CIMMYT
International Maize and Wheat Improvement Center

SIMLESA
SUSTAINABLE INTENSIFICATION OF MAIZE-LEGUME CROPPING SYSTEMS FOR FOOD SECURITY IN EASTERN AND SOUTHERN AFRICA

Australian Government
Australian Centre for International Agricultural Research

Saving labor and animal draft power: Impacts of crop management innovation packages in Ethiopia

Motivation

In 1990s Sasakawa Global 2000 introduced conservation agriculture practices in maize based systems of South Achefer District, in Amhara Region, North West Ethiopia. The specific technologies introduced were one-pass tillage for maize crop establishment, use of herbicides for weed control, and residue retention for soil fertility management. Though the last practice was not that adopted due to multi-purpose use of maize residue mainly for feed and firewood, the adoption of minimum tillage and herbicide use was considerable in the district. Thus, this study was interested in assessing the level of adoption of minimum tillage and herbicide use by smallholder farmers and evaluate the consequent impacts on maize productivity and level of draft power and labor saved in maize production due to adoption.

Methodolology

Descriptive statistics, partial budgeting, econometrics and impact assessment tools were used to generate results and check robustness of these results.

Maize plot planted with one pass ploughing

Data

Both plot and household level surveys were conducted in 2013 to document the input use and production of maize and other crops during the 2012/13 production season. A total of 290 farmers randomly selected from fourteen kebeles (local administration units, aka Peasant Association) in South Achefer were interviewed. Resource use and production of maize on 590 maize plots these sample households were operating during the specific year were also documented. Plot characteristics including soil type, depth, fertility, slope, etc. were also recorded.

0.44 t/ha.

The average effect of minimum tillage package (MTP) on maize productivity, controlling for variations in plot and household characteristics.

13.2 pair of oxen-days per ha

Decrease in draft power use for land preparation as a result of MTP adoption.

14.4 person-days per ha

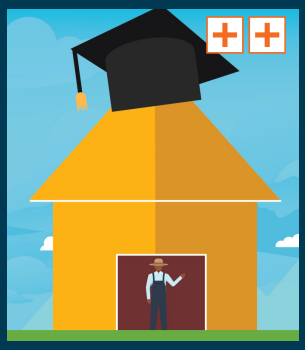
8.2 person-days per ha

Decrease in the average male and female labor use in maize production as a result of MTP adoption compared to conventional practice (CP).

Compared to CP, in general, there is a considerable short-run maize productivity gain and reduction in labor and draft power use under MTP.

Results

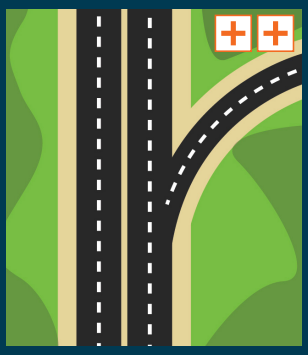
Table 1. Estimation of MTP adoption influencing factors



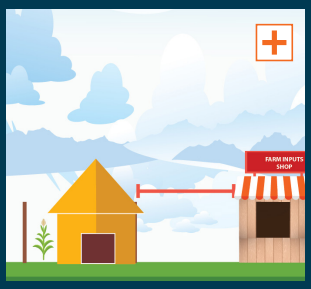
Education of household head

Social network the household involved in

Extension advice/ training on MTP

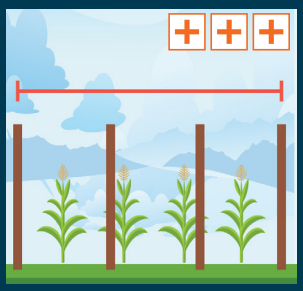


Road network/ condition

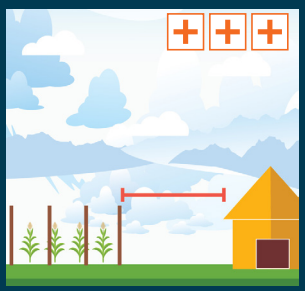


Distance to herbicide/ input dealers

Number of oxen owned



Size of maize plot



Distance of maize plot from home

Note: Frequency shows strength of effect

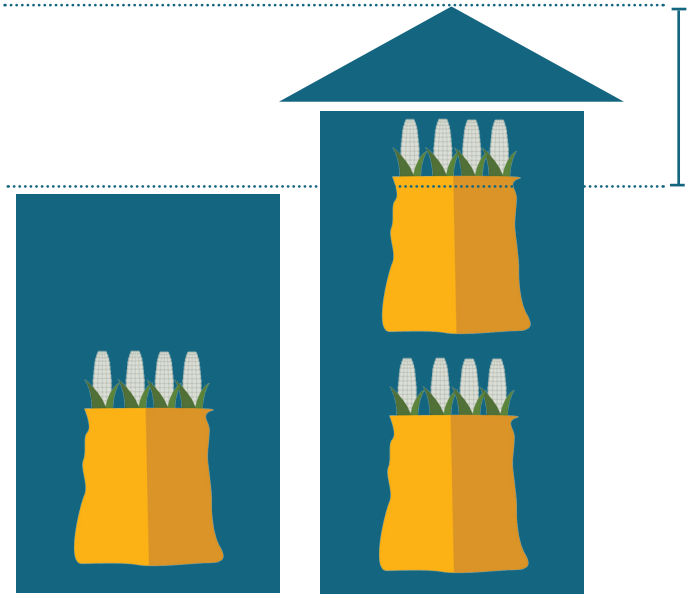
Productivity and resource saving impacts

Controlling the effects of other inputs, farm and plot characteristics, maize productivity is higher by 0.44 t/ha for plots with MTP compared to their counterfactuals (i.e., maize yield would have been decreased by 0.44 t/ha if these MTP plots were under CP). Reduction in total labor, male labor, female labor and oxen draft power use in maize production due to adoption of MTP is presented in Table 1

Table 1. Average treatment effects of MTP

Outcome Variables	Adopt MTP	Not adopt MTP	Adoption Effect
Maize Productivity (t/ha)	3.0	2.6	0.44
Total labor (Person-day/ha)	59.7	82.3	-22.6
Male labor (person-day/ha	37.4	51.9	-14.4
Female labor (person-day/ha	22.3	30.4	-8.2
Draft power (oxen-days/ha)	5.5	18.7	-13.2

All adoption effects are significant at 1% level.



0.44 t/ha

Maize productivity is higher by 0.44 T/ha for plots with MTP compared to their counterfactuals.

Partial budgeting

In situations requiring increased herbicide use for weed management, **the minimum tillage package can be a cash demanding practice but with possible high benefit-cost ratios.**

Table 2. Gross margin analysis in maize production by tillage package

	Total plots (N=590)	MTP plots (N=158)	CP plots (N=432)
Items	Mean	Mean	Mean
Revenue from maize production (Birr/ha)[a]	8,833	10,740***	8,136
Variable costs			
Seed cost (Birr/ha)	488	649**	421
Fertilizer (Birr/ha)	3,811	4,619***	3,516
Herbicide (Birr/ha	234	899***	0
Labor cost (Birr/ha)	1,467	1,145	1,585***
Oxen-days (Birr/ha)	706	278	860***
Total Variable costs (Birr/ha)[b]	6,572	7,370***	6,275
Gross margin (Birr/ha)(a-b)	2,217	3,230***	1,846

Note: Average maize grain price was 4.00Birr/kg; opportunity costs of labor and oxen-power were assumed as 20 Birr/AE/day and 50 Birr/pair of oxen/day, respectively.

***, **, and * are significantly different from the other group mean at 1%, 5% and 10%, respectively.

Conclusions and Implications

In addition to the maize yield increment under MTP, **the benefits due to labor and draft power savings outweigh the additional cost in herbicide use for weed management.** These are reasonable incentives for smallholder farmers who adopt MTP.

Although CA practices like minimum tillage potentially contribute to long-term and sustainable production benefits, farmers' adoption decisions typically hinge on the immediate benefits. Here we assessed the short-run productivity, labor, and draft power saving impacts of MTP in maize production. Controlling for variations both at plot and household level, the average treatment effects of MTP on maize productivity, estimated using an ESR model, is significantly higher for MTP plots than for counterfactual CP plots (similar plots where MTP was not implemented). Our results show that although the incremental revenue from higher yields under MTP is not dramatic, the concomitant cost savings in variable costs associated with oxen ploughing significantly improve the gross margins compared to CP. However, savings on weeding labor are contingent on affordability of weedicides. Therefore, considering the current input and output market prices in the study area, the economic feasibility of adopting MTP including herbicide use for maize production needs further investigation. Development in herbicide supply chains that can deliver these inputs cost effectively is one implication of these results.

MTP helped in decreasing the level of labor use per hectare of maize production. The substantial reduction in male and female labor use for weeding in maize production is mainly due to the use of Primagram to control germination of broad leafed weeds. However, maize-legume intercropping, which is considered one of the means of sustainable production in a diversified maize-based system, is not an option for farmers using Primagram. In such cases, maize-legume rotation could be a viable option, though this is also challenged by small farmland holdings, where farmers allocate a major proportion of their farmland to staple crops such as maize, season after season. The positive impacts of MTP in saving labor and draft power, and, at the same time, enhancing maize productivity of smallholder farmers were suppressed by the additional costs in herbicide use.

The sustainability of maize production and productivity in the system might also depend on the level of farmers' awareness and commitment in adopting the remaining conservation agriculture components such as intercropping/rotation of maize with legumes and crop residue retention for mulching and nutrient recycling. This depends on demonstrable beneficial impacts on the agricultural resource base and the financial returns to farmers.

Authors: Moti Jaleta, Menale Kassie, Kindie Tesfaye, Tilaye Teklewold, Pradyot Jena, Paswel Marenya and Olaf Erenstein.
Contact: Moti Jaleta, CIMMYT-Ethiopia, P.O.Box 5689, Addis Ababa. Email: m.jaleta@cgiar.org.

Maize field under minimum tillage

ETHIOPIA KENYA MALAWI MOZAMBIQUE TANZANIA AUSTRALIA THE UNIVERSITY OF QUEENSLAND AUSTRALIA QAAFI CIAT ASARECA ARC • LNR ILRI