MAIZE YIELDS UNDER CONSERVATION AGRICULTURE
CHIA LAGOON WATERSHED MANAGEMENT PROJECT

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September 2007

Introduction and Basic Concepts

The common method of land preparation among smallholders in Malawi involves clearing and burning of weeds and debris with annual construction of ridges 90cm apart, a practice that requires an enormous amount of hard manual labor. There is increasing evidence that this practice contributes to runoff, erosion and general soil degradation, particularly under conditions of low input, continuous cultivation. Tilling the soil accelerates oxidation of organic carbon which reduces its binding capacity, increasing vulnerability to raindrop action and erosion. Tillage also disrupts aeration and the beneficial actions of soil micro-flora and fauna.

Although incorporation of crop residues is promoted and practiced by farmers in some parts of Malawi, results suggest that residues are better left on the soil surface where they intercept raindrops and protect the soil from the elements. Results from research and extension around the world and in Southern Africa support the hypothesis that conservation agriculture can increase and stabilize crop yields, while dramatically reducing soil erosion and moisture loss. It has also been shown to be cheaper and less labor intensive than conventional annual land preparation. Achieving these benefits requires the adoption of certain management disciplines that demand a break in cultural norms.

Design

The collective experience from researchers and practitioners from within Total LandCare and Washington State University, as well as from national research institutes, universities, international centers and others resulted in the design of farmer managed demonstration plots to be established with farmers across a wide range of ecologies. The Chia Project was instrumental in supplying the human, financial and physical resources to implement the program in the field with farm communities and households very familiar with TLC. This provided the crucial starting point for launching conservation agriculture. Technical support is being provided from collaborative research trials with national and regional researchers.

Under this program, the Chia Project is collaborating with the International Maize and Wheat Improvement Center (CIMMYT) in Zimbabwe and Chitedze Research Station to demonstrate best practices for conservation agriculture (CA). This includes: farm planning and crop rotations; management of crop residues and cover crops; zero tillage and direct planting; pest, weed and soil fertility management. Key components include the use of herbicides to assist in weed control, a major limitation in smallholder farming, and the integration of Pigeon peas and *Tephrosia* as soil-improving nitrogen-fixing legumes that offer other useful products. Pigeon peas are a nutritious grain legume, while *Tephrosia* provides a useful, eco-friendly pesticide (stalk borer, aphids, weevils, fleas and ticks) as well as abundant fuelwood. Both species are deep-rooted shrubs that help to break up shallow hoe pans that have been formed on loamy and sandy clays from continuous cultivation over many years.

During the 2006/07 season, conservation agriculture was expanded from 10 farmers in 2005/06 to 68 new farmers within the Chia catchment. The aim was to promote greater awareness about the technology to improve the conservation and management of soils and water. The practice offers the opportunity for rural households to improve yields, particularly in dry years, to reduce labor, time and costs, and to increase incomes. Results from the last two seasons are generating great interest among farmers, indicating high potential for fast and wide scale adoption.

Treatments

Each of the 68 participating farmers received inputs for 0.3 ha for CA practices split between 0.1 ha under sole maize, 0.1 ha of maize intercropped with *Tephrosia candida*, and 0.1 ha under maize intercropped with pigeon peas. All treatments used hybrid maize and modest rates of fertilizer (90 kg N/ha; 26 kg P/ha and 5 kg S/ha). In addition, each farmer had 0.1 ha under the standard practice of conventional hand-hoe tillage and weeding with the same fertilizer rates.

In summary, all treatments received the same fertilizers, crop variety and seed rates. The main practices for the plots included:

1. **Control:** Standard farmer practice with land clearing, removal of crop residues, planting on ridges built manually 75cm apart and hand weeding.
2. **CA Maize Pure Stand:** Crop residues spread and retained on the surface; planting on done the flat or on old ridges by direct sowing without tillage. Glyphosate + Bullet were applied at planting time pre-emergence.
3. **CA Maize + Pigeon Pea Intercrop:** Crop residues spread & retained on the surface; planting was done on the flat or on old ridges by direct sowing of maize and the intercrop without tillage. Glyphosate was applied at planting. No bullet was applied.
4. **CA Maize + Tephrosia Intercrop:** Same as in 3 above

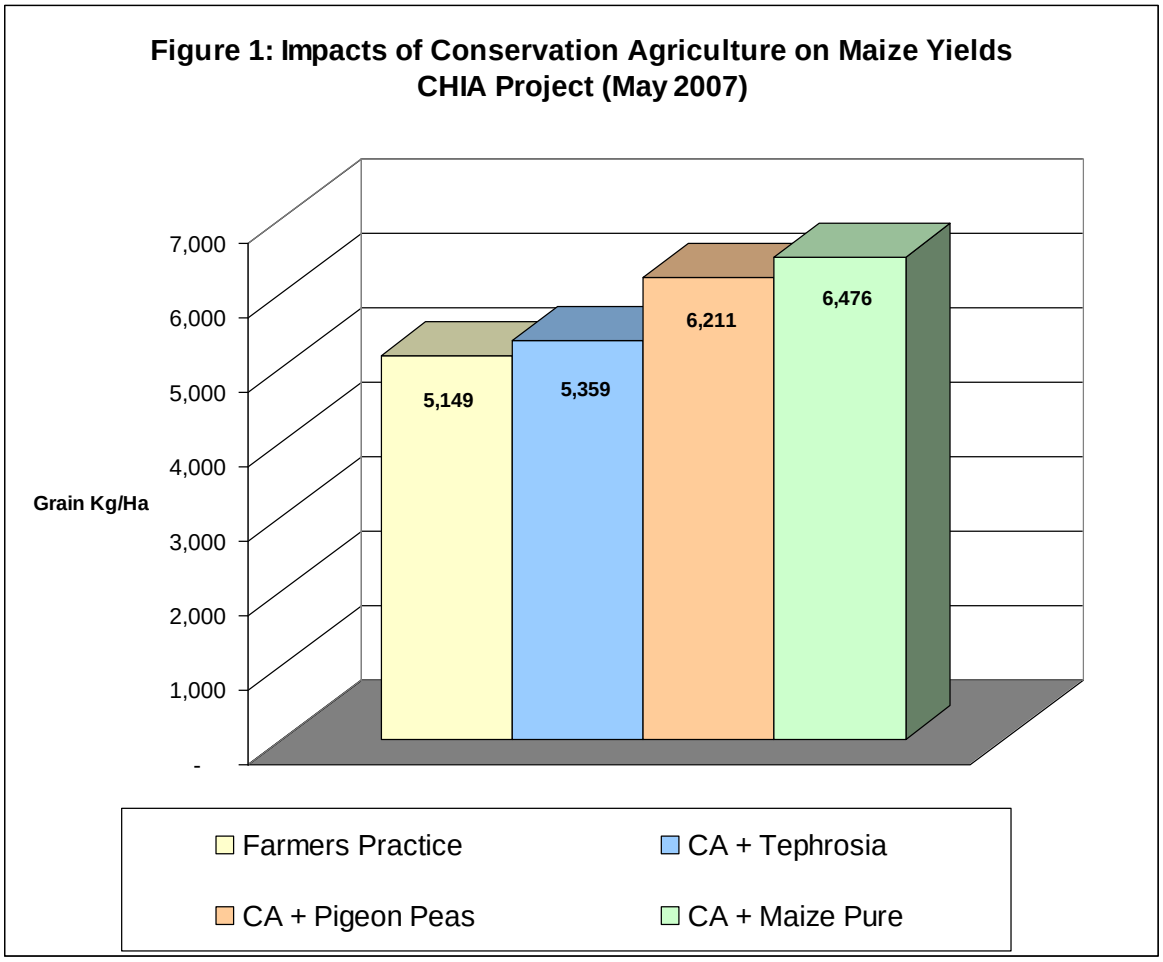
Results

Impacts of CA on maize yields from only the 2006/07 season are illustrated in **Figure 1** relative to the standard farmer practice. The effects exclude the value of the products from Tephrosia and Pigeon peas (grain harvest not expected till September). The yields of CA plots under pure stands of maize were 26% higher than under the standard sole maize practice. Total maize production from all 68 farmers on the 0.3 ha under CA was 123,000 kg plus another 35,000 kg under standard farmer practices. 50% of this produce was sold to finance inputs for the next season, with the balance contributing to food security. Over time, the differences are expected to be substantially greater from the cumulative effects on soils, capture of rainfall, and retention of soil nutrients and moisture.

In the 2007/08 season, interest in conservation agriculture rose sharply with spontaneous adoption within and outside the project boundaries. In facts, demands exceeded the ability of the project to provide loans to all interested farmers in the form of the inputs required. Farmers using CA in the 2007/08 season within the Chia watershed number 226. Over 200 outside the project have implemented CA based on observed benefits among Chia farmers. Although benefits for this season have not been fully quantified, results indicate satisfaction among farmers from significant savings in labor costs and loss of top soil combined with expectations of good harvests.

Remarks by Farmers

Previously farmers failed to harvest enough grain from 1.6 ha to take them through to the next harvest. Production from only 0.3 ha under CA exceeded this need with much less labor, not to mention future improvements in soil fertility. Farmers exposed to this practice expressed great interest to adopt it across their entire farms.



INPUTS (provided to farmers under signed loan agreements with a 40% down-payment)	US$	Per Ha Cost	
	Unit Cost	Qty	US$
Hybrid Maize Seed (kg)	**2.50**	**20**	**50**
Pigeon Peas (kg)	**1.80**	**1.2**	**2**
Herbicides			
Roundup (liters)	**12.50**	**1.67**	**21**
Bullet (liters)	**12.50**	**0.83**	**10**
Fertilizers *			
23:21:0:4 (50 kg)	**7.14**	**2.47**	**18**
UREA (50 kg)	**7.14**	**2.67**	**19**
Total Cost			**120**

*** Malawi subsidy program for smallholders**

Above: *Distribution of crop residues over the soil surface*

<u>Below:</u> *Maize at 3 weeks on same field*

bove: *Tephrosia candida after maize harvest at 6 months. Notice rich biomass and heavy litter on ground which suppresses weeds.* **Below:** *Chia Staff with Same Tephrosia fallow at 15 months*

CA after Maize Harvest: Crop residue management to reduce loss of top soil, conserve soil moisture, and suppress weeds with Tephrosia below for soil fertility