions have so far been effective in contributing to resilience and empowerment, ensuring that STIBs benefit and empower both men and women equally remains critical to maximize the overall impact at scale. The hallmark of success of UU and HER+ collaborations lie in achieving wider CA practices and STIBs by a critical mass of technological champions among the farmers for sustainable scaling and impact.

10.2 Recommendations

The following programmatic weakness/gaps were observed in the implementation and from the synthesis of the data collected that would facilitate effective and efficient implementation of the two initiatives:

S/No	Weakness/Gaps	Recommendation
	Number of target farmers in the groups not being achieved partly contributed by group dynamics.	• There is need for the implementors to devise strategies to enable them to reach the targeted 150 farmers per county especially in Embu and Makueni counties. • Further support is needed to enhance the stability of the groups and the challenges that come with the location of the mother demos which leads to dropouts.
	Delay in supply of startup kits by the partners derailing the effectiveness of the mother and baby demonstration plots. Further, there was heterogeneity in the issuance of the startup kits in the counties limiting the effective baby demos establishment and performance	• Implementing partners to increase the efficiency in the supply of the start-up kits as this will increase the level of adoption of the CA technologies. • Standardization of the startup kits to farmers by the partners.
	Weak involvement of extension officers in the implementation of the initiative's activities.	• There is a need for enhanced involvement of the government extension officers in the initiative activities to increase awareness of the technologies and for sustainability. More awareness of different components of the initiatives should be enhanced and a bespoke framework for their continued participation in the initiative activities should be put in place to guide their participation and scaling up efforts.
	Low integration in gender sensitive nutrition among the farmers	• Strengthen implementation through continued engagement of farmers gender sensitive nutrition training for effective behavioral change. • Strategic efforts to trigger conversations within household members on gender sensitive nutrition training by opening such training to the wider community, including through the field days.
	Simultaneous sequence in establishment of mother and baby demos limiting farmers to make choices on their own appropriate CA practice to be implemented in the baby demo.	• A staggered approach in establishing mother demos and baby demos is ideal for new groups to enable them pick suitable technologies as opposed to simultaneous establishment in some cases.
	Low transition in adoption of the CA practices from the demonstration plots to the general plots.	• There is a need for the project to encourage farmers to adopt their self-assessed suitable technologies to the general plots.
	Low number of social and technical innovation adopted by farmers limiting the complementarity of the innovations and STIBs in general.	• Tailor made awareness and linkages platforms on social and technical innovations to be heightened for better outcomes of STIBs.
	Low scores of transformative, adaptive, and preventive components of climate resilience. This was further evidenced by the high prevalence of climate related shocks.	• Enhance strategic interventions to capacitate farmers on transformative, adaptive, and preventive components of climate resilience. Unpacking these components and adopting them during implementation will play a big role in overcoming climate related shocks.
	Notable gender gaps in the implementation of CA activities and in outcomes e.g., productivity, climate resilience, food security etc. which are largely context specific.	• Strategic interventions to go beyond the involvement of women involvement in the initiatives to triggering conversations at household and community level to break the existing the barriers related to traditional gender norms, and social inclusion perspectives. With the heterogeneity observed, localized context specific barriers should be identified collaboratively by the partners, farmers and other stakeholders and co-designing gender equitable treatments for more progress in women empowerment.
	Low access to mechanization limiting the widespread adoption of CA with associate gendered gap that favors men.	• Co-designing by the partners, farmers and other stakeholders bespoke localized models of enhancing access to mechanization, including the involvement of government and private sector.

However, based on the findings of the study, the following lessons should be emphasized and taken into consideration by HER+ and UU initiatives to ensure effective and equitable implementation of their activities in the learning labs:

- Working with the local implementing partner i.e., KALRO to enhance a sense of community acceptance, seamless implementation, and efforts for scaling up and sustainability through the satellite institutes by providing more localized support to the initiative.
- The involvement of lead farmers facilitated the implementation through self-monitoring of the demonstration plots.
- HER+ leveraging on existing UU initiative shortened the time to achieving results and enhanced acceptance to the initiative.
- Co-designing the region-specific CA practices enhanced their adoption by increasing their appropriateness in the context of shifting the power in designing initiatives. This has also accelerated the scaling of the CA practices to the general plot.
- Organized community field days were instrumental in creating awareness of the technologies as the study team observed adoption by some of the community members who are not direct beneficiaries of the initiatives.
- The provision of startup kits was instrumental in facilitating successful establishment of demonstration plots by farmers.
- Intrinsic motivation of the farmers/farmer groups is a key driver in the learning process and utilization of the skills among women and men farmers. This was evident among the farmer group leaders, which enhanced coordination and implementation of initiatives activities. Thus, the selection of farmer groups with intrinsic motivation aided the unified and smooth implementation of the initiative activities.
- Devolvement of the mother demonstrations to the village level enhanced learning which enhanced the setting up and performance of the baby demos. Further, the devolvement enhanced cost-effective implementation through reduced logistics costs.
- Continuously monitor and evaluate the impact STIBs on different groups of farmers in learning labs. Monitoring and evaluation of impact should focus on theory of change elements such as productivity, food and nutrition security, women's empowerment, and resilience capacities. Insight from monitoring and evaluation should be used to adjust activities accordingly.

ANNEXES

Annex 1: Age, farming experience, and household size of sampled farmers

Variable	Farmer type	County						Pooled	
		Embu		Makueni		Nakuru			
		Women	Men	Women	Men	Women	Men	Women	Men
Age (years)	UU	53.06	45.96	49.03	48.95	54.43	61.37	52.19	54.82
	Overall		**51.57**		**49.02**		**56.82**		**52.86**
	Non-UU	52.99	54.16	48.56	53.71	54.89	57.43	52.21	55.42
	Overall		**53.48**		**50.47**		**56.07**		**53.57**
Farming experience (years)	UU	25.33	15.87	21.88	17.50	24.43	28.80	23.87	23.11
	Overall		**23.35**		**23.26**		**25.94**		**23.68**
	Non-UU	27.87	25.46	21.91	25.52	27.31	26.99	25.73	26.12
	Overall		**26.86**		**21.08**		**27.16**		**25.89**
Household size (number)	UU	4.00	4.00	5.00	5.00	5.00	5.00	5.00	5.00
	Overall		**4.00**		**5.00**		**5.00**		**5.00**
	Non-UU	4.00	4.00	5.00	6.00	4.00	4.00	4.00	5.00
	Overall		**4.00**		**5.00**		**4.00**		**4.00**

Annex 2: Marital status of the sampled respondents (%)

Farmer type	Marital status	County						Pooled	
		Embu		Makueni		Nakuru			
		Women	Men	Women	Men	Women	Men	Women	Men
UU	Married	71.26	78.26	84.44	95.00	52.69	95.92	69.26	91.30
	Never married/ single	8.05	8.70	1.11	5.00	15.05	2.04	8.15	4.35
	Widowed	16.09	4.35	13.33	0.00	27.96	2.04	19.26	2.17
	Separated/ Divorced	4.60	8.70	1.11	0.00	4.30	0.00	3.33	2.17
Non-UU	Married	49.37	89.47	71.60	91.67	54.55	76.62	58.47	84.62
	Never married/ single	12.66	1.75	4.94	0.00	13.64	3.90	10.48	2.20
	Widowed	25.32	3.51	23.46	4.17	28.41	10.39	25.81	6.59
	Separated/ Divorced	12.66	5.26	0.00	4.17	3.41	9.09	5.24	6.59

Annex 3: Education level of the sampled respondents

Farmer type	Education level	Embu		Makueni		Nakuru		Pooled	
		Women	Men	Women	Men	Women	Men	Women	Men
UU	No formal education	4.60	0.00	2.22	0.00	6.45	2.04	4.44	1.09
	Primary education	49.43	47.83	63.33	40.00	51.61	44.90	54.81	44.57
	Secondary (O level)	36.78	34.78	21.11	15.00	32.26	38.78	30.00	32.61
	Secondary (A level)	2.30	4.35	4.44	15.00	3.23	8.16	3.33	8.70
	College	6.90	13.04	8.89	25.00	6.45	6.12	7.41	11.96
	University	0.00	0.00	0.00	5.00	0.00	0.00	0.00	1.09
Non-UU	No formal education	10.13	1.75	8.64	0.00	11.36	5.19	10.08	2.75
	Primary education	63.29	43.86	51.85	45.83	57.95	53.25	57.66	48.35
	Secondary (O level)	16.46	42.11	28.40	37.50	23.86	19.48	22.98	31.32
	Secondary (A level)	6.33	7.02	1.23	2.08	5.68	10.39	4.44	7.14
	College	3.80	1.75	8.64	14.58	1.14	7.79	4.44	7.69
	University	0.00	3.51	1.23	0.00	0.00	3.90	0.40	2.75

Annex 4: Sources of household income in the last 12 months (%)

Farmer type	Sources of household income	County						Pooled	
		Embu		Makueni		Nakuru			
		Women	Men	Women	Men	Women	Men	Women	Men
UU	Sale of crops products	89.66	95.65	75.56	85.00	84.95	97.96	83.33	94.57
	Sale of livestock	43.68	30.43	42.22	25.00	24.73	34.69	36.67	31.52
	Sale of livestock products	29.89	17.39	24.44	25.00	37.63	40.82	30.74	31.52
	Business	17.24	30.43	28.89	25.00	7.53	12.24	17.78	19.57
	Salary	9.20	0.00	18.89	15.00	11.83	6.12	13.33	6.52
	Wages	48.28	52.17	34.44	45.00	37.63	22.45	40.00	34.78
	Social transfer payments	1.15	0.00	3.33	0.00	1.08	8.16	1.85	4.35
	Pension	8.05	4.35	3.33	5.00	2.15	2.04	4.44	3.26
	Remittances	9.20	0.00	24.44	15.00	23.66	28.57	19.26	18.48
	Rented out asset	0.00	0.00	1.11	0.00	2.15		1.11	0.00
Non-UU	Sale of crops products	78.48	87.72	64.20	70.83	92.05	87.01	78.63	82.97
	Sale of livestock	25.32	26.32	33.33	29.17	21.59	25.97	26.61	26.92
	Sale of livestock products	29.11	17.54	14.81	12.50	21.59	36.36	21.77	24.18
	Business	17.72	10.53	20.99	27.08	10.23	7.79	16.13	13.74
	Salary	2.53	0.00	13.58	8.33	6.82	0.00	7.66	2.20
	Wages	41.77	54.39	48.15	37.50	26.14	35.06	38.31	41.76
	Social transfer payments	0.00	1.75	6.17	4.17	6.82	9.09	5.65	5.49
	Pension	3.80	5.26	2.47	6.25	1.14	5.19	1.21	5.49
	Remittances	13.92	3.51	17.28	10.42	18.18	10.39	16.53	8.24
	Rented out asset	0.00	1.75	0.00	0.00	1.14	3.90	0.40	2.20

Annex 5: Technological innovations adopted by UU farmers between 2018 and 2021 (%)

Technological innovations	County						Pooled	
	Embu		Makueni		Nakuru			
	Female	Male	Female	Male	Female	Male	Female	Male
Improved seed	84.71	86.96	80.68	80.00	87.91	91.67	84.47	87.91
Fertilizer (inorganic)	74.12	82.61	46.59	45.00	71.43	70.83	64.02	68.13
Intercropping	67.06	65.22	51.14	40.00	62.64	72.92	60.23	63.74
Fertilizer (organic)	45.88	60.87	64.77	65.00	54.95	50.00	55.30	56.04
Weed management	27.06	39.13	36.36	55.00	27.47	43.75	30.30	45.05
Crop Rotation	34.12	34.78	46.59	45.00	20.88	29.17	33.71	34.07
Mechanization	5.88	0.00	14.77	15.00	27.47	41.67	16.29	25.27
Fungicides	9.41	17.39	11.36	10.00	17.58	31.25	12.88	23.08
Tillage	10.59	8.70	3.41	30.00	23.08	20.83	12.50	19.78
Mulching	21.18	21.74	9.09	10.00	9.89	16.67	13.26	16.48
Agroforestry	16.47	8.70	25.00	25.00	6.59	16.67	15.91	16.48
Windbreaks	0.00	13.04	4.55	15.00	3.30	16.67	2.65	15.38
Cover Cropping	9.41	17.39	11.36	20.00	4.40	8.33	8.33	13.19
Irrigation	4.71	17.39	10.23	15.00	4.40	10.42	6.44	13.19
Biological/cultural/chemical pest control	9.41	13.04	9.09	10.00	18.68	12.50	12.50	12.09
IPM	4.71	4.35	3.41	10.00	7.69	12.50	5.30	9.89
CSA	1.18	0.00	6.82	5.00	6.59	12.50	4.92	7.69
Improved livestock breeds	8.24	0.00	1.14	0.00	7.69	12.50	5.68	6.59
Soil testing	2.35	0.00	1.14	0.00	4.40	10.42	2.65	5.49
Post-harvest handling technology	5.88	4.35	15.91	10.00	2.20	4.17	7.95	5.49
Irrigation technology type	0.00	4.35	3.41	10.00	0.00	2.08	1.14	4.40
Digital/ICT platform	2.35	4.35	6.82	5.00	3.30	2.08	4.17	3.30

Annex 6: Technological innovations adopted by UU farmers between 2022 and 2023 (%)

Technological innovations	County						Pooled	
	Embu		Makueni		Nakuru			
	Female	Male	Female	Male	Female	Male	Female	Male
Improved seed	87.06	91.30	79.55	85.00	89.01	91.67	85.23	90.11
Fertilizer (inorganic)	80.00	91.30	56.82	70.00	65.93	75.00	67.42	78.02
Intercropping	69.41	86.96	69.32	45.00	72.53	79.17	70.45	73.63
Fertilizer (organic)	55.29	65.22	67.05	65.00	57.14	50.00	59.85	57.14
Tillage	22.35	39.13	23.86	45.00	53.85	60.42	33.71	51.65
Weed management	4.71	43.48	36.36	50.00	32.97	47.92	33.33	47.25
Crop rotation	51.76	56.52	51.14	55.00	27.47	35.42	43.18	45.05
Fungicides	11.76	21.74	14.77	10.00	19.78	33.33	15.53	25.27
Mechanization	7.06	0.00	13.64	20.00	39.56	37.50	20.45	24.18
Mulching	25.88	30.43	15.91	20.00	12.09	16.67	17.80	20.88
Cover Cropping	11.76	17.39	12.50	20.00	6.59	16.67	10.23	17.58
Biological/cultural/chemical pest control	9.41	17.39	9.09	15.00	18.68	14.58	12.50	15.38
Agroforestry	21.18	8.70	28.41	25.00	6.59	14.58	18.56	15.38

Technological innovations	County						Pooled	
	Embu		Makueni		Nakuru			
	Female	Male	Female	Male	Female	Male	Female	Male
Windbreaks	10.59	13.04	4.55	15.00	3.30	16.67	2.65	15.38
CSA	21.18	13.04	14.77	10.00	18.68	14.58	18.18	13.19
Irrigation	30.59	13.04	15.91	15.00	5.49	10.42	9.47	12.09
Improved livestock breeds	8.24	4.35	2.27	5.00	12.09	16.67	7.58	10.99
IPM	0.00	4.35	4.55	10.00	6.59	14.58	5.30	10.99
Soil testing	2.35	0.00	1.14	0.00	8.79	20.83	4.17	10.99
Post-harvest handling technology	0.00	4.35	20.45	15.00	4.40	10.42	11.74	9.89
Digital/ICT platform	4.71	4.35	11.36	5.00	10.99	10.42	9.09	7.69
Irrigation technology type	7.06	8.70	4.55	10.00	0.00	2.08	1.52	5.49

Annex 7: Technological innovations adopted by non-UU farmers between 2018 and 2021 (%)

Technological innovations	County						Pooled	
	Embu		Makueni		Nakuru			
	Female	Male	Female	Male	Female	Male	Female	Male
Improved seed	69.70	81.82	76.47	100.00	83.78	85.29	77.01	84.51
Fertilizer (inorganic)	48.48	69.7	70.59	75.00	78.38	70.59	65.52	70.42
Intercropping	48.48	60.61	64.71	75.00	75.68	67.65	63.22	64.79
Fertilizer (organic)	57.58	54.55	70.59	50.00	51.35	67.65	57.47	60.56
Crop Rotation	15.15	27.27	17.65	25.00	24.32	41.18	19.54	33.8
Weed management	36.36	21.21	58.82	75.00	24.32	20.59	35.63	23.94
Mulching	24.24	30.3	23.53	25.00	10.81	14.71	18.39	22.54
Agroforestry	15.15	21.21	35.29	25.00	2.7	23.53	13.79	22.54
Mechanization	0.00	0.00	5.88	0.00	21.62	41.18	10.34	19.72
Biological/cultural/chemical pest control	3.03	9.09	11.76	25.00	8.11	14.71	6.90	12.68
Fungicides	15.15	6.06	0.00	0.00	10.81	20.59	10.34	12.68
Tillage	9.09	3.03	0.00	0.00	5.41	20.59	5.75	11.27
Irrigation	3.03	12.12	0.00	0.00	2.70	8.82	2.30	9.86
Windbreaks	6.06	6.06	5.88	50.00	2.70	8.82	4.60	9.86
Improved livestock breeds	18.18	12.12	11.76	0.00	8.11	2.94	12.64	7.04
Cover Cropping	12.12	6.06		25.00	8.11	5.88	8.05	7.04
Post-harvest handling technology	9.09	12.12	29.41	0.00	5.41	2.94	11.49	7.04
IPM	0.00	3.03	0.00	0.00	5.41	8.82	2.30	5.63
CSA	0.00	0.00	0.00	0.00	0.00	5.88	0.00	2.82
Irrigation technology type	0.00	3.03	0.00	0.00	0.00	0.00	0.00	1.41
Soil testing	0.00	0.00	0.00	0.00	2.70	2.94	1.15	1.41
Digital/ICT platform	6.06	0.00	5.88	0.00	2.70	0.00	4.60	0.00

Annex 8: Technological innovations adopted by non-UU farmers between 2022 and 2023 (%)

Technological innovations	County						Pooled	
	Embu		Makueni		Nakuru			
	Female	Male	Female	Male	Female	Male	Female	Male
Improved seed	78.79	75.76	82.35	75.00	86.49	85.29	82.76	80.28
Fertilizer (inorganic)	69.70	78.79	76.47	75.00	72.97	70.59	72.41	74.65
Intercropping	57.58	66.67	64.71	75.00	72.97	70.59	65.52	69.01
Fertilizer (organic)	45.45	63.64	64.71	100.00	48.65	64.71	50.57	66.20
Crop rotation	9.09	27.27	23.53	25.00	21.62	44.12	17.24	35.21
Weed management	36.36	21.21	58.82	75.00	27.03	20.59	36.78	23.94
Agroforestry	12.12	24.24	35.29	25.00	8.11	23.53	14.94	23.94
Mulching	27.27	30.30	29.41	25.00	8.11	14.71	19.54	22.54
Biological/cultural/chemical pest control	3.03	15.15	11.76	25.00	10.81	17.65	8.05	16.90
Mechanization	0.00	0.00	5.88	0.00	21.62	35.29	10.34	16.90
Fungicides	15.15	9.09	0.00	0.00	10.81	23.53	10.34	15.49
Tillage	6.06	6.06	0.00	0.00	5.41	23.53	4.60	14.08
Irrigation		18.18	0.00	0.00	2.70	8.82	1.15	12.68
Improved livestock breeds	18.18	15.15	11.76	0.00	10.81	5.88	13.79	9.86
Windbreaks	6.06	6.06	5.88	50.00	2.70	8.82	4.60	9.86
Cover Cropping	15.15	9.09	0.00	25.00	5.41	5.88	8.05	8.45
Post-harvest handling technology	9.09	15.15	29.41	0.00	5.41	2.94	11.49	8.45
IPM	0.00	3.03	0.00	0.00	5.41	8.82	2.30	5.63
Digital/ICT platform	6.06	6.06	5.88	0.00	5.41	2.94	5.75	4.23
CSA	0.00	0.00	0.00	0.00	0.00	5.88	0.00	2.82
Soil testing	0.00	0.00	0.00	0.00	2.70	2.94	1.15	1.41
Irrigation technology type	3.03	0.00	0.00	0.00	0.00	0.00	1.15	0.00

Annex 9: Source of technological innovations (%)

Farmer type	Sources	County						Pooled	
		Embu		Makueni		Nakuru			
		Female	Male	Female	Male	Female	Male	Female	Male
UU	UU and HER+ initiative	95.40	91.30	83.33	80.00	88.17	93.88	88.89	90.22
	Other farmers	72.41	60.87	78.89	75.00	60.22	57.14	70.37	61.96
	Radio	43.68	39.13	28.89	35.00	39.78	61.22	37.41	50.00
	Agricultural extension service	24.14	34.78	17.78	20.00	45.16	61.22	29.26	45.65
	TV	25.29	26.09	14.44	15.00	35.48	42.86	25.19	32.61
	Governmental agency	11.49	26.09	8.89	15.00	15.05	30.61	11.85	26.09
	Research Organizations	16.09	13.04	16.67	15.00	24.73	34.69	19.26	25.00
	NGO	14.94	8.70	13.33	10.00	16.13	22.45	14.81	16.30
	Learnt in school	20.69	13.04	24.44	25.00	9.68	10.20	18.15	14.13
	Community organization	9.20	8.70	5.56	10.00	3.23	12.24	5.93	10.87
	FPO/cooperatives	9.20	4.35	4.44	5.00	12.90	14.29	8.89	9.78
	Entrepreneurship center	3.45	8.70	7.78	5.00	5.38	6.12	5.56	6.52
	Development project	3.45	8.70	7.78	5.00	1.08	4.08	4.07	5.43
	Microfinance institution	0.00	8.70	0.00	0.00	0.00	2.04	0.00	3.26
	Learning materials	0.00	4.35	1.11	0.00	0.00	2.04	0.37	2.17
	Bank	0.00	4.35	0.00	0.00	0.00	0.00	0.00	1.09
	Online education platform	0.00	4.35	0.00	0.00	1.08	0.00	0.37	1.09
	Community health workers	1.15	0.00	0.00	0.00	0.00	0.00	0.37	0.00
	Hospitals	0.00	0.00	1.11	0.00	1.08	0.00	0.74	0.00
	Internet	0.00	0.00	5.56	0.00	0.00	0.00	1.85	0.00
Non-UU	Other farmers	87.72	91.14	81.48	81.25	75.86	74.03	82.59	80.22
	Radio	36.84	30.38	25.93	22.92	29.89	42.86	28.74	35.71
	Learnt in school	36.84	17.72	27.16	27.08	17.24	28.57	20.65	30.77
	Agricultural extension service	22.81	13.92	11.11	10.42	22.99	27.27	16.19	21.43
	TV	12.28	17.72	11.11	14.58	16.09	25.97	14.98	18.68
	Research Organizations	12.28	10.13	13.58	20.83	10.34	5.19	11.34	11.54
	Governmental agency	10.53	6.33	4.94	14.58	11.49	9.09	7.69	10.99
	NGO	8.77	6.33	1.23	2.08	8.05	5.19	5.26	5.49
	Entrepreneurship center	5.26	7.59	12.35	12.50	3.45	1.30	7.69	5.49
	Development project	5.26	2.53	6.17	8.33	1.15	2.60	3.24	4.95
	Internet	1.75	0.00	0.00	6.25	0.00	1.30	0.00	2.75
	Community organization	1.75	2.53	1.23	2.08	4.60	2.60	2.83	2.20
	FPO/cooperatives	3.51	5.06	3.70	4.17	3.45	0.00	4.05	2.20
	Learning materials	0.00	0.00	0.00	0.00	0.00	3.90	0.00	1.65
	Bank	0.00	0.00	0.00	0.00	3.45	2.60	1.21	1.10
	Hospitals	0.00	0.00	1.23	0.00	0.00	1.30	0.40	0.55
	Microfinance institution	0.00	0.00	0.00	0.00	0.00	1.30	0.00	0.55

Annex 10: Technical innovations adopted by UU farmers between 2018 and 2021 (%)

Technical innovations	County						Pooled	
	Embu		Makueni		Nakuru			
	Female	Male	Female	Male	Female	Male	Female	Male
Farmer training programs on farming	67.06	69.57	59.09	75.00	63.74	66.67	63.26	69.23
Extension services	32.94	30.43	32.95	20.00	50.55	62.50	39.02	45.05
Agricultural related workshops	10.59	13.04	11.36	10.00	20.88	25.00	10.98	18.68
Demonstration farms	16.47	17.39	18.18	20.00	12.09	16.67	15.53	17.58
Nutrition education	25.88	26.09	34.09	25.00	2.20	8.33	26.89	16.48
Financial literacy programs	5.88	13.04	6.82	0.00	10.99	10.42	7.95	8.79
CSA training	4.71	8.70	7.95	0.00	6.59	12.50	6.44	8.79
Farmer field schools	7.06	4.35	1.14	5.00	12.09	10.42	6.82	7.69
Use of brochure, manuals, and guides	10.59	0.00	6.82	5.00	15.38	8.33	10.98	5.49
Digital literacy training	0.00	4.35	0.00	0.00	3.30	0.00	1.14	1.10
Gender training	4.71	0.00	0.00	0.00	6.59	2.08	3.79	1.10
Digital platforms	0.00	0.00	0.00	0.00	1.10	0.00	0.38	0.00
Mentorship programs	1.18	0.00	2.27	0.00	1.10	0.00	1.52	0.00
Youth engagement programs	0.00	0.00	0.00	0.00	10.99	0.00	0.00	0.00
Legal and land rights workshops	1.18	0.00	0.00	0.00	0.00	0.00	1.14	0.00

Annex 11: Technical innovations adopted by UU farmers between 2022 and 2023 (%)

Technical innovations	County						Pooled	
	Embu		Makueni		Nakuru			
	Female	Male	Female	Male	Female	Male	Female	Male
Farmer training programs on farming	85.88	95.65	79.55	85.00	78.02	75.00	81.06	82.42
Demonstration farms	75.29	78.26	75.00	65.00	59.34	72.92	69.70	72.53
Nutrition education	55.29	47.83	71.59	75.00	49.45	45.83	58.71	52.75
Extension services	29.41	34.78	27.27	15.00	49.45	54.17	35.61	40.66
CSA training	31.76	26.09	34.09	25.00	31.87	47.92	32.58	37.36
Farmer field schools	21.18	13.04	13.64	20.00	20.88	25	18.56	20.88
Agricultural related workshops	11.76	13.04	17.05	15.00	13.19	27.08	14.02	20.88
Financial literacy programs	14.12	13.04	9.09	5.00	15.38	10.42	12.88	9.89
Gender training	4.71	0.00	7.95	5.00	10.99	8.33	7.95	5.49
Use of brochure, manuals, and guides	5.88	0.00	6.82	0.00	24.18	8.33	12.50	4.40
Mentorship programs	1.18	0.00	2.27	0.00	1.10	2.08	1.52	1.10
Digital literacy training	2.35	0.00	1.14	0.00	4.40	0.00	2.65	0.00
Digital platforms	0.00	0.00	0.00	0.00	2.20	0.00	0.76	0.00
Youth engagement programs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Legal and land rights workshops	0.00	0.00	0.00	0.00	3.30	0.00	1.14	0.00

Annex 12: Technical innovations adopted by non-UU farmers between 2018 and 2021 (%)

Technical innovations	County						Pooled	
	Embu		Makueni		Nakuru			
	Female	Male	Female	Male	Female	Male	Female	Male
Farmer training programs on farming	36.36	39.39	23.53	75.00	75.68	61.76	50.57	52.11
Extension services	27.27	27.27	35.29	75.00	29.73	64.71	29.89	47.89
Nutrition education	39.39	33.33	52.94	25.00	18.92	20.59	33.33	26.76
Agricultural related workshops	6.06	9.09	0.00	75.00	13.51	14.71	8.05	15.49
Demonstration farms	6.06	12.12	17.65	0.00	0.00	17.65	5.75	14.08
Use of brochure, manuals, and guides	6.06	3.03	11.76	25.00	2.70	14.71	5.75	9.86
Farmer field schools	3.03	6.06	0.00	0.00	2.70	8.82	2.30	7.04
Financial literacy programs	0.00	3.03	0.00	0.00	10.81	8.82	4.60	5.63
CSA training	0.00	3.03	0.00	25.00	0.00	5.88	0.00	5.63
Gender training	6.06	3.03	0.00	0.00	0.00	2.94	2.30	2.82
Youth engagement programs	0.00	0.00	0.00	25.00	0.00	2.94	0.00	2.82
Digital literacy training	0.00	0.00	0.00	0.00	0.00	2.94	0.00	1.41
Legal and land rights workshops	0.00	3.03	0.00	0.00	0.00	0.00	0.00	1.41

Annex 13: Technical innovations adopted by non-UU farmers between 2022 and 2023 (%)

Technical innovations	County						Pooled	
	Embu		Makueni		Nakuru			
	Female	Male	Female	Male	Female	Male	Female	Male
Farmer training programs on farming	30.30	42.42	35.29	75.00	67.57	58.82	47.13	52.11
Extension services	27.27	27.27	41.18	75.00	35.14	55.88	33.33	43.66
Nutrition education	39.39	33.33	58.82	25.00	18.92	17.65	34.48	25.35
Use of brochure, manuals, and guides	6.06	9.09	17.65	25.00	2.70	20.59	6.90	15.49
Agricultural related workshops	9.09	9.09	0.00	75.00	10.81	14.71	8.05	15.49
Demonstration farms	6.06	9.09	23.53	0.00	2.70	17.65	8.05	12.68
Farmer field schools	3.03	9.09	0.00	0.00	2.70	11.76	2.30	9.86
CSA training	0.00	0.00	0.00	25.00	0.00	5.88	0.00	4.23
Financial literacy programs	0.00	3.03	0.00	0.00	10.81	2.94	4.60	2.82
Youth engagement programs	0.00	0.00	0.00	25.00	0.00	2.94	0.00	2.82
Digital literacy training	0.00	0.00	0.00	0.00	0.00	2.94	0.00	1.41
Gender training	3.03	0.00	0.00	0.00	0.00	2.94	1.15	1.41

Annex 14: Source of technical innovation bundles

Farmer type	Sources	County						Pooled	
		Embu		Makueni		Nakuru			
		Female	Male	Female	Male	Female	Male	Female	Male
UU	UU and HER+ initiative	95.40	100.00	96.63	95.00	88.17	95.92	93.31	96.74
	Agricultural extension service	24.14	39.13	21.35	25.00	46.24	59.18	30.86	46.74
	Other farmers	35.63	43.48	46.07	60.00	45.16	40.82	42.38	45.65
	Radio	21.84	30.43	17.98	30.00	43.01	51.02	27.88	41.30
	Governmental agency	17.24	21.74	17.98	15.00	24.73	36.73	20.07	28.26
	TV	18.39	4.35	10.11	10.00	27.96	30.61	18.96	19.57
	NGO	18.39	4.35	23.60	25.00	23.66	20.41	21.93	17.39
	Research Organizations	19.54	8.70	17.98	10.00	22.58	20.41	20.07	15.22
	Community organization	8.05	21.74	6.74	10.00	7.53	12.24	7.43	14.13
	Hospitals	12.64	17.39	13.48	20.00	15.05	8.16	13.75	13.04
	FPO/cooperatives	8.05	8.70	3.37	5.00	10.75	8.16	7.43	7.61
	Bank	9.20	13.04	1.12	0.00	4.30	6.12	4.83	6.52
	Development project	4.60	13.04	13.48	10.00	2.15	2.04	6.69	6.52
	Learnt in school	3.45	8.70	7.87	15.00	5.38	2.04	5.58	6.52
	Microfinance institution	3.45	4.35	3.37	0.00	2.15	4.08	2.97	3.26
	Community health workers	4.60	0.00	5.62	0.00	8.60	10.20	6.32	5.43
	Online education platform	0.00	4.35	0.00	0.00	0.00	0.00	0.00	1.09
	Learning materials	0.00	0.00	0.00	0.00	2.15	2.04	0.74	1.09
	Entrepreneurship center	0.00	0.00	0.00	0.00	1.08	0.00	0.37	0.00
	Internet	2.30	0.00	3.37	0.00	1.08	0.00	2.23	0.00
Non-UU	Agricultural extension service	21.57	30.43	34.48	20.00	27.38	31.08	26.83	29.29
	Other farmers	25.49	23.91	27.59	45.00	26.19	17.57	26.22	23.57
	Radio	21.57	13.04	10.34	30.00	15.48	18.92	16.46	18.57
	Governmental agency	9.80	26.09	6.90	5.00	11.90	14.86	10.37	17.14
	Hospitals	29.41	19.57	48.28	30.00	10.71	4.05	23.17	12.86
	Research Organizations	15.69	6.52	17.24	30.00	7.14	8.11	11.59	10.71
	TV	9.80	4.35	3.45	10.00	5.95	12.16	6.71	9.29
	NGO	3.92	8.70	3.45	10.00	16.67	8.11	10.37	8.57
	Bank	0.00	2.17	0.00	5.00	8.33	10.81	4.27	7.14
	Learnt in school	1.96	6.52	10.34	10.00	2.38	5.41	3.66	6.43
	Development project	0.00	0.00	10.34	10.00	1.19	6.76	2.44	5.00
	Community health workers	5.88	4.35	17.24	25.00	0.00	0.00	4.88	5.00
	FPO/cooperatives	9.80	6.52	3.45	10.00	2.38	1.35	4.88	4.29
	Community organization	1.96	2.17	0.00	10.00	2.38	1.35	1.83	2.86
	Learning materials	0.00	2.17	3.45	0.00	0.00	2.70	0.61	2.14
	Entrepreneurship center	1.96	2.17	0.00	0.00	0.00	0.00	0.61	0.71
	Internet	0.00	0.00	0.00	0.00	0.00	1.35	0.00	0.71

Annex 15: Social innovations adopted by UU farmers between 2018 and 2021 (%)

Social innovations	County						Pooled	
	Embu		Makueni		Nakuru			
	Female	Male	Female	Male	Female	Male	Female	Male
Group membership	54.12	82.61	67.05	65.00	72.53	81.25	64.77	78.02
Local radio stations broadcasting agricultural information	64.71	65.22	65.91	80.00	49.45	58.33	59.85	64.84
Farmer-to-farmer extension	28.24	43.48	42.05	35.00	40.66	29.17	37.12	34.07
Cooperative/group farming	7.06	26.09	6.82	5.00	15.38	14.58	9.85	15.38
Subsidy programs	7.06	8.70	4.55	15.00	15.38	14.58	9.09	13.19
Farmer field schools	5.88	4.35	0.00	0.00	10.99	14.58	5.68	8.79
Social protection	3.53	4.35	1.14	5.00	0.00	6.25	1.52	5.49
Finance mechanism for agriculture	3.53	13.04	1.14	0.00	3.30	2.08	2.65	4.40
Women's agricultural collectives/ groups	32.94	0.00	18.18	5.00	24.18	2.08	25.00	2.20
Youth in agriculture programs/ groups	0.00	8.70	0.00	0.00	0.00	0.00	0.00	2.20
Marketing contracts/arrangements	0.00	4.35	0.00	0.00	1.10	2.08	0.38	2.20
Shared machinery	0.00	0.00	0.00	0.00	1.10	4.17	0.38	2.20
Collective water management systems	2.35	4.35	0.00	0.00	0.00	2.08	1.52	2.20
Land-sharing initiatives	0.00	0.00	0.00	0.00	2.20	2.08	0.76	1.10
Production contracts	0.00	0.00	0.00	0.00	1.10	2.08	0.38	1.10
Local seed exchange arrange- ments	4.71	4.35	7.95	0.00	3.30	0.00	5.30	1.10
Crop/livestock insurance	2.35	0.00	1.14	0.00	0.00	0.00	1.14	0.00
Community seed banks	0.00	0.00	0.00	0.00	3.30	0.00	1.14	0.00

Annex 16: Social innovations adopted by UU farmers between 2022 and 2023 (%)

Social innovations	County						Pooled	
	Embu		Makueni		Nakuru			
	Female	Male	Female	Male	Female	Male	Female	Male
Group membership	75.29	91.30	88.64	90.00	85.71	89.58	83.33	90.11
Local radio stations broadcasting agricultural information	69.41	69.57	71.59	75.00	52.75	62.50	64.39	67.03
Subsidy programs	20.00	26.09	11.36	30.00	34.07	41.67	21.97	35.16
Farmer-to-farmer extension	34.12	47.83	46.59	35.00	46.15	27.08	42.42	34.07
Cooperative/group farming	17.65	34.78	14.77	15.00	23.08	39.58	18.56	32.97
Farmer field schools	12.94	13.04	6.82	5.00	19.78	31.25	13.26	20.88
Social protection	3.53	4.35	1.14	5.00	2.2	8.33	2.27	6.59
Finance mechanism for agriculture	3.53	13.04	1.14	0.00	5.49	4.17	3.41	5.49
Marketing contracts/arrangements	1.18	4.35	0.00	0.00	2.20	6.25	1.14	4.40
Women's agricultural collectives/ groups	44.71	0.00	31.82	10.00	29.67	2.08	35.23	3.30
Collective water management systems	2.35	4.35	4.55	5.00	0.00	2.08	2.27	3.30

Youth in agriculture programs/ groups	0.00	8.7	0.00	0.00	1.10	0.00	0.38	2.20
Production contracts	0.00	0.00	0.00	0.00	0.00	4.17	0.00	2.20
Shared machinery	0.00	0.00	0.00	0.00	2.20	4.17	0.76	2.20
Local seed exchange arrangements	2.35	4.35	7.95	5.00	1.10	0.00	3.79	2.20
Land-sharing initiatives	1.18	0.00	0.00	0.00	2.20	2.08	1.14	1.10
Crop/livestock insurance	0.00	0.00	2.27	0.00	1.10	0.00	1.14	0.00
Community seed banks	0.00	0.00	0.00	0.00	2.20	0.00	0.76	0.00

Annex 17: Social innovations adopted by non-UU farmers between 2018 and 2021 (%)

Social innovation	County						Pooled	
	Embu		Makueni		Nakuru			
	Female	Male	Female	Male	Female	Male	Female	Male
Local radio stations broadcasting agricultural information	66.67	75.76	88.24	75.00	48.65	61.76	63.22	69.01
Group membership	54.55	30.30	47.06	100.00	67.57	55.88	58.62	46.48
Farmer-to-farmer extension	18.18	45.45	52.94	50.00	18.92	26.47	25.29	36.62
Subsidy programs	3.03	3.03	5.88	25.00	8.11	23.53	5.75	14.08
Social protection	3.03	12.12	5.88	0.00	10.81	11.76	5.75	11.27
Local seed exchange arrangements	3.03	15.15	11.76	0.00	2.70	5.88	4.60	9.86
Cooperative/group farming	0.00	3.03	0.00	0.00	5.41	5.88	2.30	4.23
Finance mechanism for agriculture	0.00	6.06	0.00	0.00	2.70	2.94	1.15	4.23
Farmer field schools	3.03	0.00	0.00	0.00	2.70	5.88	2.30	2.82
Women's agricultural collectives/groups	9.09	0.00	5.88	0.00	21.62	2.94	13.79	1.41
Youth in agriculture programs/ groups	0.00	0.00	0.00	0.00	0.00	2.94	0.00	1.41
Marketing contracts/arrangements	0.00	0.00	0.00	0.00	0.00	2.94	0.00	1.41
Shared machinery	0.00	0.00	0.00	0.00	0.00	2.94	0.00	1.41
Local seed production models	0.00	0.00	0.00	0.00	0.00	2.94	0.00	1.41
Community seed banks	0.00	0.00	0.00	0.00	0.00	2.94	0.00	1.41
Farmers' rights advocacy groups	0.00	3.03	0.00	0.00	0.00	0.00	1.15	1.41
Collective water management systems	3.03	0.00	0.00	0.00	0.00	2.94	1.15	1.41
Crop/livestock insurance	0.00	0.00	0.00	0.00	2.70	0.00	1.15	0.00

Annex 18: Social innovations adopted by non-UU farmers between 2022 and 2023 (%)

Social innovations	County						Pooled	
	Embu		Makueni		Nakuru			
	Female	Male	Female	Male	Female	Male	Female	Male
Local radio stations broadcasting agricultural information	66.67	75.76	88.24	75.00	48.65	61.76	63.22	69.01
Group membership	57.58	36.36	47.06	100.00	67.57	52.94	59.77	47.89
Subsidy programs	9.09	39.39	17.65	25.00	10.81	35.29	11.49	36.62
Farmer-to-farmer extension	18.18	42.42	52.94	50.00	24.32	26.47	27.59	35.21
Social protection	3.03	15.15	5.88	0.00	10.81	14.71	6.90	14.08
Local seed exchange arrangements	3.03	12.12	11.76		5.41	5.88	5.75	8.45
Cooperative/group farming	0.00	3.03	0.00	0.00	5.41	5.88	2.30	4.23
Finance mechanism for agriculture	0.00	6.06	0.00	0.00	2.70	2.94	1.15	4.23
Farmer field schools	0.00	0.00	0.00	0.00	2.70	5.88	1.15	2.82
Other, specify		0.00	0.00	0.00	2.70	5.88	1.15	2.82
Women's agricultural collectives/groups	12.12	0.00	5.88	0.00	21.62	2.94	14.94	1.41
Youth in agriculture programs/groups	0.00	0.00	0.00	0.00	0.00	2.94	0.00	1.41
Marketing contracts/arrangements	0.00	0.00	0.00	0.00	2.70	2.94	1.15	1.41
Shared machinery	0.00	0.00	0.00	0.00	2.70	2.94	1.15	1.41
Community seed banks		0.00	0.00	0.00	0.00	2.94		1.41
Collective water management systems	3.03	0.00	0.00	0.00	0.00	2.94	1.15	1.41
Crop/livestock insurance	0.00	0.00	0.00	0.00	2.70	0.00	1.15	0.00
Production contracts	0.00	0.00	0.00	0.00	2.70	0.00	1.15	0.00

Annex 19: Source of social innovation (%)

Farmer type	Sources	County						Pooled	
		Embu		Makueni		Nakuru			
		Female	Male	Female	Male	Female	Male	Female	Male
UU farmer	UU and HER+ initiative	62.79	65.22	67.78	80.00	69.89	77.55	66.91	75.00
	Other farmers	67.44	60.87	72.22	80.00	51.61	51.02	63.57	59.78
	Radio	63.95	60.87	57.78	50.00	40.86	51.02	53.90	53.26
	Governmental agency	22.09	34.78	14.44	20.00	27.96	34.69	21.56	31.52
	Agricultural extension service	11.63	21.74	8.89	10.00	30.11	32.65	17.10	25.00
	TV	27.91	21.74	25.56	5.00	27.96	28.57	27.14	21.74
	Community organization	12.79	17.39	13.33	15.00	8.60	20.41	11.52	18.48
	FPO/cooperatives	12.79	17.39	4.44	10.00	15.05	20.41	10.78	17.39
	NGO	15.12	8.70	3.33	10.00	19.35	16.33	12.64	13.04
	Research Organizations	11.63	4.35	7.78	10.00	20.43	16.33	13.38	11.96
	Bank	3.49	4.35	0.00	0.00	5.38	4.08	2.97	3.26
	Development project	3.49	4.35	6.67	5.00	2.15	2.04	4.09	3.26
	Microfinance institution	2.33	8.7	0.00	0.00	3.23	2.04	1.86	3.26
	Community health workers	1.16	0.00	0.00	0.00	6.45	4.08	2.60	2.17
	Online education platform	0.00	4.35	0.00	0.00	0.00	0.00	0.00	1.09
	Entrepreneurship center	0.00	0.00	3.33	5.00	1.08	0.00	1.49	1.09
	Internet	0.00	4.35	1.11	0.00	0.00	0.00	0.37	1.09
	Learning materials	0.00	0.00	0.00	0.00	2.15	2.04	0.74	1.09
	Hospitals	0.00	0.00	1.11	0.00	2.15	0.00	1.12	0.00
	Learnt in school	1.16	0.00	1.11	0.00	0.00	0.00	0.74	0.00
Non-UU farmers	Radio	54.55	79.25	71.88	57.58	43.02	53.95	55.09	62.96
	Other farmers	50.00	60.38	67.19	66.67	33.72	42.11	48.61	53.09
	Governmental agency	19.70	32.08	21.88	12.12	29.07	28.95	24.07	26.54
	TV	28.79	16.98	26.56	12.12	13.95	22.37	22.22	18.52
	Agricultural extension service	7.58	11.32	3.12	6.06	13.95	11.84	8.80	10.49
	FPO/cooperatives	7.58	1.89	4.69	9.09	4.65	6.58	5.56	5.56
	Community organization	6.06	9.43	10.94	0.00	9.30	2.63	8.80	4.32
	Development project	1.52	3.77	3.12	3.03	1.16	5.26	1.85	4.32
	Research Organizations	3.03	3.77	6.25	3.03	2.33	5.26	3.70	4.32
	NGO	7.58	5.66	0.00	0.00	9.30	3.95	6.02	3.70
	Bank	0.00	0.00	0.00	0.00	1.16	3.95	0.46	1.85
	Entrepreneurship center	0.00	0.00	3.12	6.06	1.16	0.00	1.39	1.23
	Community health workers	0.00	0.00	0.00	3.03	1.16	1.32	0.46	1.23
	Online education platform	0.00	0.00	0.00	0.00	0.00	1.32	0.00	0.62
	Hospitals	0.00	0.00	0.00	0.00	0.00	1.32	0.00	0.62
	Internet	0.00	0.00	0.00	3.03	0.00	0.00	0.00	0.62
	Learnt in school	0.00	0.00	1.56	0.00	1.16	1.32	0.93	0.62
	Microfinance institution	0.00	0.00	1.56	0.00	0.00	1.32	0.46	0.62

Annex 20: Distribution of the complex and farmer centred STIBs by county, farmer type and gender

STIBs	County			Farmer type		Gender	
	Embu	Makueni	Nakuru	Non-UU	UU	Women	Men
Seed, Inorganic, Fungicide, Agroforestry, PHH, Demonstration, Women Collectives, Farmer-Farmer Extension, Radio information	1	0	0	0	1	1	0
Seed, Organic, Inorganic, Rotation, Intercropping, Pest Control, Weed Management, CSA, Farmer Training, Extension, Brochures, CSA Training, Nutrition Education, Subsidy, Social Protection	0	0	1	0	1	1	0
Seed, Breed, Organic, Inorganic, Intercropping, Weed Management, Fungicide, PHH, Extension, Demonstration, Group, Social Protection	0	0	1	0	1	0	1
Seed, Inorganic, Rotation, Weed Management, CSA, Farmer Training, Demonstration, CSA Training, Nutrition Education, Group, Farmer-Farmer Extension, Radio	0	1	0	0	1	1	0
Seed, Breed, Organic, Inorganic, Intercropping, Tillage, Weed Management, ICT, Farmer Training, Extension, Financial Literacy, Demonstration, Agricultural Workshop, Nutrition Education, Group, FFS, Farmer-Farmer Extension, Subsidy, Radio	0	0	1	0	1	0	1
Seed, Breed, Organic, Inorganic, ICT, Farmer Training, Extension, Demonstration, Agricultural Workshop, Nutrition Education, Group, Women Collectives, FFS, Farmer-Farmer Extension, Radio	0	0	1	0	1	0	1
Seed, Organic, Rotation, Intercropping, Soil Testing, Mechanization, Farmer Training, Extension, Group, Women Collectives, FFS, Farmer-Farmer Extension, Radio	0	0	1	0	1	1	0
Seed, Organic, Inorganic, Intercropping, Tillage, Fungicide, Farmer Training, Demonstration, CSA Training, Nutrition Education, Group, Radio	0	1	0	0	1	0	1
Seed, Organic, Inorganic, Rotation, Intercropping, Pest Control, Weed Management, Windbreaks, Farmer Training, Extension, Financial Literacy, CSA Training, Agricultural Workshop, Group, Finance, Radio	1	0	0	0	1	0	1
Seed, Organic, Inorganic, Intercropping, Mechanization, Farmer Training, Extension, Agricultural Workshop, Group, Women Collectives, Subsidy	0	0	1	1	0	1	0
Seed, Inorganic, Rotation, Farmer Training, Group, Women Collectives, Farmer-Farmer Extension	1	0	0	0	1	1	0
Organic, Inorganic, Rotation, Intercropping, Mechanization, Farmer Training, Extension, Subsidy	0	0	1	1	0	0	1
Seed, Organic, Inorganic, Intercropping, Weed Management, Mechanization, Farmer Training, Extension, Demonstration, Group	0	0	1	0	1	0	1
Seed, Intercropping, Agroforestry, Extension, Demonstration, Group, Farmer-Farmer Extension, Radio	0	1	0	0	1	1	0
Seed, Organic, Inorganic, Rotation, Intercropping, Cover, Tillage, Weed Management, Irrigation, Mulching, Fungicide, Agroforestry, PHH, CSA, Farmer Training, Extension, Demonstration, FSS, Mentorship, CSA Training, Agricultural Workshop, Group, Women Collectives, FFS, Cooperatives, Farmer-Farmer Extension, Finance	1	0	0	0	1	1	0

Components: Seed, Organic, Inorganic, Rotation, Farmer Training, Demonstration, Nutrition Education, Group, Farmer-Farmer Extension, Radio	1	0	0	0	1	1	0
Components: Seed, Organic, Inorganic, Rotation, Intercropping, Cover, Tillage, Mechanization, Farmer Training, Extension, Demonstration, FSS, CSA Training, Nutrition Education, Women Collectives, FFS, Farmer-Farmer Extension, Radio	1	0	0	0	1	1	0
Seed, Organic, Mechanization, Digital Literacy, Nutrition Education, Group	0	0	1	0	1	1	0
Components: Seed, Organic, Inorganic, Rotation, Intercropping, Pest Control, IPM, Weed Management, Mulching, Agroforestry, PHH, Farmer Training, Demonstration, Nutrition Education, Cooperatives, Subsidy, Radio	0	1	0	0	1	1	0
Seed, Organic, Inorganic, Intercropping, Mechanization, Farmer Training, Extension, Agricultural Workshop, Group, Women Collectives, Subsidy	0	0	1	1	0	1	0
Seed, Inorganic, Rotation, Farmer Training, Group, Women Collectives, Farmer-Farmer Extension	1	0	0	0	1	1	0
Organic, Inorganic, Rotation, Intercropping, Mechanization, Farmer Training, Extension, Subsidy	0	0	1	1	0	0	1
Seed, Organic, Inorganic, Intercropping, Weed Management, Mechanization, Farmer Training, Extension, Demonstration, Group	0	0	1	0	1	0	1
Components: Seed, Intercropping, Agroforestry, Extension, Demonstration, Group, Farmer-Farmer Extension, Radio	0	1	0	0	1	1	0
Components: Seed, Organic, Inorganic, Rotation, Intercropping, Cover, Tillage, Weed Management, Irrigation, Mulching, Fungicide, Agroforestry, PHH, CSA, Farmer Training, Extension, Demonstration, FSS, Mentorship, CSA Training, Agricultural Workshop, Group, Women Collectives, FFS, Cooperatives, Farmer-Farmer Extension, Finance	1	0	0	0	1	1	0

Annex 21: Farmer participation in decision-making on the type of maize and bean seed to plant (%)

Crops	Farmer type	Decision maker	County						Pooled	
			Embu		Makueni		Nakuru			
			Women	Men	Women	Men	Women	Men	Women	Men
Maize	UU	Man	1.15	35.00	0.00	20.00	3.37	32.65	1.52	30.34
		Woman	41.38	0.00	32.95	0.00	59.55	0.00	44.70	0.00
		Jointly	56.32	65.00	67.05	80.00	37.08	67.35	53.41	69.66
		Other HH member (women)	1.15	0.00	0.00	0.00	0.00	0.00	0.38	0.00
	Non-UU	Man	1.28	31.58	1.23	18.75	2.44	30.56	1.66	27.68
		Woman	52.56	1.75	37.04	0.00	59.76	0.00	49.79	0.56
		Jointly	43.59	64.91	59.26	81.25	36.59	66.67	46.47	70.06
		Other HH member (man)	1.28	0.00	1.23	0.00	0.00	2.78	0.83	1.13
		Other HH member (women)	1.28	1.75	1.23	0.00	1.22	0.00	1.24	0.56
Beans	UU	Man	1.20	28.57	0.00	16.67	3.95	16.67	1.67	19.75
		Woman	44.58	9.52	40.74	5.56	56.58	9.52	47.08	8.64
		Jointly	51.81	61.90	59.26	77.78	39.47	73.81	50.42	71.60
		Other HH member (women)	2.41	0.00	0.00	0.00	0.00	0.00	0.83	0.00
	Non-UU	Man	1.32	21.15	1.25	20.83	2.53	23.53	1.70	22.02
		Woman	59.21	11.54	41.25	8.33	62.03	7.35	54.04	8.93
		Jointly	38.16	65.38	55.00	70.83	34.18	66.18	42.55	67.26
		Other HH member (man)	0.00	0.00	0.00	0.00	0.00	2.94	0.00	1.19
		Other HH member (women)	1.32	1.92	2.50	0.00	1.27	0.00	1.70	0.60

Annex 22: Measurement of key indicators
Report on Empowerment Score Calculation

Decision-Making Variables (Responses: Man, Woman, Jointly, Other HH member (man), Other HH member (women)):

These variables were considered:

Variable	Description	Measurement
Use of own land	Decision maker on use of own land	Man, Woman, Jointly, Other HH member (man), Other HH member (women)
Livestock to raise	Who primarily decides on which livestock to raise?	Man, Woman, Jointly, Other HH member (man), Other HH member (women)
Voice opinion and concerns	Do you feel you can voice your opinions and concerns in household decisions, even if they differ from others?	Yes, No
Crops to plant	Who primarily decides on which crops to plant?	Man, Woman, Jointly, Other HH member (man), Other HH member (women)
Sale of crops and livestock	When your household sells crops or livestock who decides how the income is used?	Man, Woman, Jointly, Other HH member (man), Other HH member (women)
Use of own and co-owned resources	For the resources you own or co-own, can you make decisions about their use without seeking permission?	Yes, for all resources, Yes, for some resources, No

Scoring System

1. **Decision-making:** Decisions made by men or women alone was assigned a score one (1). We assigned a lower weight because individual decision-making not always indicate empowerment. Instead, individual decision-making may reflect gendered norms or inequalities. We assigned a score of 3 on joint decision-making as highlighted by several studies as an indicator of better household dynamics and empowerment. Joint decision-making reflects inclusivity man and woman collaborate which could lead to more balanced positive outcomes at household level. Lastly, we assigned a score of 2 when decisions are made by other household members regardless of gender. We justify this based on Quisumbing and Maluccio
   work that that suggests that involvement of other household members could indicate a diffusion of power within the household.
2. Ability to voice opinions: The ability to voice opinion reflects individual ability to participate in the decision-making process, that is man or woman's ability beyond the ability to make decisions by expressing divergent views. Therefore, responses indicating the respondents had the ability to voice opinions were scored as 2, while those indicating an inability were scored as 1.
3. Autonomy in decisions about resources: Having control over resources and the autonomy to make decisions about them is an indicator of empowerment. However, individuals can have partial or full autonomy, a distinction. Full autonomy over ownership and control over resources is associated with higher empowerment level compared to partial autonomy. In the study, responses to the question "for the resources you own or co-own, can you make decisions about their use without seeking permission?" were scored based on the level of autonomy in decisions about resources, ranging from 1 ("No") to 3 ("Yes, for all resources").
4. Empowerment score: The average of scores across the relevant variables for each respondent.

Food security

The study adopted the Household Food Insecurity Access Scale (HFIAS) by the USAID-funded Food and Nutrition Technical Assistance II (FANTA) project to measure the food insecurity status of farmers[15]. HFIAS was adopted because of its ability to detect aspects of food insecurity involving decreased access to a sufficient quantity or quality of food. In addition, HFIAS detects psychosocial manifestations of anxiety and uncertainty around food access, with negative implications for health and wellbeing[16]. The HFIAS score uses raw scores to classify households by three broadly recognized, access-related domains: uncertainty (worry about not having enough food), insufficient food quality (variety and preferences of food), and insufficient food quantity. Farmers were asked nine "frequency-of-occurrence" questions after each occurrence question to determine how often the situation happened. Rarely (one or twice in the past four weeks), frequently (three to ten times), and often (more than ten times) are coded 1, 2, and 3. Generally, the questions represent an increasing level of severity of food insecurity. Nine-food insecurity-related condition frequency during the preceding four weeks determines the score. Question 1 represents anxiety and uncertainty about the household food supply, questions 2 to 4 represent insufficient quality (includes variety and preferences of food), and questions 5 to 9 represent insufficient food intake and its physical consequences (Box 1).

The HFIAS score was computed based on the distribution of the responses to the nine items. HFIAS has four indicators, household food insecurity access-related conditions, household food insecurity access-related domains, household food insecurity access scale score and household food insecurity access prevalence. The HFIAS scores ranged from 0 to 27 where the maximum score for a household is 27 and the minimum score is 0. Using the scale frequency categories—such as "never," "rarely," "sometimes," and "often"—to categorize individuals or households as either severely food insecure, moderately food insecure, mildly food insecure, or food secure based on respondents' answers to a series as expounded by the household food insecurity access prevalence indicator. A household that is deemed **food secure** does not encounter any of the situations associated with food insecurity in terms of access, or only suffers occasional concerns, although to a minimal extent. A household experiencing **mild food insecurity** is concerned about the possibility of insufficient food on occasion or frequently. Additionally, they may be unable to consume their preferred food choices, resulting in a less varied diet than anticipated. In some instances, they may also consume items that are regarded undesirable, but infrequently. However, it does not reduce the quantity of food, nor does it entail the experience of any of the three most severe states, either food scarcity, bedtime hunger, or complete fasting for a full day and night. A household experiencing **moderate food insecurity** generally compromises on the quality of their food, opting for a boring or unappealing diet on a regular basis. Additionally, they may also begin to reduce the quantity of food consumed, as indicated by the Household Food Insecurity Access Scale Indicator Guide, v.2. The variable under consideration is the quantity of meals, which can be measured in terms of either size or number. This aspect is infrequently or occasionally addressed in relevant literature. However, it does not undergo any of the three most severe situations. A household experiencing **extreme food insecurity** demonstrates a reduction in meal size or frequency, and/or encounters any of the three most severe circumstances (depletion of food supplies, experiencing hunger before sleep, or enduring a complete day and night without consuming food), even if these occurrences are seldom. To clarify, a household that encounters any of these three circumstances at least once throughout the last four-week period (30 days) is categorised as extremely food insecure.

To complement the results of HFIAS, the Food Consumption Score (FCS) was computed. It was computed by determining the frequency of consumption of eight food groups with their associated weights[17]. FCS is useful for categorizing and tracking households' food security across time, specifically as a proxy for the quantity dimension (i.e., household caloric sufficiency) of food security, for which this indicator has been validated. This indicator captures information about usual household diets, since it asks respondents to recall what they consumed

15 Farhadian, A., Chan, V. S., Farhadian, H., & Farhadian, H. (2015). Addressing household food insecurity using the household food insecurity access scale (HFIAS) in a poor rural community in Sabah, Malaysia. Int J Humanit Soc Sci Invent, 4(8), 89-100.

16 Household Food Insecurity Scale (HFIAS) :https://inddex.nutrition.tufts.edu/data4diets/indicator/household-food-insecurity-access-scale-hfias

17 Carletto, C., Zezza, A., & Banerjee, R. (2013). Towards better measurement of household food security: Harmonizing indicators and the role of household surveys. Global food security, 2(1), 30-40

over the past seven days. In addition, the FCS can be used in a range of ways, including for program monitoring and evaluation and population-level targeting. Since it is a standardized measure, it can also be useful in comparing households in different locations. The eight food groups included starch, pulses, vegetables, fruits, meat/fish, dairy, fats/cooking oil and sugar. The eight food groups include starch, pulses, vegetables, fruits, meat/fish, dairy, fats/cooking oil and sugar. To capture FCS, a 7-day recall period was used among the beneficiaries to elicit their dietary habits. The computed score was further categorized into "poor" (0-21), "borderline" (21.5 - 35) and "acceptable" (35.5 and above)[18] .

18 Vaitla, B., Tesfay, G., Rounseville, M., & Maxwell, D. (2012). Resilience and livelihoods change in Tigray, Ethiopia. Somerville, MA: Tufts University, Feinstein International Center

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