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Exploring Adoption Effects of Subsidies and Soil Fertility Management in Malawi

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Key Messages

- The Farm Input Subsidy Program (FISP) has been implemented since 2004, yet yields for key crops have remained low due to low crop response to inorganic fertilizers, which has limited the program's effect on food insecurity and poverty.
- The poor response is partly attributed to poor soil health and low adoption rates of soil and water conservation practices.
- Using data from a decade-long nationally representative panel, we analyze joint adoption effects of input subsidies and integrated soil fertility management (ISFM) on crop income and nutrition.
- Participation in FISP is positively correlated with adoption of ISFM practices, including conservation agriculture, soil and water conservation, and organic fertilizers.
- Joint use of input subsidies and ISFM practices is positively correlated with higher crop income and improved household nutrition.
- Policy proposals to address low productivity and nutritional insecurity are highlighted.

Introduction

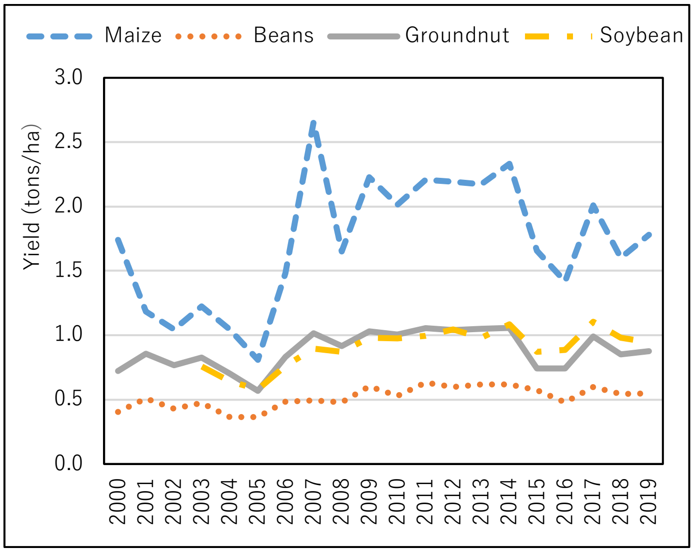
Low use of modern agricultural technologies such as improved seeds and inorganic fertilizers pose serious hindrances to increasing crop yields and reducing hunger and poverty in the global South.[1,2] Moreover, soil fertility degradation is a key contributing factor to low productivity and food insecurity, especially in sub-Saharan Africa (SSA) and regions with high, rapidly increasing population density and reduced fallowing.[3] In response to these challenges, governments in SSA are increasingly promoting diverse agricultural technologies designed to improve yields and reduce the vulnerability of agricultural systems.

Farm input subsidies and integrated soil fertility management (ISFM) practices could sustainably increase crop yields and income. Like many other countries in SSA, input subsidies have been central to Malawi's effort to promote farm productivity and input adoption. Specifically, the large Farm Input Subsidy Program (FISP) has been in effect since 2004.[4] Evidence suggests that the FISP increased maize yields and reduced the pressure to expand into marginal lands.[5,6] However, yields for key crops have remained low (Figure 1) compared to potential yields. Furthermore, the long-term effects of maize monocropping and fertilizer use on soil can be debatable; on one hand higher yields can produce organic material that can be used to rebuild soil fertility, but, on the other hand, extensive fertilizer use can contribute to soil acidification.[7]

The objective of this brief is to highlight ways Malawi's FISP is related to ISFM and explore its adoption effects on welfare outcomes.

In addition to inorganic fertilizers, we categorize ISFM technologies into three bins: conservation

Figure 1: Crop Yields between 2000 and 2019 in Malawi



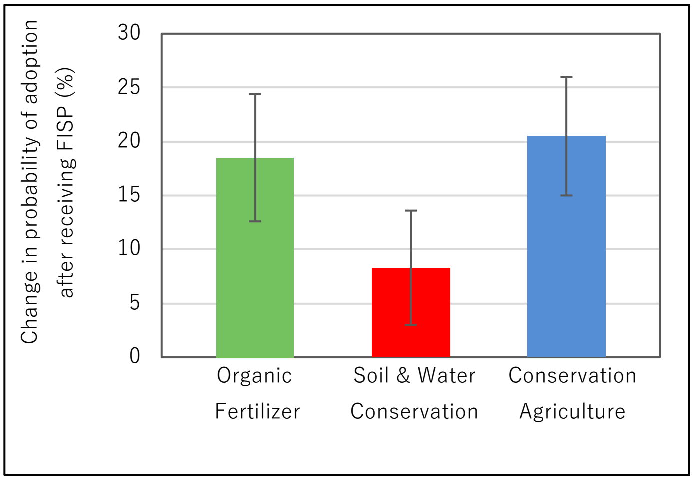
Data source: FAOstat; http://www.fao.org/faostat/en/#data/QC

agriculture (CA: zero or minimum tillage, crop residual incorporation and maize-legume intercropping); soil and water conservation (SWC: contour bunds, vetiver grass and terraces); and organic fertilizer (OF).

Few studies have analyzed joint use of input subsidies and ISFM technologies, and the evidence is mixed. Those that found FISP increased use of maize-legume intercropping and OF[8-11], but most of these were not based on nationally representative samples.[8-10] Others found input subsidies led to dis-adoption of fallowing and intercropping and crowding out farmland allocated to legumes in SSA.[12,13] Most importantly, none of the existing studies have analyzed effects of using both input subsidies and ISFM on crop income and nutrition, though most farmers who use these technologies do so jointly.

The present analysis fills this important gap using Malawi`s Integrated Household Panel Survey (IHPS) to analyze the combined adoption effects of input subsidies and ISFM technologies on crop income and household nutrition.

Figure 2: Effects of Participating in Farm Input Subsidies on Use of Integrated Soil Fertility Management



Notes: Estimates from dynamic random effects probit are shown with standard error bars. Source: Author`s calculation using IHPS data collected in 2010, 2013, 2016 and 2019. Observations (N)=7029.

Do Farm Input Subsidies Increase or Decrease Use of ISFM Technologies?

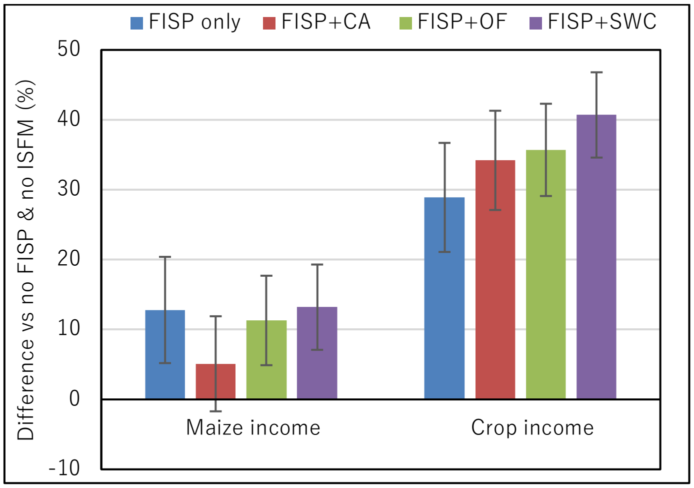
We estimated several models with CA, SWC and OF as dependent variables. A binary indicator for participation in FISP is the key explanatory variable. Selected results are summarized in Figure 2. We found that participation in FISP is positively correlated with adoption of ISFM technologies.

Conservation Agriculture (CA): Consistent with previous studies[9,11], we found that participation in FISP is associated with greater use of CA practices such as maize-legume intercropping (Figure 2). Possibly, the inclusion of improved legume seeds (2kg) in FISP helped farmers to allocate more land to legumes for intercropping with maize.

Soil and Water Conservation (SWC): We also found that participation in FISP is positively correlated with use of SWC technologies (Figure 2). This suggests that the two technologies are used as complements, and not as substitutes.

Organic Fertilizer (OF): We also found that FISP is associated with greater use of OFs (see Figure 2), suggesting farmers used subsidized fertilizer and

Figure 3: Relationship between Crop Income and Use of Farm Input Subsidies and Integrated Soil Fertility Management



Notes: Mundlak regression estimates are shown with standard error bars. Based on use of FISP and ISFM technologies, we classified farm households into several groups: Group 1; Non-participants of FISP and no ISFM, Group 2; farmers using FISP only. Group 3; farmers using FISP and CA (FISP+CA), Group 4; farmers using FISP and SWC (FISP+SWC), and Group 5; farmers using FISP and OF (FISP+OF). Source: Author`s calculation using IHPS data. N=2883.

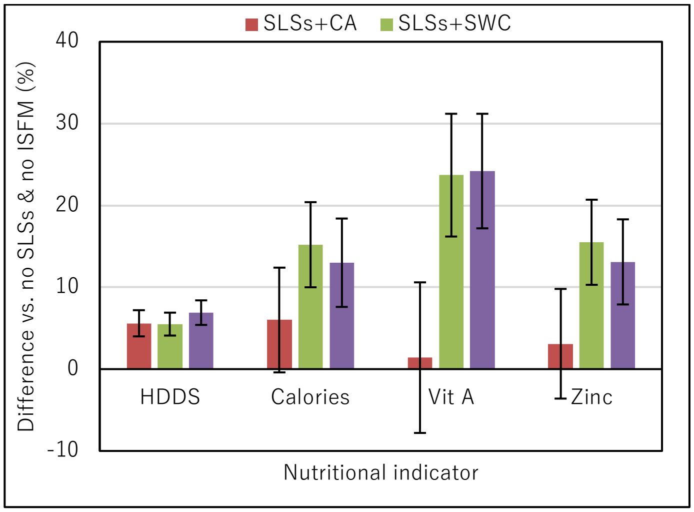
OFs as complementary inputs. This is a welcome finding as crop response to inorganic fertilizers is low due to soil fertility degradation, which can be improved with OF applications. However, there is a concern that the quantities of OFs applied by most farmers are very low.[8]

What Are the Effects of Using Subsidies and ISFM Technologies on Crop Income and Nutrition?

Figures 3 & 4 present selected regression-based results on the relationship between using both FISP and ISFM, and crop income (gross value of production in MK/ha) and household nutrition, respectively. We use dietary diversity scores, calories and micronutrient consumption as proxies for household nutrition.

Crop Income: Overall, we found that joint use of FISP and ISFM technologies is associated with 11-13% higher crop income (Figure 3). Maximum benefits are found with joint use of FISP and SWC, followed by joint use of FISP and OF.

Figure 4: Relationship between Nutritional Outcomes and Using Subsidized Legume Seeds (SLSs) and Integrated Soil Fertility Management



Notes: HDDS, household dietary diversity score. Vit A, Vitamin A. Estimates from Mundlak and Poisson (for HDDS) regressions are shown with standard error bars. We excluded results for SLSs only for brevity. Source: Author`s calculation from IHPS datasets. N=1678.

However, joint use of FISP and CA such as maize-legume intercropping was associated with lower productivity (MK/ha). This may reflect excessive nutrient availability hindering effective podding or flowering in legumes, or it could be related to these technologies being more commonly used on less productive soils. Legume plants generally require less use of nutrient-rich technologies because of their symbiotic relationship with soil microbes is capable of fixing atmospheric nitrogen.

Household Nutrition: We further found that joint use of subsidized legume seeds (SLSs) and ISFM technologies is positively associated with dietary diversity, and consumption of calories and micronutrients (vitamin A and zinc) by about 6%, 13-15% and 13-24%, respectively (Figure 4). These results suggest that inclusion of legume seeds in an input subsidy program (ISP) could improve household nutrition through productivity and income pathways.

Key Policy Implications

Include organic fertilizer suppliers in ISPs: Soil erosion and land degradation have contributed to reduction of soil organic matter in Malawi.[3,7] To replenish organic matter in the soil, current or future designs of ISPs may target producers of organic fertilizers or manure as input suppliers on a pilot basis. Furthermore, tying recipients of subsidized inputs to use of organic manure and SWC may increase its adoption.

Invest in production of organic fertilizers: Local suppliers of organic fertilizer may have limited capacity to produce large quantities of OFs. Providing credit facilities to these input suppliers may ease challenges related to production capacity.

Re-introduce legume seeds in ISPs: Improving household nutrition through productivity and income channels could be supported by re-introducing legume seeds into ISPs. If targeted appropriately, this may also help to create demand for improved legume seeds in the long run. This may further increase nutritional and income benefits from legumes.

Invest in promoting ISFM technologies: Promoting uncommon ISFM technologies such as zero or minimum tillage and crop residual incorporation is key to regenerating soils, and ultimately improving crop yields and household income. However, CA technologies are commonly associated with extra costs such as herbicides and labor requirements for residual incorporation along with opportunity costs as animal feed.

Invest in agricultural productivity through soil health programs: Improving agriculture productivity growth through ISFM technologies require more investment in research and development, extension, market infrastructure, and livestock development; meant to improve production and use of organic manure.

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