

POLICY SYNTHESIS

FOOD SECURITY RESEARCH PROJECT-ZAMBIA

*Ministry of Agriculture & Cooperatives, Agricultural Consultative Forum, Michigan State University and Golden Valley
Agricultural Research Trust (GART) – Lusaka Zambia*

Number 18

(Downloadable at <http://www.wacc.msu.edu/agecon/fs2/zambia/index.htm>)

December 2006

ASSESSMENT OF THE FARM LEVEL AGRONOMIC AND FINANCIAL BENEFITS OF THE MAGOYE RIPPER IN MAIZE AND COTTON PRODUCTION IN SOUTHERN AND EASTERN PROVINCES

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Main Highlights

This research focuses on the performance in the Magoye ripper in maize and cotton production in Eastern and Southern Provinces during the 2004/2005 production year. Findings include the following:

- In maize production, the ripper enabled higher yields compared to traditional animal ploughing, by increasing the effectiveness of nitrogen fertilizer applications, resulting in net profits per hectare of ZK575,800 in Eastern Province and ZK93,800 in Southern Province;
- In cotton, the input applications and size of fields were the most important determinants of yield, and the ripper had no significant individual effect.
- Farmers using the ripper indicated that it helped conserve water, enabled early land preparation and early planting; and
- Farmers not using their rippers indicated lack of animals to pull it, lack of repair and spare parts, and a tine that wears down and needs frequent sharpening.

INTRODUCTION: With the risk of drought in agricultural production areas of Zambia, especially in the southern region, conservation farming (CF) was introduced as one way of reducing the plant stress due to moisture constraints. Conservation farming as applied in Zambia, involves a recommended package of several key practices: dry-season land preparation using minimum tillage systems; crop residue retention; seeding and input application along furrows; and nitrogen-fixing crop rotations (Haggblade et al 2003). This study focuses on minimum tillage using the ox drawn Magoye ripper where no ploughing is done. Since its introduction in 1995, more than 2000 Magoye rippers have been distributed in Zambia. We seek to evaluate the performance of the Magoye ripper in maize and cotton cultivation in comparison to animal-drawn ploughing as practiced by farmers in selected areas of Zambia.

DATA & METHODS: This synthesis summarizes the results from a longer report¹ and uses data from the farm level survey that was conducted during the 2004/2005 production year by Food Security Research Project (FSRP) and Golden Valley Research Trust (GART). The survey involved a stratified sample of 178 households who own the Magoye rippers from Eastern and Southern

Provinces, but not all of them used the rippers for 2004/2005. We define a “ripper farmer” as one who used the ripper for land preparation without any additional ploughing for the 2004/05 season. “Non-ripper farmers” own a ripper, and may have used it in the past, but did not use the ripper for the 2004/2005 season on their cotton or maize.

The research is based on observation of farmers, rather than controlled on-farm trials, such that farmers were found to use a range of practices on their fields, varying size of fields, number of weeding, level of inputs, planting dates, etc. These variations had an effect on the overall yield and regression analysis was used to determine the factors that significantly affected the yield. The descriptive statistics were used to understand the benefits and problems the farmers were encountering during the use of the ripper. Finally crop budgets were then used for determining the profitability of the technology.

OBJECTIVES: This policy synthesis highlights the key findings and conclusions of the main report regarding the impact the Magoye ripper had on maize and cotton yields in 2004/2005, as well as other benefits and

problems that can constrain technology adoption on a wider scale.

MAIN FINDINGS: Of the 178 farmers in this study, 44% were ripper farmers while 56% were non-ripper farmers. About 28% of the farmers used the Magoye ripper continuously from 2002/2003 through 2004/2005. Southern Province farmers were more likely to have been using the ripper continuously during the period. We attribute this to their proximity to the GART office and Magoye Research Station with its extension services and contacts, although there may be other factors as well.

Farmers who had used the Magoye ripper in at least one of the previous 3 seasons identified the following as major benefits with the ripper:

- Ripped lines collected and conserved water and this enabled the crops in ripped fields to germinate and grow even when there was a dry spell.
- Magoye ripper enabled the farmers to do early land preparation.
- Magoye ripper also enabled them to do early planting.
- Farmers noted a higher yield in ripped field than in ploughed fields.

These farmers noted the following challenges after using the Magoye ripper at least once:

- Ripped fields tended to have more weeds than ploughed fields.
- The Magoye ripper tine used for opening up the furrows wears down too easily and frequently needs re-sharpening.
- There were no locally available spare parts for the ripper (tine, wings), especially in Eastern Province.
- Farmers lack sufficient or appropriate draught animals.
- Farmers indicated that they lacked adequate training on use of the ripper.

In the face of the weed problems, farmers used strategies such as timely planting, early weeding and use of a cultivator to weed. When non-ripper farmers were asked why they did not use the Magoye ripper in 2004/2005, they did not cite weeds, but rather lack of sufficient draught animals, wearing down of the tine, lack of spare parts as the reasons for not using the technology.

YIELD ESTIMATION: As indicated above, with the on farm research, multivariate analysis with regression is appropriate for determining the factors which increased or decreased yields for different farmers and fields. Factors included in the regression

were fertilizer use, type of seeds, soil type, days late in planting, and a few other factors.

Results from the regression analysis show that the Magoye ripper did not have a significant individual direct effect on maize yields; however, farmers who used the ripper combined with nitrogen applications saw significantly higher maize yields than just using the Magoye ripper alone. On the other hand, increased field size and planting after November 20th with low rainfall negatively affected the maize yield.

According to the GART Ripper Operators manual (2004), this would be expected as ripping enables the first rains to assist in efficient localized placement of fertilizer. The Magoye ripper is not a panacea but is designed to operate within a farming system to optimize production in synergy with other practices such as localized fertilizer application.

With cotton production, ripping did not have a significant direct or indirect effect on the cotton yield. Instead, the most important factors that had an effect in cotton yields were the plot size and number of chemical packets applied. The chemical packets are distributed for use on ½ and 1 hectare and comprise pesticides with limited micronutrients. Number of days late for planting were identified but not found to be significant in this analysis, possibly due to the erratic rainfall and difficulty of establishing a regional “optimal” date, as well as possibly less sensitivity of cotton to a specific planting date.

PROFITABILITY: The profitability analysis was done in each province by crop and by tillage system used. In this analysis we used Net Profit as a measure of profitability. Net Profit is calculated by subtracting Total Cost from Gross Income. Gross Income per ha is a function of the estimated yield per ha and an average price of maize or cotton. Yield estimation of maize and cotton was done taking into consideration factors from the regression analysis that had a significant effect on the yield. Total cost per ha is a function of labour cost per ha, input cost per ha and other costs per ha.

As shown in Table 1 for maize cropping, ripped fields had higher net profit than ploughed fields by ZK575,800 and ZK93,800 per hectare for Eastern and Southern provinces, respectively. This could be attributed to the higher mean yield obtained from ripped fields than ploughed fields noted earlier, including the higher rainfall and timeliness factors.

Total cost for maize under ripping was higher than under ploughing in Eastern Province because of the higher labour costs. Of the total cost under ripping, 48% can be associated with labour cost while 37% can be attributed to the cost of inputs. Total cost under ploughing shows that about 45% came from

Table 1. Profitability Analysis of the Magoye Ripper for Maize Production in 2004/05 Season

| | Eastern Province | | Southern Province | |
|-----------------------------|------------------|------------------|-------------------|----------------|
| | Maize Ripping | Maize Plowing | Maize Ripping | Maize Plowing |
| | Value per ha | | | |
| Output (kg/ha) | 2,350 | 1,479 | 1,224 | 1,122 |
| Output price (ZMK/kg) | 788 | 788 | 782 | 782 |
| Gross Income per ha | 1,851,800 | 1,165,452 | 957,168 | 877,404 |
| Total labour cost per ha | 417,412 | 336,671 | 264,677 | 245,889 |
| Cost of inputs | 317,895 | 261,906 | 293,714 | 284,960 |
| Cost of implements | 24,000 | 51,700 | 24,000 | 51,700 |
| Other costs | 105,000 | 100,000 | 105,000 | 100,000 |
| Total Cost per ha | 864,307 | 754,777 | 688,173 | 702,236 |
| Net Profit (GI - TC) | 986,500 | 410,700 | 269,000 | 175,200 |

Table 2. Profitability of the Magoye Ripper for Cotton Production in 2004/05 Season

| | Eastern Province | | Southern Province | |
|-----------------------------|------------------|------------------|-------------------|----------------|
| | Cotton Ripping | Cotton Plowing | Cotton Ripping | Cotton Plowing |
| | Values per ha | | | |
| Output (kg/ha) | 1,015 | 880 | 780 | 697 |
| Output Price (Kwacha/kg) | 1200 | 1200 | 1200 | 1200 |
| Gross Income per ha | 1,218,000 | 1,056,000 | 936,000 | 836,400 |
| Total Labour cost per ha | 499,437 | 372,604 | 306,786 | 291,617 |
| Total input cost per ha | 116,598 | 102,015 | 111,647 | 104,681 |
| Total of implements per ha | 24,000 | 51,700 | 24,000 | 51,700 |
| Other costs per ha | 105,000 | 100,000 | 105,000 | 100,000 |
| Total costs per ha | 745,000 | 626,300 | 547,400 | 547,600 |
| Net Profit (GI - TC) | 473,000 | 429,700 | 349,600 | 293,800 |

labour cost and 35% came from cost of the inputs. Even though total maize production cost per hectare was higher in Eastern Province, maize was still profitable there compared to Southern Province. The major driver for higher total cost in Eastern Province was the cost of labour for harvesting and the cost of fertilizer. The cost of labour for harvesting was twice as high as the cost of harvesting under ploughed fields. On the other hand the cost difference of ripped fields and ploughed fields was minimal for Southern Province.

The profitability analysis of cotton in Eastern and Southern Provinces shows higher net profits for ripped fields than for ploughed fields by ZK43,300 and ZK55,800 per hectare respectively. Higher yield is a key source of the higher profits, and those higher yields were due to smaller plot sizes and the relatively more concentrated use of the chemical packets the farmer used per hectare.

Cotton ripped fields of Eastern and Southern Provinces had a higher total cost than ploughed fields. From the analysis of Eastern Province, it shows that 67% of the total cost under ripping could be attributed to the labour cost while 16% could be attributed to the cost of inputs. While for traditional ploughing, 60% of the total cost for cotton could be attributed to labour costs and 16% could be attributed to the cost of inputs.

POLICY IMPLICATIONS: Given the synergies between ripping and fertilizer effectiveness, farmers with access to animal draught power would benefit from including the ripper in input programs, along with seeds and fertilizers, especially in the lower rainfall areas. This may improve maize production hence reduce food insecurity.

Animal draught power is one of the keys to labor productivity and disease problems are threatening

herds. Therefore, current efforts by the Zambian Government, the Conservation Farming Unit (CFU) of the Zambia National Farmers Union (ZNFU) and the European Union (EU) to address the diminishing supply of draught animals through restocking programs in Southern Province where disease incidence has been high should be encouraged, and possibly widened to include Eastern Province.

Training on the use and maintenance of the Magoye ripper will help to ensure its effectiveness. Earlier work in association with farmers groups and with private sector agents that are working with farmers has been helpful in diffusing the technology. Companies such as Dunavant, Cargill Cotton Company (formerly Clark Cotton), Mulungushi Cotton Company and Continental Ginnery have been involved and can continue to be a channel for facilitation of technology transfer.

Given the difficulties with maintenance and spare parts, private sector agents, including small-scale local artisans should be more strongly linked to the diffusion efforts. Researchers and private sector manufacturers should continue to evaluate the ripper tine to ensure high performance and reduced wearing down of the tine. It is also very important to continue evaluating the weeding problem and options for addressing it. This may enable farmers to continue using the technology.

The cost of steel in Zambia is high and hinders the participation of small-scale rural artisans. The import duty on steel for agricultural implements may be another issue which should be considered by policy makers if support for the ripper development is to be provided.

Looking to the future, this research focused on only a single year and was unable to thoroughly control for cropping practices in previous seasons, as well as variable impact of climate. Additional work would

follow the farmers and individual plots through time to see the effects on soil quality, weeding and other labor demands, and yields, under varying conditions.

CONCLUSION: The analysis presented indicates that choosing to use the ripper in maize production did have a significant effect on the maize yields in this study, through improvements in the effectiveness of nitrogen applications, as urea or top dressing fertilizers. With cotton production, we did not find a significant effect of tillage system on the cotton yield, and found that the most important factors were the plot size and the chemical packets applied, with Eastern Province having somewhat higher yields, controlling for other factors.

Overall, ripper farmers tended to use a combination of management practices in their ripped fields that ensured higher production and higher profitability than in ploughed fields for both crops cotton and maize. Research is needed to understand whether the training involved with rippers enables farmers to gain knowledge on a range of practices related to CF contributing to such productivity, a reason to support CF extension efforts.

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The authors wish to acknowledge Mr. James Phiri of Cargill Cotton Company (formerly Clark Cotton) and their distributors, farmers and Mr. Isaac Jere and Mr. Albert Chikubi for their time and efforts. This research was a collaborative effort between the Food Security Research Project financed by USAID and the Golden Valley Agricultural Research Trust.

The Food Security Research Project is a collaboration between the Agricultural Consultative Forum, the Ministry of Agriculture and Cooperatives, and Michigan State University, and is funded by the United States Agency for International Development in Lusaka.

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ⁱ Stephen Kabwe, Cynthia Donovan and David Samazaka. 2006. Assessment of the Farm Level Financial Profitability of the Magoye Ripper in Maize and Cotton Production in Southern and Eastern Provinces, Working Paper 21, Food Security Research Project, Lusaka, jointly published with the Golden Valley Agricultural Research Trust.