

Productivity Impact of Integrating Soil Fertility Management Interventions in Input Subsidy Programs: Evidence from a Randomized Controlled Trial in Malawi



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Abstract

This paper was developed as part of PEP-supported research project PIERI 20620, entitled “Productivity Impact of Integrating Soil Fertility Management Interventions (soil-fertility-management interventions) in Input Subsidy Programs (input subsidy programs): Evidence from a Randomized Controlled Trial in Malawi”. The objective of this companion piece is to position the project’s research work and findings within the broader policy context (including the policy strategies and decision processes) that they shall serve to inform.

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I. Strategies and Challenges of Maize Production in Malawi

Recent national estimates show that up to 63.5% of households in Malawi suffer from food insecurity, and more than half are poor (National Statistical Office, 2020). This is why Malawi's agricultural and food policy has focused mainly on supporting maize production to promote food self-sufficiency at household and national levels since the country's independence in 1964. Over the past two decades, the strategy has been to support production by subsidizing agricultural inputs. The farm-input-subsidy program, the largest input subsidy program ever to have been implemented in Malawi, was launched in 2004-2005 and relied on a voucher system to provide inorganic fertilizer and improved seeds to 50% of resource-poor farmers. The program has evolved over the years, but the main restructuring took place in the 2020-2021 agricultural season, when all registered smallholder farm households were targeted with fertilizer and maize seeds, and the program was renamed the Affordable Input Programme.

Despite twenty years of input subsidies, however, maize productivity in Malawi has remained endemically low,¹ mainly because of poor soil health caused by high rates of degradation from continuous cultivation and poor cropping practices² (Omuto & Vargas, 2018). Crop intensification and the use of inorganic fertilizers, received through the subsidy program, may also have diminished productivity in maize systems as a result of the damaging effect of chemical fertilizers on the soil³ (Willy et al., 2019). Over 40% of soils in Malawi are low in nutrition and strongly acidic⁴ (Omuto & Vargas, 2018). In other words, the government's strategy to mitigate poverty and food insecurity in Malawi must now address the country's soil health issues.

Evidence abounds that complementing inorganic fertilizers with alternative soil-fertility-management interventions such as organic fertilizers, compost manure, conservation-agriculture practices, agricultural lime (for acidic soils), and legume-based interventions, among others, may improve crop productivity by first improving the soil structure and, second, by optimizing crop-

¹ Yields of hybrid maize varieties that are targeted under the subsidy program have marginally improved from roughly one metric ton per hectare to around 1.8 metric tons per hectare, relative to potential yields of approximately seven metric tons per hectare (Benson, 2021). Other scientists put the yield potential at twelve metric tons per hectare.

² Such practices include not planting (or weeding) on time and not producing and adding adequate biomass to the soil to rebuild soil organic carbon, among others (Snapp, et al. 2014).

³ Poor soil health has resulted in low crop response rates of less than ten kg maize per one kg N, which is lower than the average for the Sub-Saharan Africa of about thirty-seven kg per one kg N.

⁴ Acidity in soils impairs agricultural productivity worldwide by 30 to 40% (Berihun, et al. 2017). Soil acidity can be lowered by the application of lime. Liming, either alone or in conjunction with mineral and organic fertilizer, is widely suggested for field crops grown in acidic soils (Ayalew, 2011); liming is not required for non-acidic soils.

response rates to inorganic fertilizers (Jayne & Rashid, 2013; Snapp et al., 2014; Kisinyo et al., 2015). Unfortunately, Malawi's input subsidy program does not directly support the integration of soil-fertility-management interventions; although the policy does encourage farmers to use integrated soil-fertility-management techniques, the subsidies for inorganic fertilizer downplay this. Efforts and actions to promote integrated soil-fertility management have been undertaken through localized projects and programs but never at a national scale.

The current national development plan, Malawi 2063 (MW2063), has laid out ambitious targets for improving agricultural productivity (National Planning Commission, 2020). Investing in maize productivity-enhancing interventions through the restoration of soil health would, therefore, directly contribute to achieving these priority development targets. Indeed, it seems unlikely that Malawi's long-term aspirations in terms of agricultural productivity could be achieved without introducing innovative and holistic interventions that promote sustainable intensification. Furthermore, such interventions may also help address land shortages that currently affect the country's agricultural sector.⁵

Strategically, the Affordable Input Programme is an ideal framework to ensure the integration of soil-fertility-management interventions in agricultural practices at the national level. Decisions regarding such major investments must be based on sound empirical evidence, however, as well as on a thorough comparative assessment of alternative options in terms of design and implementation for the restructuring of the national subsidy program.

II. Need for Evidence to Support Strategic Policy Decisions

The lack of deliberate efforts to integrate alternative soil-fertility-management interventions into country-level agricultural productivity-enhancing initiatives has meant that empirical evidence about the impact size and plausibility of such interventions, which could support decisions for national-level upscaling, is scant. This dearth of evidence can be partly explained by the limited availability of causal studies on the role of complementary inputs or technologies in enhancing

⁵ A 2020 study showed that average landholding sizes declined by 9%, from 0.77 hectare per household to 0.70 hectare, between 2010 and 2016 (Muyanga et al., 2020).

and/or sustaining agricultural productivity. Moreover, the role of land-resource conservation and management practices in enhancing and/or sustaining productivity has not been fully explored at the national level. Indeed, the landscape of a large input subsidy program of the magnitude of the Affordable Input Programme is not only new in Malawi, but also in the Sub-Saharan Africa region. It is also important to note that the evidence used to inform the design of large-scale input subsidy program programs is largely non-experimental. To our knowledge, no experimental studies have been undertaken to directly link agricultural input subsidy programs with productivity outcomes.

2.1 Empirical Evidence Attesting to the Impact of Soil-Fertility-Management Interventions in Maize Productivity

To help fill these knowledge gaps and provide reliable evidence to support debates and decisions related to the current Affordable Input Programme and maize-productivity interventions, we conducted an experimental study using a randomized controlled trial to assess the productivity impact of complementing subsidized inputs with alternative soil-fertility-management interventions. The experiment was conducted in two districts—Mzimba and Nkhosakota, selected because of their acidic soils, where groups of farmers who benefited from inorganic fertilizer subsidies (through the Affordable Input Programme) were also provided with organic fertilizer and agricultural lime (i.e., soil-fertility-management interventions that are expected to improve soil health). Through this experiment, the researchers sought to know whether the inclusion of soil-fertility-management interventions in Malawi’s agricultural randomized controlled trial input subsidy program would increase maize productivity of smallholder farms.

The experiment involved distinct “treatments” for three different groups of Affordable Input Programme beneficiaries:

1. The “control group” consisted of farm households that benefited from Affordable Input Programme subsidies and extension services for good agricultural practices but were NOT provided with soil-fertility-management interventions.
2. The “Affordable Input Programme + organic fertilizer” treatment group. In addition

to standard Affordable Input Programme inputs, this group of farm households was provided with organic fertilizer, as well as extension services on how to supplement organic fertilizers with improved maize seeds and chemical fertilizers.

3. The “Affordable Input Programme + organic fertilizer and agricultural lime” treatment group. In addition to standard Affordable Input Programme inputs, this group was provided with organic fertilizer and agricultural lime as well as extension services on how to apply them.

Results from the experiment demonstrate that adding organic fertilizer and agricultural lime to inorganic fertilizer that is accessed through the input subsidy program contributes to increasing maize productivity, and thus enhances the program’s impact and benefits (Chiwaula et al., 2024).

The evidence generated through the study, reinforced by findings from other studies (Wanjiru, 2018, Ndengu et al., 2022), clearly supports the recommendation for the Malawi government to integrate soil-fertility-management inputs into the Affordable Input Programme. However, the government must consider alternative potential strategies or pathways for the integration of soil-fertility-management interventions into the current national program.

III. Evaluation of Policy Options

3.1 Outline of possible alternative strategies to integrate soil-fertility-management interventions into the Affordable Input Programme

Literature indicates that the input subsidy program in Malawi partially delivers on its objectives (Chirwa & Doward, 2013) and, from a policymaking perspective, the program is considered relevant (it aligns with the country’s development priorities) and equitable (it targets all smallholder farms) and thus politically adequate. Important challenges nonetheless remain

related to efficiency, effectiveness, and cost, and these must be taken into account when considering strategies to restructure the program.

The experts who conducted the experiment described above identified three possible pathways for the integration of soil fertility management inputs as part of a restructuring of the current Affordable Input Program (Affordable Input Programme):

- **Option 1:** Including additional subsidies for organic fertilizer and agricultural lime directly into the Affordable Input Programme.
- **Option 2:** Promoting the adoption of organic fertilizer and agricultural lime among Affordable Input Programme beneficiaries. The government would continue with the current scope of the input subsidy program (i.e. subsidizing inorganic fertilizer and improved seeds only) but use existing agricultural extension services to promote the adoption and use of soil-fertility-management interventions such as organic fertilizer and agricultural lime.
- **Option 3:** Making access to improved seeds and inorganic fertilizer through the Affordable Input Programme conditional on the adoption and use of soil-fertility-management interventions. Farmers would only be eligible for existing Affordable Input Programme subsidies if they adopted the soil-management-improvement technologies recommended for their specific agroecological zones. Specifically, farmers in nearly all agroecological zones would be required to use organic fertilizer, and farmers in zones with highly acidic soil would also be required to use agricultural lime.

3.2 Comparative Evaluation of the Alternative Options

Alternative options for policy interventions are usually assessed using standard criteria that are relevant to government decision-makers; in addition to the relevance of the options in relation to desired outcomes, these criteria include relative efficiency and effectiveness, equitability, relative cost-effectiveness, and feasibility from both a political and an administrative point of view.

The **effectiveness criteria** are defined as the likelihood that the options can achieve the desired outcome—in this case, to increase access to and use of organic fertilizer and agricultural lime among Affordable Input Programme beneficiaries. **Efficiency**, on the other hand, relates to

the “capacity” of the option to achieve the desired outcome but with the least amount of resources (or lowest investments) required. **Equity** implies that inputs are made available to all target beneficiaries, irrespective of their characteristics or attributes. **Political feasibility** refers to the attractiveness of the option to political leaders (i.e., the option is considered “politically feasible” if it increases the popularity of political leaders). The criteria for **administrative feasibility** on the other hand, include logistical challenges that are associated with making the inputs accessible to the Affordable Input Programme beneficiaries; this also largely entails assessing the “affordability” of the option for the government. The options are also assessed in terms of **cost-effectiveness** (whether the alternative provides value for the money spent). Cost-effectiveness identifies the least costly alternatives.

Each of the alternative strategies proposed above were assessed and compared using this set of criteria. The results are presented in Table 1 and then discussed below. The criteria are rated as high, low, or medium.

Table 1: Policy Options for Integrating Soil Fertility Management Interventions into Input Subsidy Programs

Evaluation Criteria	Option 1 Including subsidies for soil-fertility-management interventions in the Affordable Input Programme	Option 2 Promoting use of soil-fertility-management interventions through Affordable Input Programme extension services	Option 3 Making access to Affordable Input Programme subsidies conditional on adopting soil-fertility-management interventions
Effectiveness	Medium	Low	Medium
Efficiency	Low	Medium	High
Cost-effectiveness	Low	Medium	High
Equity	High	Low	Low
Political Feasibility	High	High	Low
Administrative Feasibility	Low	High	High
Recommended	No	Yes	Yes

1. **Option 1-Adding organic fertilizer and agricultural lime to subsidized inputs.** Organic fertilizer and agricultural lime would be accessed through the same market channels as are currently subsidized inputs; the effectiveness of this option is therefore expected to be negatively influenced by the current absence of markets for these inputs, especially agricultural lime, which is not easily accessible in Malawi. This means that formal suppliers may not be able to meet demand as required by large programs on the magnitude of the Affordable Input Programme. The efficiency of this option is also expected to be low, given the amount of resources that will be required for the government to deliver the inputs to the farmers. Indeed, the huge cost of this option makes it the least cost-effective, as the government will bear higher costs to attain the same productivity gains as with the alternative options. Nevertheless, with proper targeting, the policy alternative would attain equity objectives and would also be politically feasible because it would be incorporated into the current (largely accepted) program. The option is not recommended due to its low performance in efficiency, cost-effectiveness, and administrative feasibility.

2. **Option 2-Promoting the adoption/use of soil-fertility-management interventions through the existing Affordable Input Programme extension services.** Farmers would be required to obtain and use the inputs on their own, after encouragement from agricultural extension officers. The effectiveness of this approach is expected to be low, because of the ineffectiveness of current government agricultural extension services, which is mainly due to a critical shortage of extension workers (i.e., or a high farmer-to-extension worker ratio (Mangani, et al., 2022), Furthermore, soil fertility-enhancing technologies have already been promoted through the existing extension system, but the resulting uptake has been very low, and this approach would, therefore, not be expected to significantly change farmers' practices. While it would not require the government to spend significant additional resources to increase the use of soil-fertility-management interventions (and can thus be considered relatively efficient), the option cannot be considered "equitable" because farmers' access to the inputs would depend on their capacity to buy them. From the government's perspective, however, the option would be both politically and administratively feasible, as it builds on already existing government extension services. The only factor that may limit administrative feasibility is the need to recruit more extension officers, implying related operational costs. Despite low expectations in terms of the desired outcomes, the option can still be recommended as it would be relatively easy and inexpensive to implement.

3. **Making access to Affordable Input Programme subsidies conditional on adopting agricultural lime and organic fertilizer.** This option would be an effective way of promoting access to and use of relevant soil-fertility-management interventions because it leverages farmers' desire to take advantage of current Affordable Input Programme subsidies for inorganic fertilizer and improved seeds. Indeed, a review of the literature by Jayne et al. (2018) showed that smallholder farmers preferred input subsidies as an incentive to adopt soil-conservation practices. Yet the option's effectiveness is expected to be altered by undeveloped markets for soil-fertility-management interventions in Malawi. As with the previous option, the cost of acquiring organic fertilizer and agricultural lime would be borne by the farmer, making the option efficient, administratively feasible, and cost-effective from the government's

perspective. It would not, however, be equitable because those farmers who cannot afford the additional inputs would not benefit from the enhanced productivity. Excluding some beneficiaries from the Affordable Input Programme because they have not adopted soil-fertility-management interventions may also be considered politically undesirable; however, the current Affordable Input Programme reforms implemented by the Ministry of Agriculture already target productive farmers, most of whom will be able to afford the additional inputs. Based on the overall assessment of the three alternative strategies, this third option is considered the most desirable and is thus recommended for implementation.

IV. Conclusions and Policy Recommendations

Based on the results of the experimental study described in Section 2 above, our primary recommendation is for the integration of organic fertilizer and agricultural lime into the government's input subsidy program, in order to increase maize productivity in Malawi. As a secondary recommendation, we suggest that the adoption of such inputs by farmers should either become a mandatory condition for farmers to obtain Affordable Input Programme subsidies or alternatively be promoted through the program's existing extension services.

Furthermore, when implementing these recommended policy reforms, the government should take into account the fact that some soil-fertility-management interventions, such as agricultural lime, are area-specific. This requires a continual updating of soil information and soil maps by the government. The study cited above used what were then the most recent soil maps available, which dated back to 2017, to select the districts of Mzimba and Nkhotakota for the experiment (which tested the use of agricultural liming). The maps identified these regions as being highly acidic, but the study's findings (including soil analysis and trial results) showed that the soils were not as acidic as presented in the soil maps. Therefore, to ensure that the soil-fertility interventions promoted through the Affordable Input Programme achieve the best possible results, any strategy implemented should be based and rely upon up-to-date soil maps.

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