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Science in Agricultural Relief and Development Programs: The Case of Conservation Farming In Zimbabwe

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Abstract

Drought is endemic to southern Africa. In Zimbabwe farmers have been experiencing drought once every two to three years. Relief agencies have traditionally responded to drought by providing farmers with enough seed and fertilizer to enable them to re-establish their cropping enterprises. But, in the absence of these interventions there are limited sustainable options for farmers to maintain higher productivity levels. ICRISAT has been working with government, NGOs and the donor community to test more sustainable farming strategies that will increase food production levels even under drought conditions. For years, ICRISAT sought to develop more drought-tolerant varieties of sorghum, pearl millet and groundnut. But these offered only limited gains in productivity. More recently, ICRISAT and its partners have been testing strategies to sustainably improve crop productivity. These encompass two major components – conservation farming techniques that include the use of planting basins, which concentrate limited water and nutrient resources to the plant, and the precision application of small doses of nitrogen-based fertilizer. These simple technologies have increased average yields by 15−75 percent, being obtained by more than 300,000 farm households. Rather than simply handing free inputs to farmers, this strategy teaches farmers how to apply the inputs most efficiently. The pursuit of input-use efficiency provides higher and more sustainable productivity gains necessary to achieve food security in drought-prone farming systems. A farm enterprise budget analysis has been employed to show that it is more viable to adopt conservation farming techniques particularly under drought conditions.

Keywords: Drought, Farmers, Relief, Zimbabwe

Introduction

Relief and recovery programs are a big part of the development landscape in Africa – and Zimbabwe is no exception. In the past 25 years, large-scale relief programs have been implemented in the country in at least 12 years following a drought (Rohrbach, Charters and Nyagweta, 2004). The government and donors have been providing not only food aid but also farm inputs to help smallholder agriculture recover. However, despite the frequency and huge size of agricultural input relief programs, there has been a struggle to choose between two kinds of investments options: short-term relief interventions versus development investments that will give bigger pay-offs in the long term. In search of this more sustainable long-term commitment to smallholder agricultural development, a broad-based partnership in Zimbabwe has brought together a wide range of institutions that have a presence in research and relief interventions. The aim has been to research and test sustainable farming strategies that will increase food production levels even under drought conditions. Since 2004, ICRISAT, working within this partnership, has been providing technical assistance to more than 10 Non-Governmental Organizations (NGOs) to promote conservation farming to more than 300,000 farmers across 13 districts in the semi-arid areas of Zimbabwe (Mazvimavi and Twomlow, 2007). The attraction of conservation farming in a relief context is that the most vulnerable households that have limited or no access to draft power can implement it. With conservation farming farmers have managed to obtain yield gains ranging from 15 to 75 percent (Twomlow and Hove, 2007). This paper presents results from ICRISAT's experience in providing technical support to relief programs through improved crop and natural resource management with the work on conservation farming. The analysis is based on results from a 2007 adoption and impact study carried out in 12 districts.

Methodology

Twelve districts were selected in areas where NGOs have been promoting conservation farming for the past 3 years. Twenty-one focus group discussions were carried out and a total of 229 households were interviewed through a formal questionnaire. Seven of the locations were from districts that have been closely monitored by ICRISAT. The study used an enterprise budget analysis to assess the viability of adopting conservation farming against conventional farmer practice based on the use of draft animal power tillage services.

Results and discussions

Conservation farming characteristics

The conservation farming protocol being promoted by ICRISAT includes preparation of planting basins during the dry season; mulching with the previous season's stover, weed control throughout the year, use of basal fertilizer amendments – either manure or compound fertilizers, followed by micro-dosing top dressing fertilizer. Planting basins concentrate soil fertility amendments below the crop and concentrate early rains that facilitate early planting. Conservation farming is promoted as a package of all the above components, with the poorest households provided initially with seed and fertilizers as an incentive to adopt all components of the practice. There were many variations in how the package was being practiced from district to district and promoted by the various NGOs. But farmers tend to disassemble technology packages, and adopt the most relevant parts initially, followed by additional components over time. This is particularly the case with conservation farming targeting the poorest households with varying resource endowments. Apart from digging the planting basins, techniques followed by at least 70 percent of the interviewed farmers include manure application, topdressing and timely post-planting weeding (Table 1). The least implemented techniques are: crop residue application, basal fertilizer application and crop rotation. Winter weeding has not been practiced much, particularly in the first year of adoption, partly because some farmers joined the program late in the season. Less than 30 percent of farmers practiced crop rotation due to limited access to legume seed. There has been a significant drop in the number of farmers applying basal fertilizer and timely weeding, from 67 percent and 94 percent in 2004/05 cropping season to 44 percent and 76 percent in 2006/07 season,

respectively. This change in adoption patterns is attributed primarily to a decline in agency support, whereby in the early years NGOs provided free inputs and technical partners closely monitored crop management practices.

Nitrogen effects

The practice of applying nitrogen fertilizer has been followed by at least 75 percent of interviewed farmers (Table 1). Ammonium nitrate (AN) is the most common inorganic nitrogen fertilizer used in Zimbabwe and is available in prill form. Results show that there is better response to nitrogen application realized with conservation farming than conventional farmer practice, particularly during drought years (Figure 1). With farmer practice, good returns to nitrogen application are only evident in a higher rainfall season. Micro-dosing is practiced in basins where fertilizer is spot applied at the 5 to 6-leaf stage in cereal crops (Mashingaidze, Belder, Twomlow and Hove, 2007). This has led to better water harvesting and infiltration, and improves the agronomic nitrogen efficiency.

Dealing with crop residues

One critical problem faced by adopters of conservation farming is how to ensure enough residues remain in the field to meet the threshold needed for good mulch. Available evidence from data collected in 2005/06 season show more yield benefits from mulching with conservation farming than farmer practice (Figure 2). In order to access crop residue for use as mulch, conservation farmers have to place a value on the product. This value can be expressed as an opportunity cost of collecting and transporting the residues, or investment in fencing off the field.

Farm enterprise budget analysis

A budget analysis was carried out based on maize enterprise because it is the most common crop grown under conservation farming practice in Zimbabwe. Results from Table 2 show that farmers doing conservation farming for the first time and some with experience (second + year) achieved higher yields than conventional farm practice in 2006/07 cropping season. On average 2006/07 was considered a drought year (FAO, 2007). First year and experienced conservation farmers spent double the labor requirements to produce a hectare of maize compared to conventional farmer practice. The difference in labor requirements is primarily due to demands in basin establishment and weed control.

Farmers practicing conservation farming for the first year had a gross margin of greater than five times that earned with only farmer practices. The more experienced conservation farmers earn an even higher gross margin than first time farmers. These results hold despite the fact that digging planting basins is labor intensive, requiring 30 days/ha for basin establishment only. The results also confirm the higher labor returns to maize production under conservation farming compared to conventional farmer practices. The sensitivity analysis based on yield variability due to season quality show that conventional farm practice remain viable only under high rainfall conditions (Table 3). Yield levels achieved under normal and below normal rainfall season maintain conservation farming as a more viable enterprise than conventional farmer practice using draft animals.

Conclusion

Conservation farming has demonstrated great potential in increasing crop productivity for poorer farmers in drought-prone areas. The adoption of conservation farming by these vulnerable farmers could save on food aid assistance, leading to sustainable agricultural development among smallholder farmers. The study has shown that conservation farming is a more viable option to conventional tillage system, especially when faced with drought situations. But there is need to develop input markets necessary for farmers to adopt full components of conservation farming techniques in these marginal areas.

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Table 1: Proportion of farmers practicing components of conservation farming (%)

Techniques	Cropping season (n=229)		
	2004/05	2005/06	2006/07
Winter weeding	51.1	87.2	74.5
Application of crop residues	39.6	75.0	68.8
Digging planting basins	100.0	96.0	90.0
Application of manure	78.0	82.0	70.0
Application of basal fertilizer	66.7	68.8	43.8
Application of top dressing	90.0	92.0	74.0
Timely weeding	94.0	96.0	76.0
Crop rotation	7.5	30.0	25.0

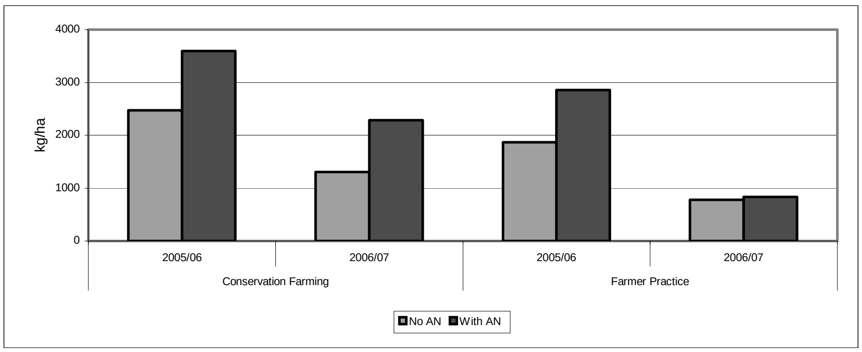

Figure 1: Effects of nitrogen application to basin and farmer practice

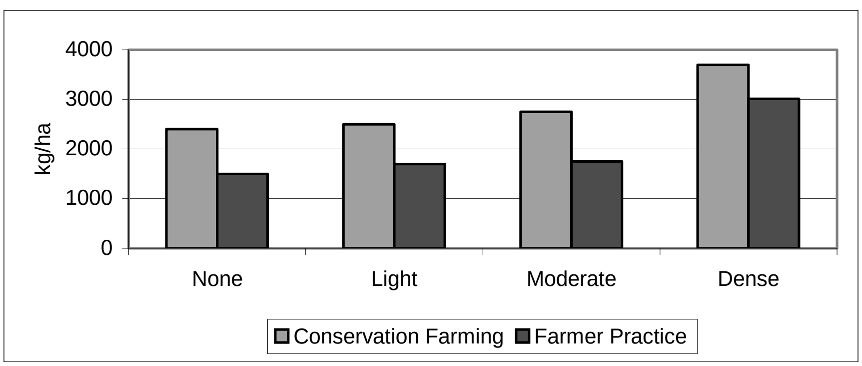

Figure 2. Impact of different mulch cover on maize yield

Source: Twomlow and Hove, 2007

Table 2: Enterprise budget analysis for 1 ha of maze, 2006/07 cropping season

Item	Unit	Price/Unit US$	First year		Second + year		Farmer practice	
			Quantity	US$	Quantity	US$	Quantity	US$
A. Revenue	Maize grain (kg)	0.40	1520.00	608.00	1780.00	712.00	368.80	147.52
	Stover (kg)	0.12	0	0.00	0	0	129.08	15.49
	Total Revenue			608.00		712.00		163.01
B. Variable Costs	Maize seed (kg)	0.47	20.00	9.40	20.00	9.40	20.00	9.40
	Basal fertilizer (kg)	0.33	92.50	30.53	92.50	30.53	0.00	0.00
	Top dressing (kg)	0.35	83.30	29.16	83.30	29.16	0.00	0.00
	Plowing services (ha)	22		0.00			1.00	22.00
	Total Inputs			69.08		69.08		31.40
	Labor (day)	0.88	144.56	127.22	148.27	130.47	68.61	60.38
	Total Variable Costs			196.30		199.55		91.78
C. Returns	Gross Margin (US$/ha)			411.71		512.45		71.23
	Cost per ton (US$/kg)			0.13		0.11		0.25
	Returns to labor (US$/day)			3.73		4.34		1.92

Table 3: Sensitivity analysis

			First year	Second + year	Farmer practice
High rainfall	Maize yield	kg/ha	2100	2900	1650
	Gross margin	US$/ha	643.71	960.45	637.52
	Cost per ton	US$/kg	0.09	0.07	0.06
	Returns to labor	US$/day	5.33	7.36	10.17
Normal rainfall	Maize yield	kg/ha	1750	2200	790
	Gross margin	US$/ha	503.71	680.45	257.40
	Cost per ton	US$/kg	0.11	0.09	0.12
	Returns to labor	US$/day	4.36	5.47	4.63
Low rainfall	Maize yield	kg/ha	1520	1780	370
	Gross margin	US$/ha	411.71	512.45	71.23
	Cost per ton	US$/kg	0.13	0.11	0.25
	Returns to labor	US$/day	3.73	4.34	1.92