CIMMYT MR
International Maize and Wheat Improvement Center

IIAM
Instituto de Investigação Agrária de Moçambique

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Australian Centre for International Agricultural Research


Photo Credit: T.Samson/CIMMYT

The Benefit Package:

The promise of conservation agriculture in maize-based systems of Malawi and Mozambique

Key messages

- In addition to the long-term ecological benefits, conservation agriculture (CA) is attractive to farmers due to its short-term resource saving effects with little, if any, yield penalty.
- Compared to conventional practices, CA reduces labor demand for land preparation and weeding activities in maize production.
- Labor saving in land preparation under CA is associated with the shifting from soil banking in conventional practices to basin and dibble stick planting under CA in Malawi and Mozambique.
- Use of herbicides before planting maize reduces labor demand for weeding.

Background

Mozambique and Malawi are two of the five countries where the Sustainable Intensification of Maize-Legume Cropping Systems for Food Security in Eastern and Southern Africa (SIMLESA) project has been implemented since 2010. The core component of the project has focused on the introduction and adaptation of conservation agriculture (CA) practices in maize-based systems of the region with the aim of increasing maize productivity without compromising both the short and long-term environmental and economic benefits.

Conventionally, farmers grow sole maize on furrow and ridges with limited rotation and intercropping with legumes, which is not sustainable in terms of soil nutrient recycling and management. Under SIMLESA, based on the agroecology, maize was intercropped with cowpea or pigeon pea and all crops were established with no-tillage (or reduced tillage) practices using either planting basins or dibble stick. In the experiments summarized here, these two CA-based practices were demonstrated next to farmers' conventional practices with the same maize varieties and same fertilizer application rates.


Farmer's field under conservation agriculture in Malawi Photo Credit: T.Samson/CIMMYT

For More information contact
Moti Jaleta International Maize and Wheat Improvement Center (CIMMYT), m.jaleta@cgiar.org, **Isaiah Nyagumbo** (CIMMYT), i.nyagumbo@cgiar.org.

Contributors
Donald Siyeni, Department of Agricultural Research Services Malawi (DARS); **Donwell Kamalongo,** DARS; **Amos Ngwira,** DARS; **Isabel Cachomba,** Instituto de InvestigaçãoAgrária de Moçambique (IIAM); **Amâncio Nhantumbo,** IIAM, Domingos Dias, IIAM; **Angelo Cumbane,** IIAM; **Custodio George,** IIAM; **Sarah T. Chowa,** Ministry of Agriculture and Food Security; **Munyaradzi Mutenje,** CIMMYT; **Paswel Marenya,** CIMMYT.

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Location

• Mozambique • Malawi

Plot size

20mX25m

Time period

4yrs

2010/11-2013/14)

Where did the data come from?

Data used in this analysis were collected from on-farm experimental plots at different locations in Malawi and Mozambique. These trials were conducted for four years (2010/11-2013/14). The study sites were Gorongoza (Mozambique), Balaka, Ntcheu, and Salima (Malawi). The experimental plots had a size of 20mX25m but the yield data were extrapolated to a kg/ha basis using a 10% downward adjustment for yield calculated from small plots.

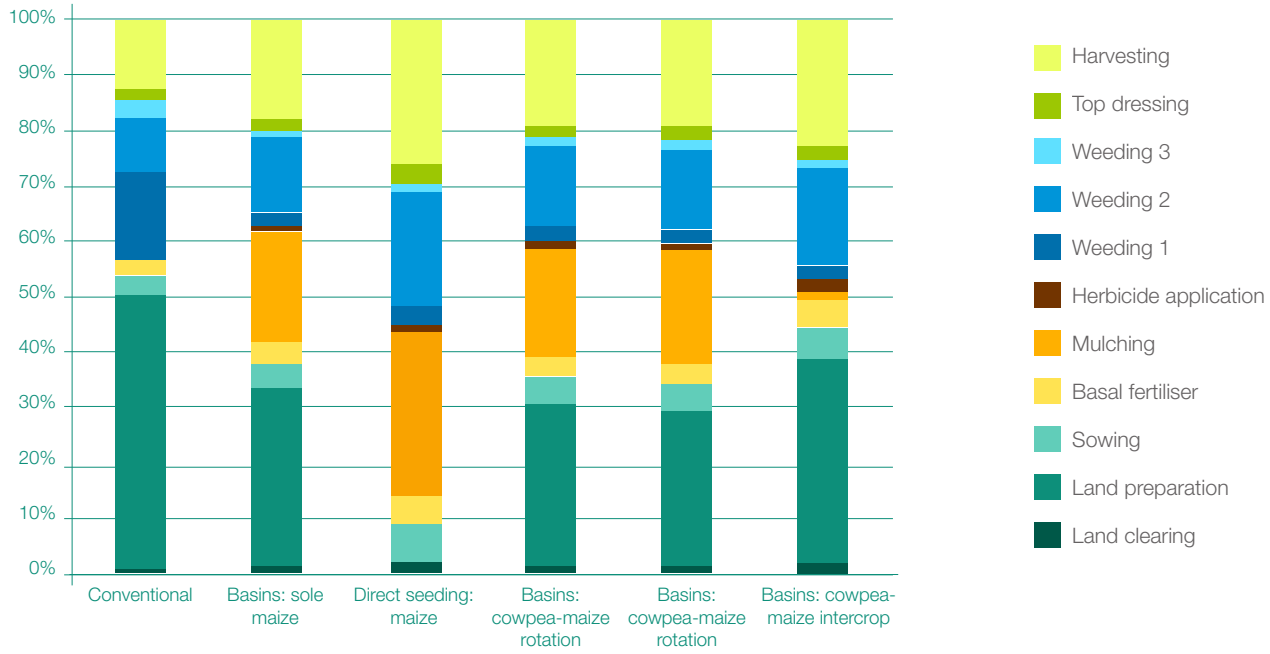
In Mozambique and Malawi, the experiments included CA basins and direct seeding using a matraca or jab planter or a pointed wooden stick known as a dibble stick. Several systems were tested on six farms over a four seasons. The conventional practice involved hoe digging 10-15 cm deep to a flat seedbed prior to planting as land preparation for a clean seed bed ***(Conventional).*** A second system involved planting the crop in basins ***(Basins: sole maize)***. A third treatment involved direct seeding using a hand-held jab planter or a dibble stick to sow seed on sole maize plots ***(Direct seeding: sole maize)***. The fourth system involved planting sole maize or cowpea/pigeonpea in basins on different plots but rotating the two crops in subsequent seasons ***(Basins: maize-cowpea/pigeonpea rotation*** and ***Basins: cowpea/pigeonpea-maize rotation).*** Therefore, in Fig.1 below note that only one rotation sequence is reported in any one season. The sixth system involved planting maize and cowpea/pigeonpea as intercrops in basins ***(Basins: maize-cowpea intercrop).*** In the intercrop system cowpea/pigeonpea was planted in the middle of maize rows spaced at 90 cm. Fertilizer application was standardized across all treatments and plots over four seasons with the six participating farms acting as replicates. In Malawi, a few variations in the set up included 75 cm inter-row spacing for maize. The conventional farmer practice involved the ridge and furrow system in which ridges are prepared annually and alternate positions between seasons as the ridge of the previous year is dug up to make up a new ridge on the furrow position into which crops were planted, a fairly aggressive tillage practice.

What does the evidence say in Mozambique?

At the Gorongoza site, Mozambique, the experiments included basin planting and direct seeding of maize, maize-legume rotations and intercrops involving cowpea. Looking into the four years of experimental results from Gorongoza, direct seeding resulted in maize yield increases of up to 19% while CA basins gave increases of up to 20% relative to the conventional flat seeding. In maize-cowpea rotations involving CA, yield increases of up to 40% were obtained compared to conventional practices. In terms of labor demand in maize production, the conventional practice demands (on average) 60.6 person days per ha of maize production. This was higher than any of the CA-based practices. The least labor demand was recorded on plots allocated to direct seeding of maize (28.9 person-days/ha). Most of the labor demand in maize production was associated with land preparation, mulching, weeding and harvesting. Any practice that reduces both land preparation costs and level of weed infestation could help in reducing labor demand in maize production substantially. Accordingly, under zero-tillage, the use of herbicide (glyphosate applied at 2.5 l/ha) as weed management is important to reduce labor demand including under dibble and basin planting in maize production.

Figure 1: Maize productivity under different practices (kg/ha), Gorongoza, Mozambique

Figure 2: Labor shares by practice, Gorongoza, Mozambique



What does the evidence say in Malawi?

The results from the sites in Malawi also showed that compared to the conventional maize production, dibble stick and basin planting of maize reduced labor demand in maize production. These two practices reduced labor demand from 63 to 22 person-days per ha, which was about 41 person-days per ha, two-thirds of the demand under conventional practices. In Salima and Ntcheu, in all the four cropping seasons, maize intercropped with pigeonpea and planted using a dibble stick performed well compared to the basins system apparently due to water-logging in the latter system. In Balaka, though there were seasonal variations, overall, maize planted using basins performed better than or at least equal to the conventional furrows and ridges (banking) method, suggesting that basins worked well in this area given the low rainfall (600mm annually). There were clear differences in productivity and financial outcomes between the conservation and conventional tillage practices. Both the dibble stick and basin planting of maize intercropped with pigeonpea performed better than conventional tillage plots.

Comparing the two practices (dibble stick and basin planting), there is not much difference both in terms of productivity and the overall financial benefits from these practices across the three sites in Malawi. However, during 2011/12 cropping season the financial returns from dibble stick practice was more than that from basin planting.

HIGHLIGHTS FROM MOZAMBIQUE

Maize productivity has been relatively higher for those plots planted in basins

60.6
person days per ha

Average labor demand under conventional practice

28.9
person-days per ha

Least labor demand under a direct seeding practice

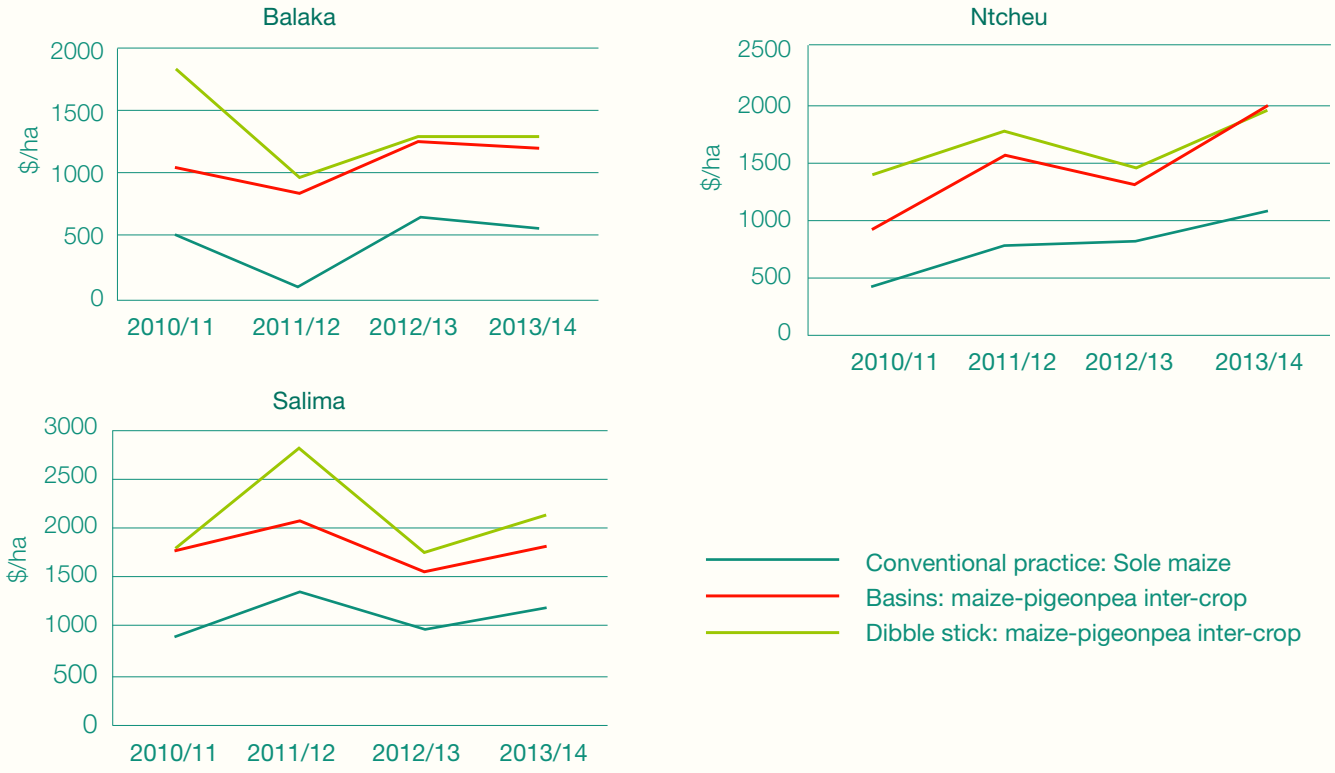
HIGHLIGHTS FROM MALAWI

Reduction in Labor demand from CA practices in Malawi

63 person-days per ha to **22** person-days per ha

Reducing *both* tillage costs and level of weed infestation is critical in reducing labor demand in CA-based maize production systems. The use of herbicides for weed management can be important to secure the promise of labor reduction.

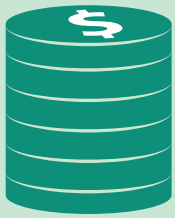
Figure 3: gross margin analysis of ca practices in Malawi



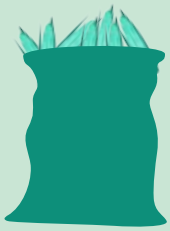
Take home message

There are clear benefits of CA practices in terms of labor saving, increased maize yield and better economic returns on investment. However, these benefits are context specific as they vary between the experimental sites. Moreover, CA practices (zero/minimum tillage, legume intercropping and residue retention) in dry environments could reduce the potential yield loss due to moisture stress. A case in point is the situation in 2011/12 cropping season in Balaka, Malawi (reported in Fig. 3) where maize productivity declined seriously due to moisture stress whereas maize plots under zero tillage performed much better than the conventional plots both in yield and economic returns.

Labor saving



Better economic returns



- Increased maize yield
- Potentially reduce the risk of drought related yield loss

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ETHIOPIA KENYA MALAWI MOZAMBIQUE TANZANIA AUSTRALIA

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