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INNOVATION LAB FOR FOOD SECURITY POLICY RESEARCH, CAPACITY, AND INFLUENCE

Adoption of sustainable agricultural intensification practices and their welfare impacts: Comparative evidence from Ethiopia, Malawi, and Uganda

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Introduction

Agricultural productivity in Sub-Saharan Africa is constrained by low adoption of new technologies, adverse effects of climate change, land degradation, declining soil fertility, and declining land sizes due to population growth (Kassie et al., 2015). However, sustainable intensification practices (SIPs) present a viable option for enhancing agricultural productivity and improving household welfare (Jindo et al., 2020). Households adopting SIPs are expected to have an improved food and nutrition status and higher farm incomes. Nevertheless, there is limited empirical evidence to back this hypothesis. Furthermore, the adoption of SIPs is generally low in many developing countries (Abdulai, 2016; Arslan et al., 2013), including Ethiopia, Malawi, and Uganda. Bridging knowledge gaps in these areas is essential for enhancing the understanding of the impact of SIPs on welfare outcomes in developing countries, and informing evidence-based policies and interventions for unlocking the potential of SIPs in improving household welfare.

Key Facts

- **Sustainable intensification practices (SIPs) have demonstrated positive impacts on food and nutritional security across various contexts.**
- **Interventions must be tailored to local conditions, accounting for gender differences and the unique needs and circumstances of each country.**
- **Extension and crop-livestock integration farming should be scaled up as they are pivotal in enhancing SIP adoption.**

SIPs involve approaches aimed at improving agricultural productivity while minimizing the negative effects on the environment and without the conversion of additional non-agricultural land (Jayne et al., 2019). The term SIP encompasses various agricultural practices and technologies aimed at improving productivity such as agroforestry, the use of organic and inorganic fertilizers, herbicides, crop residue retention, minimum tillage, and the adoption of improved seed varieties. Despite significant investments in research aimed at raising agricultural productivity and combating the adverse effects of climate change and rapid population growth, farm families, especially those headed by females, continue to face chronic food insecurity (Theriault et al., 2017). The adoption of SIPs has the potential to improve food security for agricultural households (Ngoma et al., 2023) while preserving natural resources (Pandey et al., 2022). Considering the important role played by women in agricultural production across Africa (Vemireddy & Pingali, 2021; Kawarazuka et al., 2022; FAO, 2023), it is essential to analyze the role of role gender in influencing the adoption of SIPs. Furthermore, this analysis is important for guiding the development of effective programs and policies aimed at sustainably increasing agriculture productivity (Quisumbing & Doss, 2021).

Understanding the adoption of SIPs and their effects on welfare indicators is essential for the formulation of initiatives aimed at enhancing the adoption of SIPs and improving the welfare of small-scale farmers (Njuki et al., 2022). This research contributes to empirical evidence in three main ways. Firstly, while analyzing the factors associated with the adoption of SIPs, we utilize decision-making at the farm level as our gender indicator. This new approach is better than previous approaches of focusing on the gender of the household head or sex of the farmer which does not reflect how farming decisions are made at the plot level. Our gender variable is categorized into there: male decision maker, female decision maker, and joint decision maker depending

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on who makes decisions at the farm. Secondly, we analyze the impacts of the adoption of SIPs on food and nutritional security. Thirdly, we utilize a cross-country comparative analysis to study the adoption and welfare effects of SIPS. This approach sheds light on how outcomes vary across diverse contexts and settings and enables us to draw more robust conclusions.

Research Aim, Methods, and Data

The study utilized nationally representative panel data from the Living Standards Measurement Study – Integrated Surveys on Agriculture (LSMS-ISA) collected between 2008 and 2019 from Ethiopia, Malawi, and Uganda. The study is based on nearly 4,600; 1,500; and 3,000 households from Ethiopia, Malawi, and Uganda, respectively. Utilizing quantitative regression analysis, our study focuses on two main objectives. The first objective of the study is to analyze the factors associated with the adoption of SIPs. These practices include conservation agriculture (zero or minimum tillage, residual crop incorporation, and maize-legume intercropping); soil and water conservation (contour bunds, vetiver grass, and terraces); organic fertilizer (animal manure and compost); and chemical fertilizer (nitrogen, phosphorus, potassium, and urea. The second objective is to estimate the effects of the adoption of SIPs on food and nutritional security. This is done by comparing the outcomes of those who adopt SIPs and those who do not. The food consumption score (FCS) is our chosen indicator of food and nutrition security. FCS is a widely accepted and commonly used metric in the analysis of nutrition and food security research used to assess the quality and diversity of household food consumption, making it an appropriate choice for our study (Kennedy et al., 2010; Villa et al., 2011).

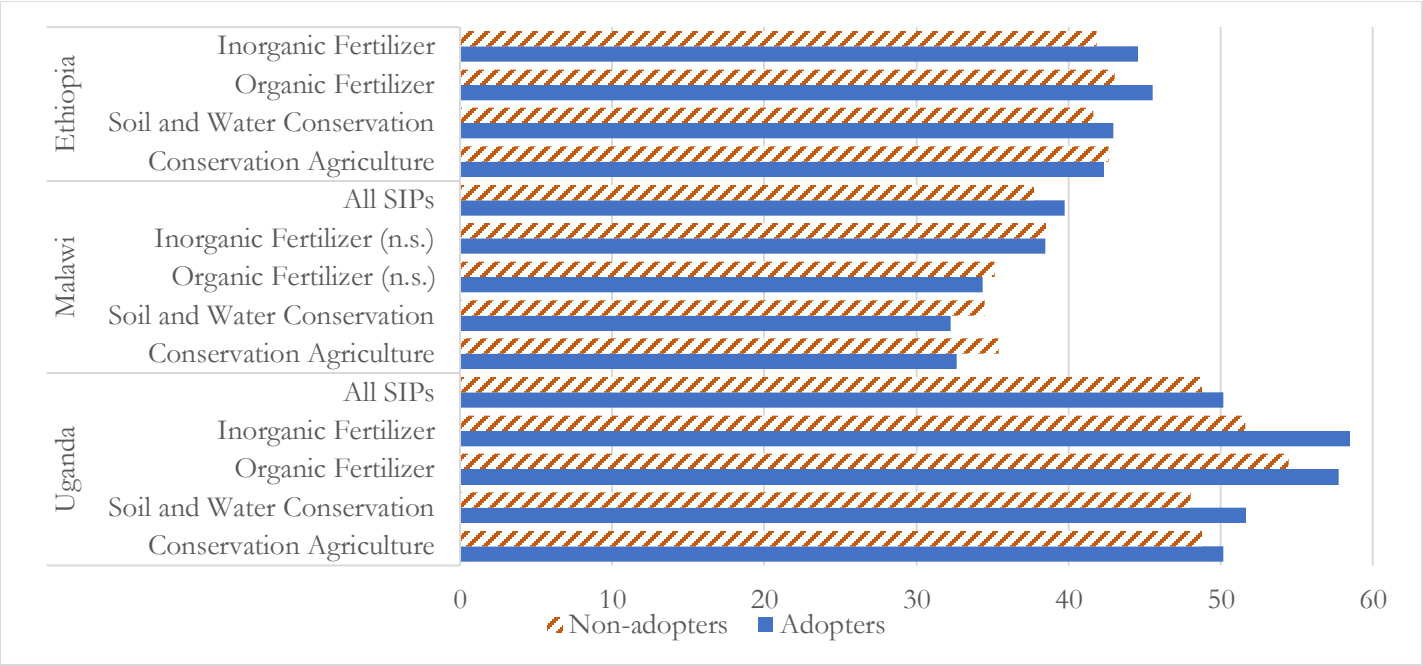
Results

On average, about 69%, 94%, and 68% of the households under analysis reported to have adopted some form of SIP. In Ethiopia and Malawi, inorganic fertilizer was the most widely adopted SIP, adopted by 45% and 67% of the households, respectively. In Uganda, conservation agriculture was the most adopted SIP adopted by about 51% of the households. Our analysis shows that factors positively associated with the adoption of SIPs in the three countries include the gender of decision maker at the farm level, access to extension services, ownership of durable and agricultural assets, ownership of livestock, literacy levels, proximity to roads and markets, access to credit, and agro-ecological zones. However, each country exhibits unique distinctions suggesting the need for country-specific policies for promoting the adoption of SIPs. In Ethiopia, access to extension, livestock ownership, and agro-ecological zones are the most significant factors. In Malawi, access to credit and ownership of agricultural assets emerge as the most significant factors. In Uganda, livestock ownership and joint decision-making are particularly influential factors.

Figure 1 presents the impacts of the adoption of SIPs on food and nutritional security. Specifically, we compare FCSs between households that adopted SIPs and those that did not. In all three countries, FCSs were above the minimum threshold of acceptable consumption status (Poor: FCS less than or equal to 21; Borderline: FCS greater than 21 but less than or equal to 35; Acceptable: FCS greater than 35). Between 2011 and 2016, the FCSs averaged 45.65, 37.54, and 52.18 for Ethiopia, Malawi, and Uganda, respectively.

The results on the impacts of the adoption of SIPs on FCS vary across countries, underscoring the importance of considering local contexts and practices when designing agricultural interventions. In Ethiopia, the adoption of SIPs has a positive effect on food consumption scores. The adoption of inorganic has the largest impact followed by organic fertilizer. Similarly, in Uganda, all SIPs positively impact food consumption scores. Notably, the adoption of inorganic fertilizers has the largest impact followed by soil and water conservation and organic fertilizers. In Malawi, not all SIPs positively impact food consumption scores. Some practices such as conservation agriculture and soil and water conservation are negatively associated with food consumption scores. However, jointly adopting all SIPs is positively associated with food consumption scores. Notably, both organic and inorganic fertilizers are insignificant. One explanation for this finding is that soils in Malawi are depleted of essential nutrients and the application of inorganic fertilizers has not resulted in improved crop yields and better food consumption scores. This observation is corroborated by previous research which has shown that the crop yield response to inorganic fertilizers is generally low in Malawi (Burke et al., 2020). Recent evidence has therefore suggested that combining inorganic fertilizers with other inputs such as organic fertilizers and lime can improve soil health (Islam et al., 2021).

Figure 1: Impacts of adoption of SIPs on food consumption scores in Ethiopia, Malawi, and Uganda



Source: Authors' analysis. Note: n.s. denotes insignificant differences between adopters and non-adopters for these SIPs. Results are significant for the rest of the SIPs.

Policy Implications

A number of policy implications and recommendations emerge from the study findings. Firstly, the adoption of SIPs should be promoted due to their demonstrated positive impacts on food and nutritional security. However, the country-specific contexts should be taken into account, taking into account the unique needs and circumstances of each country. Interventions will require a collaborative approach, bringing together researchers, policymakers, and agricultural practitioners to co-create context-specific knowledge and solutions. These partnerships are essential for developing informed policy decisions, and successful adoption of sustainable agricultural intensification practices. Furthermore, promoting agricultural practices that integrate multiple SIPs is important, as seen in Malawi and Uganda, where joint adoption of practices has positively impacted food and nutritional security outcomes. There is a need to scale up investments in agricultural research and extension services due to the positive role played by extension in the adoption of SIPs. Specifically, access to extension services is expected to equip farmers with the knowledge, training, guidance, and support necessary for the effective adoption and implementation of SIPs. Specific considerations in extension services should include the promotion of climate-smart agriculture practices considering their potential benefits in mitigating climate change while enhancing food and nutritional security. Furthermore, extension services should be tailored to meet the specific needs of women who disproportionately face cultural barriers and other challenges that limit their access to extension services and productive resources. The study recommends the promotion of integrated crop-livestock farming considering that the ownership of livestock is positively associated with the adoption of SIPs. Under the crop-livestock farming systems, livestock provide a source of organic manure thereby improving soil fertility and nutrient cycling. This farming approach can assist smallholder farmers reduce their reliance on inorganic fertilizers which are expensive for most farmers. Combining crops and livestock diversifies income sources for farmers, thereby enhancing the financial stability of farmers and motivating them to invest in SIPs in the long term. Finally, the study recommends the development and implementation of agricultural policies that are gender inclusive. This includes providing training and awareness programs on sustainable intensification practices, such as conservation agriculture and soil and water conservation, for both male and female farmers. It is important to ensure that these programs are accessible and tailored to the specific needs of different gender groups. These programs can empower women in agriculture and mitigate some of the challenges and barriers they face, like limited access to productive agricultural resources.

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