

**Food Security Research Project/Michigan State University**

**Sustained use of Conservation Farming Practices  
Among Small and Medium Scale Farmers in Zambia**

**By**

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## **ABSTRACT**

With the recent Poverty Reduction Strategy Program and the Agricultural Commercialization Program, the Zambian government seeks to promote the development of an efficient, competitive, and sustainable agricultural sector, which would enhance food security and increase small-scale farmers' incomes. Since 1996, policy makers have emphasized programs promoting the development of farming technologies and practices including conservation farming (CF) technologies. NGOs and others stakeholders have promoted CF technologies to small and medium scale farmers. The questions that are unanswered are: Which farmers are adopting these CF crop management practices? Among those adopting, which farmers are sustaining adoption of these practices? What are the relationships of the sources and levels of income, human resources, household and geographical characteristics to adopters and those sustaining adoption of CF methods?

The data for this study come from two household surveys carried out for the 2000/2001 and 2002/03 agricultural seasons covering a panel of 5342 households. The surveys are nationally representative and this can help the stakeholders understand household as well as geographical characteristics associated with sustained adopters of CF practices. The CF practices promoted in Zambia and evaluated here are dry-season land preparation using minimum tillage methods (hand hoe basins or animal draft power ripping), crop residue retention, improved fallow, and crop rotation.

Results show that farmers are more likely to use and sustain CF practices that are closest to traditional cropping than the main CF practices over time. It was also found that MACO is the most important supplier of CF practices advice to farmers and equally important is fellow farmer to farmer interaction. Informal conversation, workshops and field days are some of the most important methods of disseminating CF message. Investment in training agricultural extension officers in CF practices is likely to increasing the rate of adoption and sustained adoption of CF practices.

## 1. Introduction

Agriculture is the main source of income for the majority of rural households in Zambia, and while there have been some improvements in agricultural production diversification and cash cropping in the mid-1990s through the current time, small and medium scale farmers still constitute the largest group in income poverty in the country. About 84% of these farm households exist below the national poverty line, and 72% of farm households are in extreme poverty (PRSP 2001).<sup>1</sup> Combined, small and medium scale farmers contribute about 60% of agricultural output (Saasa 2003). Increasing their production and productivity has the potential to make an important contribution to agricultural output and general economic growth of the country (Thurlow and Wobst 2004).

There are several reasons which can explain the low income of small and medium scale farmers in Zambia, and the lack of overall improvements in the past ten years. Agricultural systems among these farmers are primarily rainfed and there were several severe drought periods experienced in most parts of the country in 1990s that lowered land and labor productivity of the farmers. During the same period, many farmers lost animals due to corridor disease, reducing both beef cattle for income as well as reducing animal draught power availability. Thirdly, with the liberalization of the economy, fertilizer, improved seeds, and other agricultural inputs were no longer subsidized and distributed through government channels, so farmers reduced their use. Liberalization also resulted in the reduction of direct government involvement in setting maize prices and guaranteeing markets for production, thus farmers needed to deal with the risks of both price variability and search for markets. Lastly, soils, particularly in more intensively farmed regions of Zambia (Southern Province for example) were being degraded, due to cultivation methods without soil conservation measures along with a reduction in use of inorganic inputs, including fertilizers and minerals. The result from these factors is that in the early 21<sup>st</sup> century, yields were getting lower and rural poverty was increasing.

To reverse that trend, researchers and farmers looked for experiences and technologies that could provide viable, more sustainable farming systems in Zambia. Conservation farming (CF) in Brazil and Zimbabwe was showing success using crop

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<sup>1</sup> As defined by the Central Statistical Office (CSO 2000), small farmers are those who cultivate 5 or less hectares of land while medium scale farmers cultivate between 5 and 20 hectares of land.

rotation, minimum tillage and other CF practices, within both animal traction and hand hoe production systems. CF, as applied in Zambia, generally involves a package of several key practices: dry-season land preparation using minimum tillage systems; crop residue retention; seeding and input application in fixed planting stations; and nitrogen-fixing crop rotation (Haggblade and Tembo 2003a and 2003b). Research in the region and elsewhere indicates that those who adopt CF methods have the potential to reduce their costs, increase their yields, reduce food security risks, minimize the chances of crop failures in drought years, increase their profits, and in time improve the fertility of their land.

It is from that background that agricultural stakeholders started advocating the use of conservation farming practices by small and medium scale farmers. At policy level, the government of the Republic of Zambia through the Ministry of Agriculture and Cooperatives (MACO) and Ministry of Finance have developed the Agricultural Commercialization Programme (ACP) and Poverty Reduction Strategy Programme (PRSP) that seek to promote the development of an efficient, competitive and sustainable agricultural sector that would enhance food security and increase income for the farmers. Regarding agricultural policy the government since the mid-1990s has affirmed that it would continue to promote conservation farming practices to the farming population (MACO 2004). Stakeholders such as the Department of Field Services in MACO, the Conservation Farming Unit (CFU) of the Zambia National Farmers Union (ZNFU), the Soil Conservation and Agroforestry Extension Project (SCAFE), the Golden Valley Agricultural Trust (GART), the Cooperative League of USA (CLUSA) and other NGOs spearheaded the introduction of conservation farming to small and medium scale farmers in Zambia in the mid-1990s.

The success has been varied. A recent study conducted by Haggblade and Tembo (2003b) in Zambia based on Post Harvest Survey data indicates that about 63,000 (7.8%) small-scale farmers and 3,000 (13%) medium scale farmers prepared land in the form of planting basins. They also determined that about 398,000 (49.2%) small-scale farmers and 13,000 (60.4%) medium scale farmers left residues in their fields. Another study focused solely on the adoption of improved fallow in Eastern Province of Zambia estimated that 20,000 farmers were following the practice (Kwesiga et. 2003).

Recently, the Central Statistics Office with MINAG revisited the households from the Post Harvest Survey of 2000/2001. The earlier data were used by Haggblade

and Tembo, so this new survey is useful for evaluating the extent of sustained usage of specific practices with CF and the types of farmers that are more likely to sustain usage. The surveys will also reflect new adoption and trends. These surveys enable us to understand some of the relationships between sources and levels of income and household human resources of the adopters and disadopters of CF methods for the same period. There are limitations on which practices were identified in each survey and how they are defined, as noted by Haggblade and Tembo (2003b), but the information and analysis will help provide policy makers, researchers and extension workers with a better sense of strengths and weaknesses of the CF diffusion efforts. Given the relatively high disadoption rates found in this work, there are clearly new efforts needed to reach the potential productivity improvements.

### **1.1 Objectives and the rationale of the study**

The general objective of the study is to evaluate the extent to which different CF crop management practices have been adopted or disadopted by small scale and medium scale farmers for two seasons (2000/01 and 2002/03). Specific objectives include the following:

1) To identify and describe households that have continued to use selected CF crop management practices over time (sustained adopters), households that were adopters in the early period and are no longer using the practices (disadopters), households that are new adopters, and those that did not use the CF practices in either survey;

2) Based on these classifications, to determine how household characteristics influence the adoption and disadoption of selected CF crop management practices: and

3) To determine the relationship of sources and levels of income, sources and methods of advice on practices, available human resources, gender and level of education of the head, and other factors to the sustained use of CF crop management practices.

The data sets of 2000/01 and 2002/03 provide an important although brief panel that can help stakeholders to understand some of the dynamics of adoption of CF technologies between these years. For policy makers, investment in the promotion of

CF technologies meets poverty reduction goals only if the technologies are seen to benefit resource-poor farmers as well as those with greater resources. Knowledge intensive technologies such as CF may require greater educational levels or much greater extension efforts in order to be successful particularly with lower resource farmers. This research seeks to contribute to knowledge on who is adopting and what that means for future work.

## **1.2 Study area and time period**

Zambia is divided into three main agro ecological zones. Agro ecological zone 1 (AEC I) is the lowest rainfall zone and covers the Luangwa valley and Zambezi valley within Eastern, Southern and Western Provinces. The region receives less than 800mm of rainfall annually and it covers 12% of Zambia's total land area. The soils of the valleys are loamy to clayey while those on the escarpments are coarse to fine loamy shallow soils. Since the region receives low rainfall, only drought resistant crops are recommended there and these are cotton, millet, sorghum and sesame. Due to tsetse flies the region is not suitable for cattle rearing.

Agro-ecological zone II (AEC II) includes the most productive agricultural land in the country and receives between 800 and 1000mm of rainfall annually and covers approximately 42% of the country. AEC II is further subdivided into AEC IIa and AEC IIb. AEC IIa covers the fertile plateaus of Central, Lusaka, Southern and Eastern Provinces while AEC IIb covers the sandy areas of Western Province. AEC IIa supports production of a variety of crops such as maize, sunflower, soyabeans, groundnuts irrigated wheat, tobacco and other crops. AEC IIb supports the production of rice, millet, cashew nuts, timber and vegetables. The region is also suitable for beef and dairy production.

Agro-ecological zone III (AEC III) covers the northern parts of Zambia and this includes Northern, Luapula, Copperbelt and North Western Provinces. It receives between 1000mm and 1500mm rainfall annually and constitutes approximately 46% of the country's total land area. The soils are mostly leached and acidic and therefore, the potential can be enhanced by application of lime. The main crops that are grown are cassava, millet, beans, sorghum, groundnuts, coffee, pineapples sugarcane and rice.

The spread of conservation farming crop management practices started in low rainfall areas of AEC I and II because the practices were perceived to help in capturing and maintaining soil moisture. Recently, the CFU has been developing and promoting crop management practices suited for the relatively high rainfall region III, but these efforts are fairly new and not wide-spread, and so will not be reflected in the PHS statistics.

The two cropping seasons covered during the data collection were dissimilar in terms of rainfall, but so was each year preceding them. In terms of adoption, a low rainfall year in one year may promote adoption of water conservation technologies in the following year. If we look at 1999/2000, the cropping season just before 2000/01, we find that the average rainfall is relatively low in each of the main regions (AEC I = 852 mm, AEC II = 877 mm, and AEC III = 989 mm), suggesting that adoption of planting basins and other CF practices would be relatively high in 2000/01. Mean amount of rainfall in 2001/02 season from all the three agro ecological zones (AEC I = 1069 mm, AEC II = 1055 mm and AEC III = 1070 mm), was higher than in 1999/2000 season. This might lead farmers to disadopt or adopt at a slower rate in 2002/2003.

### 1.3 Analytical Framework

When households adopt new technologies, they make their decisions based on the information received from various sources, and their own evaluation of the potential benefits and costs of the technology. The adoption of the technology is also based on the human and financial capital available to the household and other characteristics of the household, as they relate to the technology and the potential benefits. Institutional considerations also may influence adoption decisions, particularly where special extension programme benefits are tied to use of specific practices.

In this study it is hypothesized that households that adopted planting basins will be initially constrained by family labor access since this practice is more labour intensive than other land preparation methods. However as time passes, the labour requirement reduces as noticed in Haggblade and Tembo report (2003a), so temporary access to labor may release that constraint, such that once adopted, sustained adoption is more likely in labor constrained households than in other households. The education level of the household head is also another characteristic that can have an influence on the adoption and sustainability of the technology. Literate household heads are more likely to make informed decisions and apply a combination of practices effectively. In Haggblade and Tembo 2003, it was noted that level of education and experience had an influence in the management ability of the technology. Adoption of animal traction CF, with ripping, may be limited to households with enough income that can afford to buy oxen and other ripping implements; however, increased animal traction rental markets may open up the possibilities for more farmers (Haggblade and Tembo 2003b).

As noted in Haggblade and Tembo (2003b), extension contacts and information may influence the adoption of conservation farming practices. However, those farmers receiving subsidized fertilizers in recent years may have a disincentive to practice CF technology, so the extension contacts associated with fertilizers may have a negative impact on adoption. There are also other characteristics of the agroecological zones that may be major factors in adoption and sustained use of conservation farming practices. It is expected that farmers in areas where rainfall is erratic are more likely to adopt planting basins or ripping for its potential water conservation aspects as well as the timeliness of activities to use what water is

available. Access to markets may also play a role in ensuring returns to production technologies.

### **1.3 Data and Methods**

The data used in this paper were obtained from two supplemental surveys carried out by the Central Statistics Office (CSO) on behalf of Food Security Research Project of Michigan State University Department of Agricultural Economics, with the collaboration of MACO. The surveys were conducted in 2001 and 2004 in June/July and August/September respectively.

The supplemental surveys are based on a clustered, stratified design that included all provinces and districts, and then a probability proportional to size sampling scheme was used with selected Census Supervisory Area (CSA) and the Standard Enumeration Area (SEA) within the districts. Stratification was also based on the category of farm household. In the listing, households were categorized as small scale (generally with land holdings less than 5 hectares) or medium scale, with landholdings of 5 to 20 hectares). Large and commercial farms were excluded. The medium scale households were sampled with greater frequency to ensure sufficient sample numbers for analysis.<sup>2</sup>

Both the 2001 and 2004 surveys are considered to be representative to the provincial levels for statistical analysis. During the supplemental survey of 2004, enumerators visited the same households that were visited in 2001. Therefore, panel data are used in this study and there are about 5342 households as shown in table 1. For population estimates, weights were developed based on the sampling strategy.

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<sup>2</sup> To estimate the population numbers and percentages, weighting procedures are used here.

**Table 1: Households surveyed and included in analysis**

	2000/2001	2003/04
All households in the sample <sup>1</sup>	6922	5419
Households used in the study <sup>3</sup>	5342	5342
Estimated total farm households	846941	

Source: Supplemental survey data 00/01 & 02/03 Total estimated using weighted population.

Note: <sup>1</sup>Not all households in each sample were able to be included in the analysis due to missing information or other difficulties. For a discussion on the attrition rate in the panel, see Chapoto and Jayne, 2005.

In Zambia, conservation farming crop management practices have been extensively promoted in areas where rainfall has been erratic such as Central, Eastern, Lusaka and Southern Province. This study will cover those areas as well as areas where they have not been promoted. This will help stakeholders understand the rate of diffusion of conservation farming crop management practices to areas where few research programs or promotion activities have been done. However, with a nationally representative sample, highly specific areas where targeted efforts have been made may not fall within the sample frame and thus will not be included. Thus it is not an appropriate sample for evaluating the effectiveness of a specific extension program with a narrow geographical focus of activities.

In each period, the surveys included information on the composition of households, their land use, cropping patterns, total agricultural production, sales of agricultural goods, and other sources of income. The surveys were not identical in each period, particularly in classification of cropping practices, and this influences the analysis here, and will be discussed in the section below.

This paper will present preliminary descriptive statistics based on for several types of households: 1) “new adopters” i.e., households that adopted a selected CF practice for use in the 2002/2003 season; 2) “sustained adopters”, i.e., households that sustained the use of selected CF practices from 2000/2001 to 2002/2003; 3) “disadopters” i.e., households that disadopted selected practices between 2000/2001 and 2002/2003; and finally 4) “non-adopters” i.e., households that were non-adopters of the selected CF practices over the two seasons. Relationships between household

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<sup>3</sup> Households considered in the study are those that matched between 2001 and 2004 supplemental data sets

characteristics and the types of households will be explored through simple comparisons, with multivariate analyses to be presented in a future report.

#### **1.4 Differences between the two data sets.**

This study uses panel data for agricultural years of 2000/01 and 2002/03. A panel study is one that captures the same information for a period of two years or more using the same types of questions and asked to the same households. This section explains the basic differences with regards to the CF questions of the two surveys.

In 2000/01 survey, the conservation farming techniques that were captured in a single use/non-use set of questions at a farm level are (1) mixing of two or more crops in one field (2) improved fallow, (3) Pot holing/Planting basins, (4) crop rotation, (5) leaving crop residues (except cotton & tobacco) and (6) other minimum tillage systems.

In 2002/03 agricultural season, the following are the conservation farming techniques that were captured: planting basins, zero tillage tillage, ripping, planting basins/ripping, leaving crop residues, nitrogen fixing crop rotation. Field level questions asked the basic tillage used, including planting basins, zero tillage, and ripping as separate options along other tillage methods. Also at a field level, farmers were asked about intercropping, leaving crop residues, improved fallow, and previous crop on the field (useful for crop rotation), more general questions were asked about advice and use of advice on specific production technologies, including nitrogen-fixing crop rotations and minimum tillage.

Thus, when comparing the responses from the two surveys, care must be taken. For example, since ripping was not specifically identified individually in the survey for the 2000/2001 season, we cannot evaluate sustained adoption of that technology (ripping). The broader household questions in 2000/2001 do not have the specificity of the 2002/2003 questions and households may have over-stated their use of CF practices, but households may also have been reluctant to give details on all plots and thus may understate their use of practices in 2002/2003.

## 2 Descriptive Statistics

This chapter provides a descriptive analysis of the small and medium scale household farmers in Zambia according to the type indicated above: new adopters, disadopters, sustained adopters and non-adopters. Also as noted above, for ripping, we only have information for 2002/2003 and thus classification of households is limited to new adopters and non-adopters. Table 2 shows the frequency of each of the four types of farmers for each of the six conservation farming crop management practices. The first column in each of the six conservation farming practices represents the percentage of households across the categories, while the remaining three columns represent the percentages of households in each category across the three ecological zones. For example, for improved fallows, the first column indicates that 90 percent of farmers are non-adopters, and of those, the majority are in AEC II and III. For improved fallows, intercropping, planting basins and ripping, there are many more non-adopters than households in the other three household types. There are relatively few new adopters and sustained adopters of these technologies, but among those using in 2002/2003, a higher percentage of households are found in AEC II. For example, 56% of the new adopters and 55% of the sustained adopters of leaving crop residues are found in AEC II (Table 2). The results seem to be consistent with the findings of Chomba (2004) that crop rotation and leaving crop residues in the field are the most prevalent practices used by small and medium scale farmers. AEC II also has the largest number of farmers, with 47% of all medium and small scale farmers. For those who have worked to diffuse the CF practices, the degree of disadoption is discouraging, with high disadoption of planting basins in AEC II. There was a relatively higher sustained adoption of planting basins in AEC I, the drier zone.

**Table 2: Categories of households by practice & agro-ecological zones (estimated population)**

	IMF			INCR			CRRO			CRES			PBAS			RIP <sup>1</sup>								
	Zones			Zones			Zones			Zones			Zones											
	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III						
% of total	% between regions			% of total	% between regions			% of total	% between regions			% of total	% between regions			% of total	% between regions							
New Adopters	0.9	4	53	43	8	11	24	65	32	9	37	54	12	8	56	36	2.1	4	50	46	1.1	21	79	0
Disadopters	8.8	9	52	39	26	6	47	47	8	15	52	33	37	10	48	42	7.7	14	56	30	0	na	na	na
Sustained Adopters	0.2	16	47	37	12	5	12	83	44	4	57	39	14	12	55	33	0.2	20	53	27	0	na	na	na
Non-adopters	90.1	9	47	44	54	10	60	30	16	17	45	38	37	6	43	51	90.0	8	47	47	98.9	12	85	3
Total %	100				100				100				100				100				100			

Total sample: 5342 households

Key: IMF=Improved fallow, INCR=Intercropping, CRRO=Crop rotation, CRSE=Leaving Crop Residues, PBAS=Planting Basins

Note: <sup>1</sup>Ripping was not separately identified in 2000/2001, so disadopters and sustained adopters cannot be identified. Only Central, Eastern, Lusaka and Southern Provinces have been considered in the analysis of the ripping technology since they were only distributed there. The number of observations of the ripping technology is 2511

Source: Supplemental survey data 00/01 & 02/03. (% based on weighted population estimates).

After seeing the distribution of households in each category and zone, it is valuable to step back and take a look at the overall sample of households and their characteristics, before proceeding to the analysis by category of farmer. Table 3 shows the general attributes of the sample in the combined 2000/2001 and 2002/03 panel data set. More than three quarters of households in the sample were male headed. As noted in Chomba's report (2004) there are approximately 93% of households headed by women were small-scale farmers as compared to 79% of households headed by men. In this report we have seen an increase in households headed by females who were small-scale by 6% as compared to 18% of households headed by males. The difference could be more households for medium scale dropped out in 2002/03 seasons and were not interviewed hence pushing the percentage for small-scale farmers up. The number of household members was 1.34 times higher in male headed households than in households headed by females. However, the number of adults in the household did not differ between the male and female headed households. The mean dependency ratio of the sample is low, just below one, indicating there is fewer than one dependent for each adult in the households, on average. Given the potential incidence of HIV/AIDS, a modified dependency rate was estimated in which chronically ill adults were considered dependents, and the result is an expected rise in dependency rate to about 1, indicating that each adult has one person (child, elderly or ill adult) dependent on them. On 2002/2003, 9% of male household heads were chronically ill, while 15% of female household heads were chronically ill, numbers that roughly correspond with expectations, given prevalence rates for HIV/AIDS (Chapoto and Jayne 2005).

From the 2000/01 data set, using the median incomes, male-headed household income is twice median income of female-headed households. This changes only slightly in 2002/03 data set, when male-headed household income is 1.75 times higher than that of female headed households. For both male and female headed households, the median income nearly doubled in the period involved, not a surprise given the better cropping conditions for 2002/2003 compared to 2000/2001, as well as shifts to greater crop diversity.

**Table 3: General characteristics of household heads and their households, by gender of head in 2002/2003 Survey**

		Male Heads	Female Heads
Distribution of Household heads (%)		76	24
Age of household head (mean)		49	53
Number of Household members (mean)		6	5
Labour force per hh (mean)		3.4	2.6
Traditional dependency ratio		0.89	0.78
Modified dependency ratio		1.02	0.88
Percent of hh heads participating in salaried employment		18.4	7.00
Percent of hh heads participating in informal/formal business		21.6	17.0
Percent of hh heads who are chronically ill		9.00	14.4
Percent which are small-scale farmers		97	99
Percent which are medium-scale farmers		3	1
Household Income (1,000 ZK) (median)	00/01	793	440
	02/03	1360	725
Sample households		4060	1282

Source: Supplemental survey data sets of 00/01 & 02/03. The survey covering the 2002/2003 agricultural season was conducted in mid-2004, so most of the characteristics presented above were observed in mid-2004. Income, however, is observed for the both agricultural years, adjusted for inflation, using base year of 2004. Percentages based on weighted estimates. Modified dependency ratios are calculated with children, elderly, and ill adults in the numerator and active age (non-ill) adults in the denominator. Traditional dependency ratios do not distinguish between ill and non-ill active age adults.

**Table 4: Methods of obtaining CF practice advice, for those farmers who indicated having received advice, according to the practice**

	Planting basins/ Ripping	Leaving crop residues	Crop rotation
	% of households		
Informal Conversation	28.7	37.3	37.8
Workshop	36.3	35.5	34.8
Field days	14.7	12.1	12.5
Demonstration plots	11.9	6.9	6.0
Radio programmes	4.6	5.1	5.5
Meetings	1.7	1.0	1.2
Training program	0.6	0.5	0.5
Pamphlet/News papers	0.8	0.7	1.1
Visit	0.2	0.1	0.1
Not specified	0.5	0.8	0.5
<b>Total of farmers receiving advice</b>	<b>100</b>	<b>100</b>	<b>100</b>
Population estimate of % of farmers receiving advice on practice	28%	34%	37%

Source: Supplemental survey data 00/01 & 02/03. % based on weighted population estimates. Each household could select only one method per practice.

Table 4 shows how farmers obtained information on selected CF practices in 2002/2003. For the three practices noted, the farmers were asked about the most important source of information on the practice. There was only one response per practice per farmer. The most common methods are informal conversations and workshops. Of the households that had received advice on planting basins, between a quarter and a third of households obtained information through informal conversation and workshops. For households that obtained advice of leaving crop residues, more than a third obtained it through informal conversation and another third through workshops. This was also true for crop rotation. Field days and demonstration plots were also cited for the three practices, although less frequently. About one third of the farmers across the country indicated receiving advice on the various practices. This represents considerable efforts in trying to get information out, but it cannot measure the quality of the advice received, not the methods for its dissemination.

**Table 5: Most important supplier or organizer of the CF practices advice<sup>2</sup>**

Source	Planting basins	Leaving crop residues	Nitrogen fixing crop rotation
	% of households		
MACO	66.2	65.1	65.5
Fellow farmers	7.3	14.8	14.2
CLUSA group	10.6	8.2	7.4
NGOs	11.8	8.2	8.7
Private Firms	2.5	2.8	2.9
ZNFU	1.4	0.9	0.9
No response	0.3	0.3	0.4
<b>Total of multiple cases</b>	<b>1533</b>	<b>1874</b>	<b>2081</b>

Source: Supplemental data 02/03, sample statistics.

<sup>2</sup>Each farmer was able to indicate only one source for each practice, for a maximum of three responses per farmer. MACO includes SSAFE, RIF, other MACO agents, FRA and cooperatives; Private Firms include Dunavant, Clark Cotton, Amaka, other outgrower & private dealers & commercial banks; NGOs include CARE, World Vision, EEOA, Church based Group, HODI, ICAZ, other NGOs & localized groups.

Dissemination of conservation farming practices is done by different agencies and organizations. The results on the source of information for CF practices are consistent with what Chomba (2004) found except that in 02/03 supplemental survey traditional practices was not included. Table 5 shows that MACO extension agents are identified most frequently as the most important provider of CF information to households, followed by fellow farmers for leaving crop residues and nitrogen fixing crop rotation. Since the sample in these surveys is relatively small and many NGOs and others work in concentrated geographical areas, the survey may have missed specific pilot areas with intensive programs. Also, MACO extension agents work in collaboration with some outgrower schemes as well as with SSAFE and other programmes, blurring the distinction between MACO extension agents and others.

### **3 New adopters of Conservation Farming Practices in 2002/03**

As noted earlier, new adopters of conservation farming practices are those households that used the practice in 2002/03 season, but not in 2000/2001. New adoption is more common in AEC II. As was found by Haggblade and Tembo (2003b), this study shows that when the tillage system is considered, planting basins are more likely to be found in AEC II (table 6). To understand what may have motivated the change in practices between the two periods, it is valuable to look at all the households who were not adopters in 2000/2001, and compare new adopters to those who still did not adopt in the recent period, so the number of households in each case is less than the full sample.

#### **3.1 Distribution of New adopters and Non-adopters of CF by AEC zones**

Table 6 demonstrates the distribution of these new adopters and non-adopters out of the population of households that did not use the practices in 2000/2001, again based on the AEC zones. Despite the evidence of high potential of selected CF practices in AEC II and I, there are still more non-adopters for all the CF practices than new adopters except for crop rotation. Table 6 shows that, of the households that did not use leaving crop residues in the field in AEC I during 2000/01, 29% were new adopters in 2002/03 and 71% were non-adopters. On the other hand, of the households that did not use the crop rotation in AEC I during 2000/01, 52% were new adopters and 48% were non-adopters.

Adoption or disadoption of conservation farming crop management practices is dependent on several characteristics of the household. Basically it is expected that households who are new adopters of CF crop management practices are likely to have higher income than non-adopters and this is confirmed in Table 7. Households that recently adopted leaving crop residues and crop rotation had 1.4 times and 1.2 times more income than those that were non-adopters of the practices.

**Table 6: Percent of New adopters & Non-adopters by Practice & Agro-ecological Zone  
(% based on weighted population estimates)**

	IMF		INCR			CRRO			CRES			PBAS			
	Adop Non-adop		Adop Non-adop		Adop Non-adop		Adop Non-adop		Adop Non-adop		Adop Non-adop				
	Sample #	%	Sample #	%	Sample #	%	Sample #	%	Sample #	%	Sample #	%			
AEC I	483	0.5	99.5	411	13.4	86.6	352	52.3	47.7	191	29.0	71.0	468	1.1	98.9
AEC II	2252	1.1	98.9	1797	5.4	94.6	999	37.2	37.2	1171	28.3	71.7	2256	2.6	97.4
AEC III	2128	1.0	99.0	1083	23.0	77.0	1224	74.7	25.3	1231	17.7	82.3	2197	2.4	97.6

Key: IMF=Improved fallow, INCR=Intercropping, CRRO=Crop rotation, CRSE=Leaving Crop Residues, PBAS=Planting Basins.

Sample number indicates the number of households in the sample who did not use the practice in 2000/2001 by agro-ecological (AEC) zone.

**Table 7: Characteristics of New Adopters & Non-adopters of Conservation Farming Crop Management Practices in 2002/03, based on all households that did not use the practice in 2000/2001**

		Conservation Farming Crop Management Practices									
		IMFA		INCR		CRES		CRRO		PBAS	
		Adop	Non-ad	Adop	Non-ad	Adop	Non-ad	Adop	Non-ad	Adop	Non-ad
Mean age (years)		52	48	49	48	48	48	50	50	50	48
Formal/informal business (% of hhs)		19	20	26	18	17	22	17	22	26	20
In salary employment (% of hhs)		4	16	19	16	17	14	19	15	15	15
Chronically ill hh heads (%)		8	10	8	9	9	10	11	9	7	10
Household members (mean #)		6	6	6	6	6	6	6	5	6	6
Total Labour force		3	3	3	3	3	3	3	3	3	3
Modified dependency ratio		0.81	0.98	0.96	0.98	1.02	0.97	0.97	0.92	0.98	0.99
Household income ('000)	Median	1084	1144	1158	1189	1558	995	1391	770	1912	1155
Land cultivated (ha)	Median	1.27	1.22	1.25	1.22	1.38	1.13	1.22	0.81	1.45	1.25
Category of farmers (%)	Small-scale	91	97	98	97	96	98	97	98	96	97
	Medium-scale	9	3	2	3	4	2	3	2	4	3
Sample figures		50	4813	404	2887	630	1963	1737	838	114	4807

Key: IMFA = Improve fallow, INCR = Intercropping, LCRES = Leaving crop residues in the field, CRRO = Crop rotation, PLBAS= Planting basins, Adop=New adopters, Disado=Disadopters.

Note: Modified dependency rate includes ill active age adults as dependents (in the numerator) rather than as active adults (in the denominator).

Source: Supplemental survey data 00/01 & 02/03

Households that were new adopters of planting basins tended to be less likely to have an ill household head (Table 7), something that should be expected given labor demands of the planting basins. On average 10% of household heads that did not adopt (non adopters of) conservation farming practices were chronically ill and only 8% heads that adopted CF practices were chronically ill, similar to the overall population average. However, differences in dependency ratios were not as important. Those who adopted planting basins in 2002/2003 did tend to have more land and were more likely to be involved in formal or informal businesses, in addition to agriculture (Table 7).

### 3.2 Education level of New adopters and Non-adopters of CF practices.

One of the questions asked is whether these technologies tend to be adopted only by farmers with higher education levels. Table 8 shows that there are few patterns in the high education bracket. It is assumed that household heads that reached upper primary and above are literate, and this means about half of household heads that adopted conservation farming practices are among the literate ones, but many adopters are within the lower educational levels. What does this mean to the policy maker? With so many farmers adopting regardless of education level, dissemination of information on conservation farming technologies should be made in local languages and in training sessions that these farmers can read and understand. This also suggests that there is not an education bias to the technology.

**Table 8: Education level of New adopters/Non-adopters hh heads of CF practices in 2002/03 (estimated population)**

	IMFA		INCRO		CRRO		CRES		PBAS	
	Ado	Non-ad	Ado	Non-ad	Ado	Non-ad	Ado	Non-ad	Ado	Non-ad
	% of household heads									
None	28	20	19	21	20	25	14	21	15	19
Lower Primary	31	26	25	25	26	27	26	25	25	26
Higher Primary	27	34	33	33	34	33	23	35	36	35
Junior Secondary	0	11	14	11	12	8	14	11	10	11
Higher Education	14	9	9	10	9	7	13	8	15	9
Sample hh	50	4813	404	2887	1737	838	630	1963	114	4087

Key: Ado = New adopters, Non-ad = Non-adopters

Source: Supplemental Survey data 02/03

## **4 Farmers who sustained the use of Conservation Practices**

Households that sustained the use of conservation farming methods in this study are those that used them in 2000/01 and 2002/03 agricultural seasons. In contrast to the previous section based on 2000/2001 non-users of CF technology, this section studies the farmers that did use the given practice in 2000/2001 and then made a decision to either sustain adoption or dis-adopt. It first looks at the distribution of these categories of farmers among the three ecological zones of Zambia.

### **4.1 Distribution of Sustained Farmers and Disadopters of CF practices.**

Table 9 presents the results and what stands out is the very low level of sustained adoption of planting basins and improved fallows. The previous section showed some new adopters of these technologies, but it is important to understand the dynamics of why households disadopt. It is expected that households in areas more prone to drought are more likely to sustain the use of conservation farming practices that capture moisture and prevent the loss of moisture from the soils. That suggests that AEC I has the highest potential in which farmers can sustain the use of planting basins and leaving crop residues. However, on average, AEC I has relatively few households sustaining the use conservation farming practices. AEC II also has the potential to attract households sustaining the use of conservation farming that would improve capturing of moisture as well as prevention of water loss through evaporation. About half of the farmers who sustained the use of conservation farming practices are found in AEC II.

What are the implications of this scenario? There is need to evaluate how farmers implement these practices, and whether more extension effort is needed for farmers to obtain the benefits of the practices. Extension officers may need additional training in conservation farming techniques so that their extension work is effective. Disadoption may be related to lack of perceived benefits. Multivariate research may be able to identify relationships to evaluate whether or not government subsidized fertilizer and other inputs may be negatively affecting adoption. Another possibility is that HIV/AIDS effects on the labor supply are reducing farmer labor resources, directly or indirectly through reduced income.

**Table 9: Percent of Sustained Adopters & Disadopters of CF Practices by Agro-ecological Zone  
(% based on weighted population estimates)**

	IMF			INCR			CRRO			CRES			PBAS		
	Susta		Disadop	Susta		Disadop	Susta		Disadop	Susta		Disadop	Susta		Disadop
	Sample #	%		Sample #	%		Sample #	%		Sample #	%		Sample #	%	
AEC I	52	4	96	124	30	70	183	58	42	344	30	70	64	3	97
AEC II	243	2	98	698	11	89	1496	86	14	1324	30	70	239	2	98
AEC III	184	2	98	1229	46	54	1088	87	13	1081	22	78	115	2	98

Key: IMF=Improved fallow, INCR=Intercropping, CRRO=Crop rotation, CRSE=Leaving Crop Residues, PBAS=Planting Basins

Susta=Percent of Sustained adopters of CF practice in 2002/2003, Disadop=Percent of disadopters in 2002/2003. Sample # =Number of HH that practiced the CF system in 2000/01.

## 4.2 Education level of farmers who sustained the use of CF practices

Table 10 shows the education level attained by household heads among households sustaining the use of CF practices and those that disadopted. The patterns indicated here basically repeat those of new adopters, with slightly less than one-half of sustained adopters having household heads that are classified as literate with at least upper primary education. The small numbers on sustained adoption of improved fallows and planting basins makes it difficult to draw conclusions on those practices. However, for the other practices, there are few differences between sustained adopters and disadopters, with the possible exception of crop rotation, for which those farmers with lower education levels are more likely to disadopt the practice.

**Table 10: Level of Education of sustained adopters & disadopters of CF practices**

	IMF		INCR		CRRO		CRES		PBAS	
	Sust	Disad	Sust	Disa	Sust	Disad	Sust	Disad	Sust	Disad
	% of households within adoption category									
None	13	11	13	18	15	26	16	20	10	21
Lower Primary	48	25	28	27	25	30	27	26	34	23
Higher Primary	37	41	39	35	37	25	34	34	29	32
Junior Secondary	0	12	12	11	12	10	10	11	27	9
Higher education	2	11	8	9	11	9	13	9	0	14
Sample households	10	469	663	1388	2360	407	741	2008	8	413

Key: Sust = Sustained, Disad = Disadopters

Source: Supplemental survey data 02/03

## 4.3 General household characteristics of sustained adopters and disadopters.

Looking at the relationship between income and adoption decisions, there are two possible relationships. The practices enable higher agricultural income, and thus the farmers wish to continue using the practices. The second possibility is that farmers with higher incomes can afford to experiment with some of their land, and thus might sustain adoption even when immediate income benefits are not accruing. Thus, the direction of causality between income and adoption may not be uni-directional. Results in Table 11 confirm that, on average sustained adopters had income that was 1.4 times higher than disadopters in 2002/03 season, while in 2000/01 season, sustained adopters had 1.2 times income higher

than disadopters. Unfortunately, it is not possible to determine if the income level increased with adoption or higher income from other sources facilitated adoption.

**Table 11: Characteristics of Farmers who sustained the use of CF Crop Management Practices in 00/01 & 02/03**

		Conservation Farming Crop Management Practices											
		IMF				INCR				CRES			
		Sustained		Disadopter		Sustained		Disadopters		Sustained		Disadopters	
		00/01	02/03	00/01	02/03	00/01	02/03	00/01	02/03	01/01	02/03	00/01	02/03
Formal/informal business (%)		30	0	28	25	25	25	23	20	24	20	25	20
In salaried employment (%)		10	10	13	14	12	15	14	16	15	18	15	16
Chronically ill hh heads (%)		14	11	10	12	10	12	11	11	10	11	11	10
Household members (mean #)		8	7	7	6	6	6	6	6	7	6	6	6
Labour force (# of adult hh members)		3	3	3	3	3	3	3	3	3	4	3	3
Modified dependence ratio		2.22	1.37	1.33	1.03	1.16	1.07	1.20	0.95	1.25	1.03	1.18	0.97
Household income in (1,000 ZK)	Median	1037	2600	929	1494	665	1211	734	1194	967	1637	703	1120
Land cultivated (ha)	Median	1.88	1.75	1.25	1.42	1.37	1.50	1.21	1.31	1.31	1.50	1.12	1.25
Sample Households		10		469		663		1388		741		2008	

Key: IMF = Improve fallow, INCR = Intercropping, LCRES = Leaving crop residues in the field, CRRO = Crop rotation, PLBAS= Planting basins

Source: Supplemental survey data 00/01 & 02/03

**Cont'd Table 11: Characteristics of Farmers who sustained the use of CF Crop Management Practices in 00/01 & 02/03**

		Conservation Farming Crop Management Practices							
		CRRO				PLBAS			
		Sustained		Disadopters		Sustained		Disad	
		00/01	02/03	00/01	02/03	00/01	02/03	00/01	02/03
In formal/informal business (%)		22	18	18	18	51	63	23	18
In salaried employment (%)		13	14	18	18	16	25	21	20
Chronically ill hh heads (%)		10	11	12	10	50	24	10	8
Household members (mean #)		6	6	6	6	8	8	8	6
Labour force (# of adult hh members)		3	3	3	3	3	4	4	4
Modified dependency ratio		1.15	1.03	1.14	0.89	1.41	0.97	1.17	0.96
Household income (1,000 ZK)	Median	816	1500	700	921	970	1315	773	1168
Land cultivated (ha)	Median	1.48	1.56	1.01	1.00	0.75	1.01	1.06	1.22
Sample statistics		2360		407		8		413	

Key: IMFA = Improve fallow, INCR = Intercropping, LCRES = Leaving crop residues in the field, CRRO = Crop rotation, PLBAS= Planting basins

Source: Supplemental survey data 00/01 & 02/03

Equally important is the comparison of land cultivated by these two categories of households. On average sustained adopters had 1.2 times higher of land area cultivated than disadopters of conservation farming practices. Looking at the practices with relatively large samples of sustained adopters and dis-adopters, sustained adopters had higher modified dependency ratios, a puzzle. It was expected that higher dependency ratios would mean less labor available for agriculture and less likelihood of sustaining adoption.

## **5 Conclusions**

Conservation farming is seen by many as a way to develop sustainable farming systems in a region with high risk and relatively low productivity crop production. In spite of the potential identified by researchers and extension officers in demonstration plots, the practices associated with CF are having limited success. Those practices which are closest to traditional cropping, including intercropping, leaving residues and crop rotation are much more likely to be used and sustained over time than the main CF practices which require a more significant shift in production methods, namely improved fallow and planting basins. On going research on the Magoye ripper is likely to show the same results, with low adoption rates and rapid disadoption among some farmers.

Farmers rely heavily on their neighbors and informal communications methods, with MACO extension agents and workshops also important. Mandatory use of CF for program participation has not yet translated into widespread acceptance.

Multivariate methods are needed to look more carefully at the linkages between income, education, extension contact, rainfall and other factors that may be associated with adoption and disadoption of CF technologies.

The use of the panel dataset has helped in the understanding of the dynamics of adoption and disadoption of CF practices by small and medium scale farmers over time. It has been found out that there are few small scale farmers who continuously use the CF practices year after year. Most of them drop some of the CF practices once they are used once.

CF has not yet gained the momentum of adoption needed to make a major difference in overall agricultural production in Zambia. Years of drought stress seem to be the best years to demonstrate the difference to farmers. The 2005 agricultural season may represent a turning point, with sufficient farmers having demonstrably improved results due to erratic rainfall and the efficient water use characteristics of CF technologies.

More extension is needed to farmers so that benefits of using CF practices can be communicated and this would ensure an increase in adoption rates and a reduction in dis-adoption. Investment in infrastructure such as road net and giving incentives such as increase in crop prices can speed up the adoption rates of CF practices.

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