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# *Synopsis:* Row planting teff in Ethiopia: Impact on farm-level profitability and labor allocation

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**Improved technologies are increasingly being promoted to farmers in sub-Saharan-African countries to address low agricultural productivity in their staple crops. There is, however, a lack of evidence on how adoption affects farmers' labor use and profitability at the farm level, as well as the importance gender roles play. This paper analyses the labor and profitability impact of the recently introduced row planting technology in teff production in Ethiopia. Based on agronomic evidence in experimental settings, the government of Ethiopia has focused extension efforts on promoting the widespread uptake of row planting to address low teff yields, replacing the traditional broadcasting method of planting teff. Using an innovative Randomized Controlled Trial set-up, we show that the implementation of row planting at the farm level significantly increases total labor use, but not teff yields, relative to broadcast planting, resulting in a substantial drop in labor productivity when adopting row planting. Moreover, the implementation of row planting has important consequences for inter- and intra-household labor allocation, with relatively more use of non-family labor. The adoption of row planting was further found not to be profitable for farmers in the first year of the promotion campaign, seemingly explaining the limited success in up-scaling the adoption of the technology by farmers in the second year of the program.**

## INTRODUCTION

While agriculture remains the main income source of many farm households in sub-Saharan Africa, productivity levels are low. Despite promoting new technologies to farmers in the region, improved technology uptake has been disappointingly low. Thus, development practitioners, researchers, and policymakers are increasingly looking for other approaches to address low agricultural productivity in sub-Saharan Africa, but with limited success.

In this paper, we evaluate the farm level impact of the introduction of row planting in teff production in Ethiopia, specifically its effect on labor and profitability. Teff is a major staple crop for Ethiopian farmers, but national yield levels are low. The traditional broadcast sowing method has been identified as a major constraints to increased teff yields. Therefore, attention has shifted to alternative sowing technologies to optimize growth of teff.

From 2012, the government of Ethiopia started a widespread promotion campaign to stimulate the adoption of row planting by farmers; and substantial yield benefits have been claimed from such (ATA 2013). To date, however, there has been no rigorous empirical evidence obtained on the impact of row planting of teff.

## TEFF PRODUCTION AND ROW PLANTING IN ETHIOPIA

In the main production season (*meher*) of 2012-13, teff was produced by more than 6 million farmers in Ethiopia, with a total production of over 4 million metric tons. This accounted for the largest share of cereals cultivated in the country (CSA 2012).

The agronomic practices of teff production have changed relatively little over time. Teff is usually planted in July or August (shortly after the start of the main rainy season) after the land has been prepared by removing stones, plowing (three to six times), and leveling the field.

Teff seed is very small, and sown almost exclusively through broadcasting, i.e., scattering by hand at a high seeding rate. The traditional sowing method seems one of the main reasons why teff yields are low. Therefore, row planting is considered superior to traditional broadcasting because by reducing the amount of seed used per unit area, it decreases competition between seedlings for water and nutrients, and it makes weeding easier (Figure 1). Research trials have shown that row planting can increase teff yields up to three times and with lower seed costs.

In light of these research results, the government of Ethiopia rolled out a nationwide campaign to promote the use of improved teff sowing technologies. In the promotion campaign, farmers were offered the **TIRR** package – **T**eff, **I**mproved seed (*Quncho*), **R**educed seed rate, and **R**ow planting. Extension agents taught farmers about the agronomic benefits and the recommendations for the use of these new technologies.

In the pre-scale up phase of this promotional campaign, teff yields increased substantially, but the labor constraint associated with row planting was seen as a major disadvantage to its adoption.

## DATA AND METHODOLOGY

To analyze the impact of row planting on teff production, we randomly surveyed farmers that were part of the pre-scale-up phase of the public promotion campaign in 2012. The survey collected experimental data at the farm level using a Randomized Control Trial (RCT) design. This process sought to minimize any bias in the assignment of famers into different sowing technologies. The pre-scale-up phase

**Figure 1: Teff planting methods, photos of results of broadcasting and row planting teff**

Broadcasting

Row planting

was rolled out in 23 Agricultural Growth Program (AGP) *woredas* (district-level administrative unit) in Oromia region.

Four study villages were randomly selected in each *woreda* for this study. Within each village, 60 farmers had been randomly selected to be part of the pre-scale-up phase. From these 60 farmers, 20 farmers were then randomly selected to participate in the experiment in each village, with 10 farmers implementing row planting (*treated*) and the other 10 participating in traditional broadcasting (*control*). Row planting farmers received 150 grams (5 kg per hectare) and traditional broadcasting farmers received 900 grams (30 kg per hectare) of improved teff seed (*Quncho*) for free. Both groups also received identical fertilizer packages (3 kg each of both urea and DAP) at no cost to ensure that the same amount of inputs was used by each farmer. Local extension agents, Development Agents, were responsible for selecting, training, and assisting participating farmers, who were instructed to row plant teff on a small experimental plot of 300 m². The plot was later harvested and the yield was then measured to assess production and profitability.

We assessed daily wage rates for labor over the different activities in teff production, as well as wages for each production activity, averaged over the production season 2011-2012 and averaged over all villages in one woreda. We further investigated the labor inputs for different activities in teff production. For each activity, farmers provided the source of the labor in order to distinguish between the labor supplied from family, hired-in, or *dabo* communal labor arrangements. We note that it was often difficult to separate the actual time that farmers spent on specific activities.

In collecting data on operations on the experimental plot, farmers were also asked to provide information on the intra-household allocation of supplied family labor (male, female and children). We also assessed the inter-household allocation of supplied labor.

During the impact survey in February 2013, we made careful compliance checks – and there were some non-compliance issues. Therefore, we needed to be cautious in interpreting the results obtained. In addition, we paid special attention to ensure the two groups of study farmers – those using row planting and those planting their teff by broadcasting – were balanced in terms of their characteristics that determine teff yield.

## LABOR USE AND PROFITABILITY IN TEFF PRODUCTION

There are clear differences in the requirements for and type of labor used between broadcasting and row planting. We observe that the largest labor input for broadcasting teff is for land preparation, planting, and weeding –combined, they account for half of the labor used in teff production. However, the most labor intensive teff activity is threshing. With row planting, labor increases strongly when sowing the teff seed and applying fertilizer, largely because of the extra effort needed to work within the constructed rows.

The adoption of row planting affects inter- and intra-household labor allocation in teff production, whether family, hired or *dabo* labor sources, as well as the share of allocated tasks between men and women. Males are traditionally responsible almost exclusively for teff production, but the adoption of row planting, and it subsequent extra labor requirements, forces females and children to supply labor to teff sowing and applying fertilizer.

Moreover, all inter-household labor requires more input at all levels – notably the share of external labor in total labor significantly increases for land preparation, sowing, and weeding.

It appears to be much more costly to produce teff through row planting, but we find no statistical difference in terms of farmers' profit between the two planting methods. Furthermore, we note other factors impacting profitability and production outcomes, *positively*, i.e., education level of the household head, high quality soils, and on-time seed germination, and also *negatively* i.e., receiving inputs as part of the promotion campaign too late, rains arriving earlier than normal, and harvesting teff earlier than normal.

## CONCLUSION AND POLICY IMPLICATIONS

We find that the labor requirements associated with row planting of teff are 30 percent greater than when teff is broadcast planted, primarily for teff production activities that take place early in the season. This leads to a higher share of external labor engaged in teff production. We find that row planting does not result in a significant increase in land productivity. However, labor productivity drops substantially. Moreover, the adoption of row planting does not lead to significantly higher profits for the adopting farmers.

As the design of the experiment was rolled out in line with the government-led promotion campaign, our results have important policy implications for the adoption of row planting in Ethiopia. Notably, the increased labor requirements when teff is row planted appears to be a major constraint to the adoption of the technique. Farmers will only adopt a new technology if it is profitable, but we show that during the first year in which the teff row planting technology was promoted to farmers, profitability levels did not improve relative to broadcast planting.

These results illustrate the need for careful on-farm assessment of the constraints to adoption, especially the labor implications, when starting up widespread promotion campaigns to scale up adoption of such technologies. Continued experimentation and learning-by-doing with the row planting technology may improve farmers' implementation and management of the technology and, hence, their profitability outcomes, spurring increased adoption.

This study contributes to a wider policy discussion on how to promote new agricultural technologies, like row planting, in Ethiopia. However, as this study was purposely designed to rigorously measure the productivity and profitability impacts of row planting, our results cannot be interpreted as a program evaluation of the complete TIRR package. Our work has shown that farmers have tended not to adopt the fertilizer and seed packages with the new planting technique because of high costs with lack of credit and delivery problems. Further studies to assess dynamics in the adoption process would prove valuable.

## REFERENCES

See **ESSP Working Paper 92** for the references used in this study.

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