From Afterthought to Forefront: Transforming Agricultural Resilience through Co-Designed Socio-Technical Innovations

Abstract

Although social innovations are recognized as important to enabling technology use, when implemented, they are often considered as an afterthought or rarely co-designed with beneficiaries. The study used data collected from 783 farmers in three counties of Kenya to assess effectiveness co-designed socio-technical innovation bundles (conservation agriculture practices and inclusive, gender-sensitive, and policy-supported innovations) in enhancing climate resilience and productivity. Results indicate significantly higher resilience capacities among users of sociotechnical innovation bundles than non-users. Significant differences in agricultural output were reported, with users demonstrating higher productivity in maize (545 kg/acre vs. 398 kg/acre) and beans (237 kg/acre vs 187 kg/acre) under climate change. The effect of bundles on productivity was higher when co-designed for both crops – maize (556 kg/acre vs 520 kg/acre) and beans (240 kg/acre vs. 231 kg/acre). However, no significant differences were reported regarding the effect of co-designed socio-technical innovation bundles on farming households' capacity to obtain support from community/local groups in times of climate-related shocks. These findings underscore the importance of co-designing and integrating socio-technical innovations into agricultural programs.

Keywords: socio-technical innovation, climate resilience, resilience capacities, co-design, adaptation

Introduction

Most developing countries in the world depend on agriculture for economic growth, employment, and food security. However, food systems in developing countries face numerous challenges (Lamine et al. 2012), including low total agricultural productivity. Productivity in these countries is lower among women than men (Huyer, 2016). This hampers progress towards achievement of sustainable development goals (SDGs), such as zero hunger and gender equality (Devaux et al., 2021). Climate change is another cause of gender disparities in agri-food systems in less developed regions (Shaw et al., 2013). The high dependency on agriculture makes farmers in these regions more vulnerable to climate extremes such as frequent and adverse climatic events such as droughts, flooding, and heat stress (Mirza, 2003; Millner & Dietz, 2014). Women in these regions are more vulnerable to climate change due to high poverty rates, social inequality, and weak institutional capacity (Chilunjika & Gumede, 2021).

For decades, technological progress has driven agri-food systems transformation efforts in poor countries. The Green Revolution the most cited example of the role of technological innovations in increasing agricultural productivity. Secondly, technological innovations have also been a driver for climate resilience across nations (Vermeulen et al., 2012; Wheeler, T., & Von Braun, 2013; Rosenzweig et al., 2014). However, technical innovations have not translated into the much-needed transformation in agri-food system, such closing gender gaps in productivity and resilience to climate change.

Sub-Saharan Africa has the most unequal agri-food system globally, with women facing substantial barriers in climate change adaptations relative to men. For instance, gender gap in agricultural productivity is approximately 11% in Ethiopia and 28% in Malawi (UN Women, 2019). Similar gaps are observed in other countries, such as Kenya (8%) and Nigeria (over 30%). In terms of adaptation to climate change, women are less likely to adopt climate-smart technologies and practices such as drought tolerant crop varieties and fertilizers (Hailemariam et al., 20224). This gender gaps costs up to $100 million in Malawi, $105 million in Tanzania, and $67 million in Uganda (Huyer, 2016).

Barrett et al. (2022) suggested socio-technical innovations bundling (STIBs) as an approach that can transform the agri-food systems in developing countries. However, existing STIB approaches for agri-food systems transformations are designed in unsystematic manner. They lack deliberate efforts that combine social and technical innovations in effective ways. Secondly, the perspectives of diverse groups, such as women, youth, or marginalized communities, are rarely considered during bundling or are treated as an afterthought, resulting in inequitable outcomes. Additionally, while bundling of innovations is recognized as critical to enhancing agri-food resilience, there is limited systematic evidence on their effectiveness in different contexts. To address these gaps, the CGIAR gender equality initiative as known as Harnessing Gender and Social Equality for Resilience in Agrifood Systems (HER+) is co-designing and testing STIBs in diverse contexts in Asia and Africa (Ayuya et al., 2024). In Africa, the HER+ initiative conducts STIBs research in Kenya and Ethiopia.

This abstract aim to answer one research question: why socio-technical innovation bundling? What are the processes and the effects on productivity, empowerment, and resilience. It achieves this by providing findings from HER+ learning labs in Kenya.

Methodology

Study area and STIB processes

The data presented in this abstract were collected from three HER+ learning labs in Kenya. Learning labs are virtual and physical spaces for multi-stakeholder engagements. HER+ is working with Diversification for Resilient Agribusiness Ecosystems in East and Southern Africa (UKama Ustawi), a CGIAR initiative, which targets to address food and nutrition security risks associated with climate change through climate-resilient, water-secure, and socially inclusive approach in three counties in Kenya – Nakuru, Makueni, and Embu. The Ukama Ustawi (UU) support farmers to test and adopt climate-smart agriculture practices, conservation agriculture, and sustainable intensification by conducting on-farm demonstrations. The goal is to intensify, diversify and de-risk maize-mixed farming systems. HER+ is integrating STIBs in UU mother and baby on-farm experiments in three counties. It is co-designing social innovations and modelling diverse scenarios for bundling climate-smart technologies to empower women and men to be partners in innovation processes and build their resilience to climate change.

Data collection

We collected baseline data from three learning labs in Kenya in October and November 2023. The study used quasi-experimental research design by collecting data from 376 farmers participating in HER+ activities and 430 non-project participants. Sampling method for treated group combined purposive selection farmers participating in UU's on-farm experiments and stratified random sampling for the comparison group. A semi-structured survey questionnaire was used to collect information of STIBs adoption. Collected data were analysed descriptively using percentages and frequencies. Statistical tests were performed to test whether outcome variables of interest – maize and common productivity and climate resilience – were statistically significantly different by STIBs adoption status. These results were visualized and presented for ease of interpretation and drawing inferences.

Results and Discussion

STIBs adoption status

Figure 1 presents adoption status of STIBs by farmer type – UU and non-UU farmers. Significantly higher percentages of UU farmers adopted STIBs than non-participants (Ayuya et al., 2024). There were no significant variations in STIBs adoption rates by region and gender for both groups.

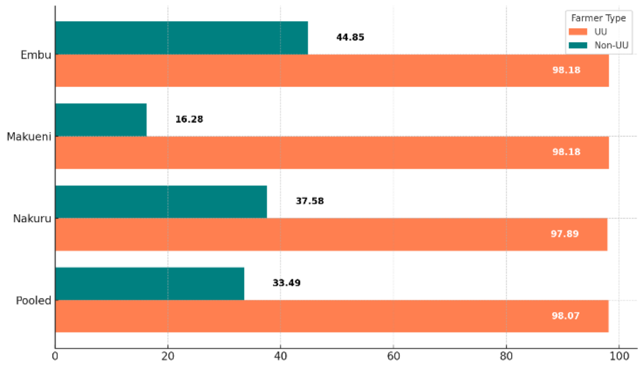

Figure 1: STIB adoption rates

In Figure 2, significant differences in agricultural output were reported, with STIBs users demonstrating higher productivity in maize (545 kg/acre vs. 398 kg/acre) and beans (237 kg/acre vs 187 kg/acre) when they experienced prolonged droughts. The effect of bundles on productivity was higher when co-designed for both crops – maize (556 kg/acre vs 520 kg/acre) and beans (240 kg/acre vs. 231 kg/acre). However, no significant differences were reported regarding the effect of co-designed socio-technical innovation bundles on farming households' capacity to obtain support from community/local groups in times of climate-related shocks. Comparison of by gender showed no significant difference in productivity among STIBs users but significantly different productivity among non-users (Ayuya et al., 2024)

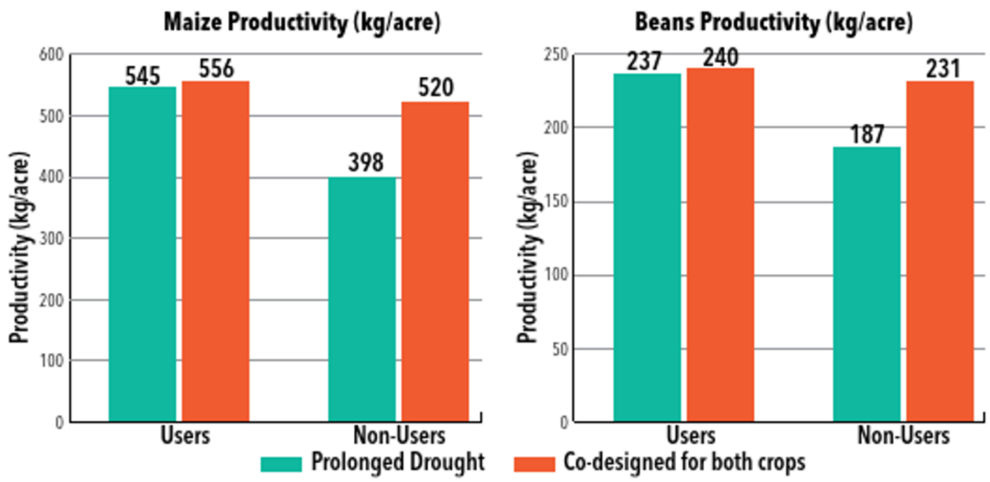

Figure 2: Comparison of maize and bean productivity

Figure 3 are overall climate resilience scores out of 50. There was a significant difference between users of co-designed STIBs that and non-users in their resilience scores. The gaps in men and women users and non-users were both negative but not significant. This means that women users of STIBS were equally as resilient as men. Important observation was lower resilience for both men and women non-users compared to users regardless of the size of the gap in resilience.

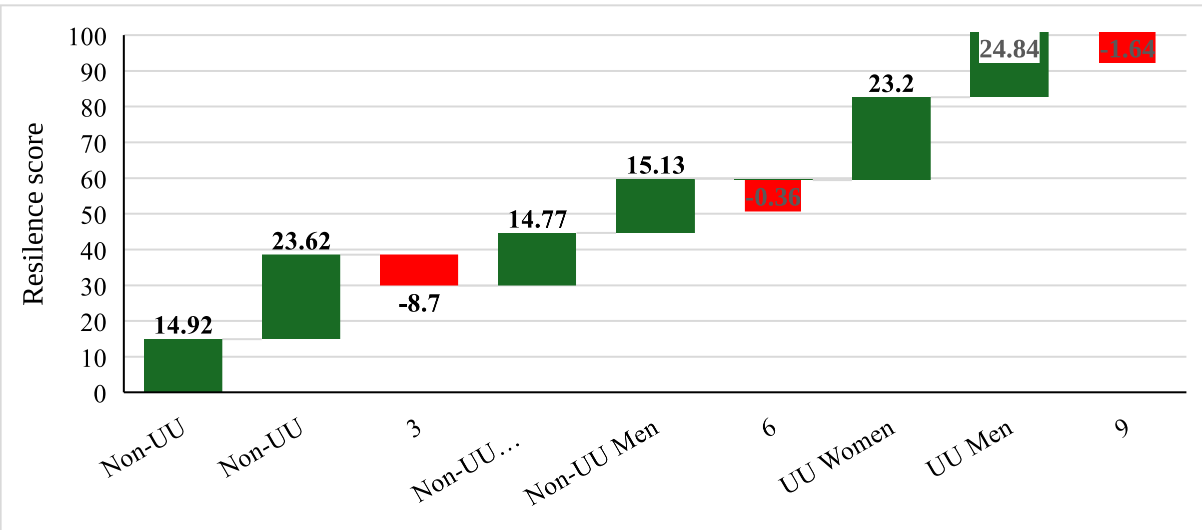

Figure 3: Overall climate change resilience scores

Conclusion

The results reveal that co-designing and integrating STIBs into agricultural programs are critical for agri-food systems transformations. Development practitioners and policymakers should prioritize co-designing of socio-technical solutions with direct community participation to optimize climate resilience, agricultural productivity, and secure livelihoods.

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