Developing Conservation Agriculture technologies in Southern Africa maize-based farming system: Understanding Farmers circumstances and perceptions

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Starting 2004/2005 crop season CIMMYT and its partners in Malawi, Tanzania, Zambia and Zimbabwe have been engaged in the evaluation and promotion of conservation agriculture technologies through a collaborative project. A baseline study was undertaken to characterize the dominant maize-based farming system, describe farmers' resource endowments and socio-economic attributes, understand factors influencing adoption of CA and farmers' knowledge, awareness and perceptions of different CA components. Soil erosion was perceived as a problem by 79% and 85% of farmers in Zimbabwe and Malawi respectively. Much fewer farmers in Zambia (54%) and Malawi (44%) said it was a problem in their fields. Few farmers in Zambia mentioned the use of conservation agriculture methods, to control soil erosion. In Zimbabwe, the ox-plough, used by 98% of the survey farmers, the dominant tillage method; only a few farmers (9%) used hand hoes. In Zambia the ox-plough is used by 70%;f hand hoes (26%) and basins (72%). In Malawi hand hoes are used by 96% of the respondents, only a few (4%) used ox-ploughs. In Northern Tanzania 52 % and 18% of the sample household used ox plough and hand hoes, respectively. About 47% reported having had tractor services provided by local institutions. The analysis reveals significant differences among and within the study districts implying the need to develop a suite of specific CA practices that are compatible to farmers' resource endowments- animal traction CA equipment for those who own cattle in Zimbabwe and Zamia labor saving tools for those using hand hoe in Malawi. i.
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Media Summary
Diagnosis of small farmer circumstances and asset base and their perceptions are critical in developing farmer friendly CA technologies

Key words
Resource endowment, farmer income, policy instruments, adoption

Introduction

Livelihoods of poor farm families in eastern and southern Africa are heavily dependent on agriculture, largely dedicated to subsistence farming. Maize, a staple food in most of the countries is the dominant crop grown for both subsistence and cash income. For most of these farmers maize accounts for 50-90% of the population's caloric intake, with the greatest reliance on maize for food among the very poor. Maize production and yield trends over the past 20 years show stagnation or decline in most of the countries (Siziba and Mekuria, 2004) exposing the many smallholder farmers to food insecurity and abject poverty. Recurrent droughts, floods and lack of inputs are some of the causes of maize yield decline. In southern Africa, degraded and infertile soils are the salient factor explaining the reduction in productivity (see Kumwenda, 1996).

The smallholder sector is characterised by maize mixed farming systems, which has resulted in a "maize-poverty trap" with reinforcing mechanisms of increasing land degradation, accelerating poverty and food in-security (SOFECSA, 2006). Soil erosion and land degradation problems have led to declining crop yields, and the inability of the crops to withstand even short periods of the more frequent droughts. Generally, soils are infertile and thin, with low soil organic matter content and little moisture-holding capacity, all exacerbated by excessive tillage and overgrazing, leading to low system productivity and food insecurity (Wall, 2004). The major cause of declining agricultural productivity in SSA is the deterioration in the natural resource base on which agriculture depends. Degradation of soils and other natural resources proceeds at a high rate largely due to low rates of use of sustainable natural resource management strategies (Barrett et al, 2002). Productivity-increasing, cost-reducing, resource-conserving technologies for maize systems can be considered as one alternative pathway for poverty reduction as well as for natural resource conservation. Resource poor farmers in southern Africa managing maize-based farming systems need to adopt intensification strategies to increase productivity from less than 1 t/ha to above 2-3 t/ha to be able to diversify to higher value crops that generate income (SOFECSA, 2006). A number of research and development efforts to combat the degradation of the natural resources base and to resolve declining soil fertility have been promoted in the region.

In eastern and southern Africa different institutions have tried to promote various components of CA and/ or CF mainly in commercial farms and in some cases in smallholder farms It is only recently(2004/2005) that CIMMYT started implementing a CA project with a range of partners in Malawi, Tanzania, Zambia and Zimbabwe. supported by a BMZ grant from the German government. CIMMYT and its partners (NARS and NGO) in the four project countries have been engaged in the evaluation and promotion of conservation agriculture technologies through a collaborative project. The paper presents the findings of a baseline survey undertaken in 2004-2005 season to characterize the dominant maize-based farming system, describe farmers' resource endowments and socio-economic attributes, understand factors influencing adoption of CA and farmers' knowledge, awareness and perceptions of different CA components.

Methodology

The main goal of the study was to understand elements of farming systems of farmers in targets sites with the view to assess factors likely to encourage or constrain adoption of conservation agriculture. The following were the specific objectives: characterize the maize-based farming system; describe farmers' resource endowments and socio-economic attributes; understand factors influencing adoption of CA and farmers' knowledge, awareness and perceptions of different CA components and establish benchmark indicators for future impact assessment,
A structured formal household questionnaire survey was used as the basic tool to collect socio-economic and technical production information pertaining to selected individual households. This enabled the research team to ask standardized questions and to collect uniform information from selected households. Issues covered by the formal household questionnaire survey included geo-physical information, socio-economic data, land tenure regimes, asset ownership, agricultural labor, agricultural inputs, land use systems, natural resources management amongst many issues. In each country the questionnaire was reviewed, pre-tested and fine-tuned to suite the local farmer contexts before the final use. In each country the surveys were conducted by CIMMYT in collaboration with a partner organization that provided their staff for enumeration and requisite facilities such as offices and transport. The enumerators were trained by CIMMYT personnel paying particular attention to ensuring uniformity in asking of questions and data collection of n in all the countries. In Zimbabwe the data collection was done during the period of October, 2004-January, 2005. In Shamva the survey was done in conjunction with Development Aid from People to People (DAPP), an NGO active in the district and in Zimuto

with Agriculture Research and Extension (AREX), of the Ministry of Agriculture. In Zambia data collection was done during February 2005 in conjunction with CLUSA, an NGO active in both sites, Kabwe and Monze. Data collection was done during April 2005 in Malawi in collaboration with the personnel of Chitedze Research Station of the Department of Agricultural Research and Technical Services (DARTS). In Tanzania, the surveys were conducted using November-December, 2005 with the Salian Agricultural Research Institute (SARI) and RECODA an NGO. Within the target sites, farmers included in the surveys were chosen using a random sampling procedure in order to get samples that were representative of these target sites. In Zimbabwe and Zambia where lists of farmers that resided in the target villages existed, farmers to be surveyed were selected randomly from these lists. In Malawi and Tanzania where the sampling frame did not exist, enumerators randomly selected from list households s that was provided by the local agents to constitute approximately representative samples. The compositions of the survey sample in the different sites are shown in Table 1.

Table1: CA Pilot study districts and baseline survey households sample distribution

Country	**District(zone)**	**Sample size**
Zimbabwe	Zimuto (south)	75
	shamva (North)	60
	Total	***135***
Zambia	Kabwe (Central)	59
	Monze (South)	63
	Total	***122***
Malawi	Kasungu(central)	58
	Mzuzu (North)	53
	Salima (Central)	48
	Liwonde (South)	60
	Total	***219***
Tanzania	Armeru(Arusha)	64
	Karatu(Arusha)	64
	Hanang(Manyara)	71
	Total	***199***

Results

The maize based farming systems

Surveyed households were about 26% headed by females. The level of education was low for the heads of households and all members of farm families. Land is allocated to annual crops, mainly to maize, groundnuts beans and limited area allocated to cash crops such as cotton and tobacco. Average yield of maize is below 2t/ha The area under maize ranged from 0.8ha(Malawi) to 3.4ha (Tanzania).The natural capital is made essentially of smallholdings and land of poor soil fertility with limited financial assets to invest on the land. About half of the households surveyed in Tanzania, Zambia and Zimbabwe and 82% in Malawi indicated facing a recurrent deficit in maize supply (the main staple crop)

Figure 1 below shows that maize was the major crop in all the study sites covering over half of the cultivated land area of the interviewed farmers in Zimbabwe, Zambia and Malawi 42% in Tanzania. This reflects the important role of maize as a staple food in the study and sites. In addition to growing maize for household food security, farmers grew other crops to earn cash

income. In Zimbabwe and Zambia, cotton was the major cash crop covering 17% and 11%, respectively of the total cultivated land area on the surveyed areas. In Malawi, cotton (6%) and tobacco (8%) were the main cash crops and in Tanzania, beans and pigeon-peas grown for both food and cash income, each covered a third of cultivated area. It is noteworthy that in all sites farmers grow grain legumes (groundnuts, cowpeas, beans) which are important oil and protein sources to complement maize. Surpluses of all crops were sold for cash. Farmers grew many other minor crops such as millet, pumpkins and vegetables (which were important income sources in Zimbabwe and Zambia).

Soil erosion was perceived as a problem by 79% and 85% of farmers in Zimbabwe and Malawi respectively. Much fewer farmers in Zambia (54%) and Tanzania (44%) said it was a problem in their fields. Few farmers in Zambia mentioned the use of conservation agriculture methods, to control soil erosion. In Zimbabwe, the ox-plough, used by 98% of the survey farmers, the dominant tillage method; only a few farmers (9%) used hand hoes. In Zambia the ox-plough is used by 70%;f hand hoes (26%) and basins (72%). In Malawi hand hoes are used by 96% of the respondents, only a few (4%) used ox-ploughs. In Northern Tanzania 52 % and 18% of the sample household used ox plough and hand hoes, respectively. The shortage and problem of crop residue management is further compounded by the prevailing community free grazing system which calls for a local collective action and solution in order to promote CA by the community. Although it is too early to observe any meaningful adoption of CA by smallholder in the region, the baseline data show that farmers have heard or have limited experience and knowledge of the different practices such as crop residue management, zero or minimum tillage but have not used the integrated practices of CA as promoted by CIMMYT.

Figure 1 Aggregate crop area allocation in the study sites of the four countries

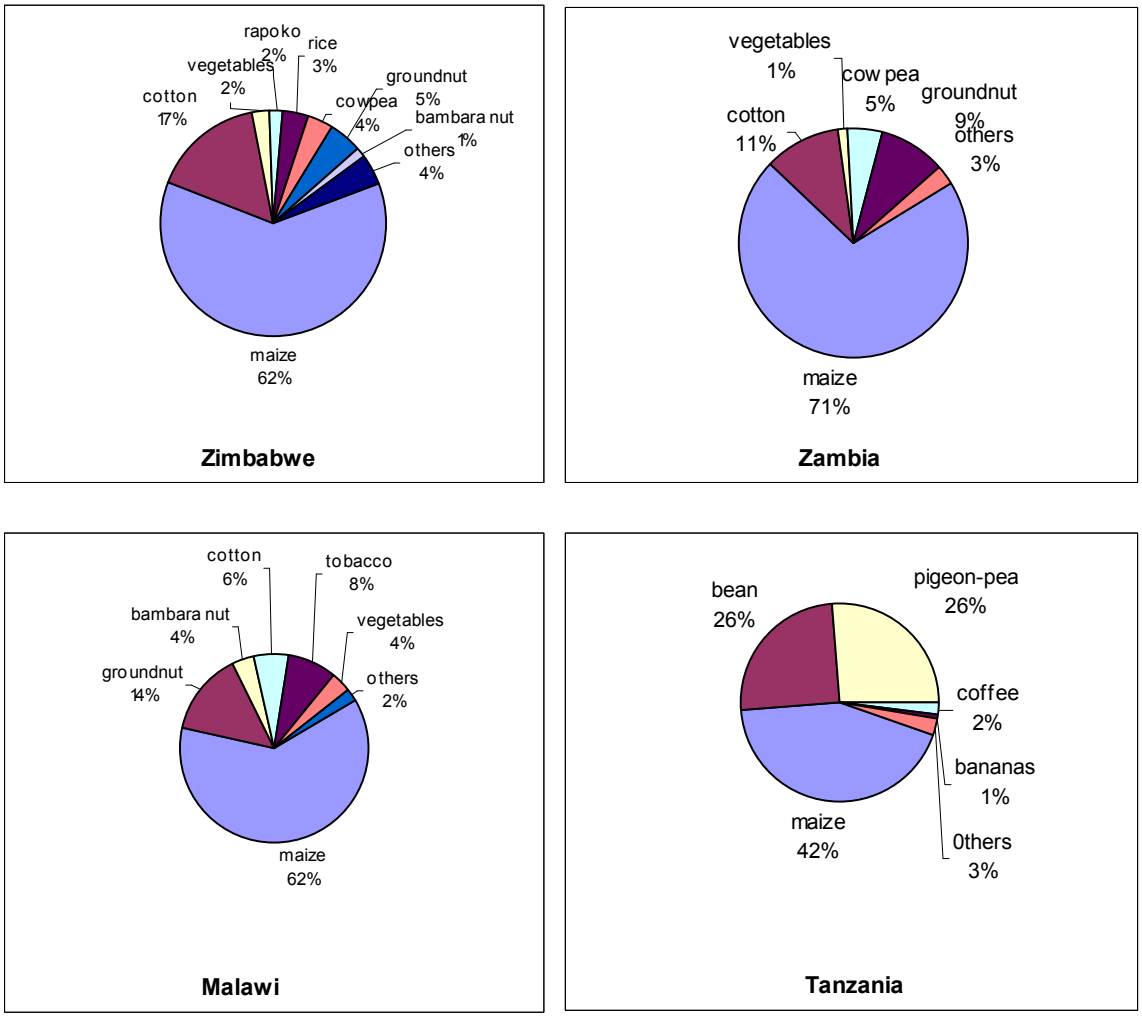


Table 2 Household income sources and their contributions to total income

	Zimbabwe		Zambia		Malawi		Tanzania	
	proportion of income	% of hhds	proportion of income	% of hhds	proportion of income	% of hhds	proportion of income	% of hhds
crop sales	0.20	65	0.23	65	0.29	68	0.35	70
vegetable sales	0.19	60	0.16	46	0.15	35	0.04	8
livestock sales	0.11	36	0.23	67	0.09	22	0.21	43
hire out family labor	0.09	29	0.09	25	0.22	51	0.15	31
remittance	0.14	45	0.14	39	0.06	14	0.09	18
formal salary/pension	0.06	20	0.01	2	0.03	7	0.00	0
beer brewing	0.08	24	0.04	12	0.05	11	0.02	4
petty trade	0.08	27	0.07	20	0.07	16	0.11	23
artsenry	0.04	12	0.03	10	0.05	11	0.02	5

Source survey data, 2005

Table 3 Income sources by household income groups

	Zimbabwe			Zambia			Malawi			Tanzania	
	Poor	Rich		Poor	Rich		Poor	Rich		Poor	Rich
	%	%		%	%		%	%		%	%
Crop sales	48	89		40	93		55	68		56	85
vegetable sales	48	63		34	65		24	50		5	8
livestock sales	30	59		50	77		11	34		32	51
hire out family labour	30	19		30	32		55	30		36	26
remittances	37	59		34	20		11	7		15	21
formal salary/pension	24	11		2	4		5	25		-	-
beer brewing	35	19		10	12		9	16		1	36
petty trade	19	33		14	12		10	21		17	5

Source survey data, 2005

Table 4 Resources ownership and distribution

	Zimbabwe	Zambia	Malawi	Tanzania
land holding(ha)	3.7	4.6	1.7	3.9
cultivated area(ha)	2.7	3.4	1.2	3.7
Per capita cultivated land (ha)	0.47	0.40	0.23	0.54
Cattle*	4.75(80)	3.75(51)	0.2(3)	2.5(62)
Sheep*	0.56(12)	0.05(2)	0.04(1)	1.92(45)
Goat*	2.02(49)	6.36(66)	1.29(24)	3.92(70)
Chickens*	11.96(95)	14.95(90)	5.52(65)	8.55(77)
ox-plough (%)	81.7	66	5.7	31.7
knapsack sprayer(%)	29.7	25.8	1.8	20.6
**in brackets are the percentage of house holds owning*				

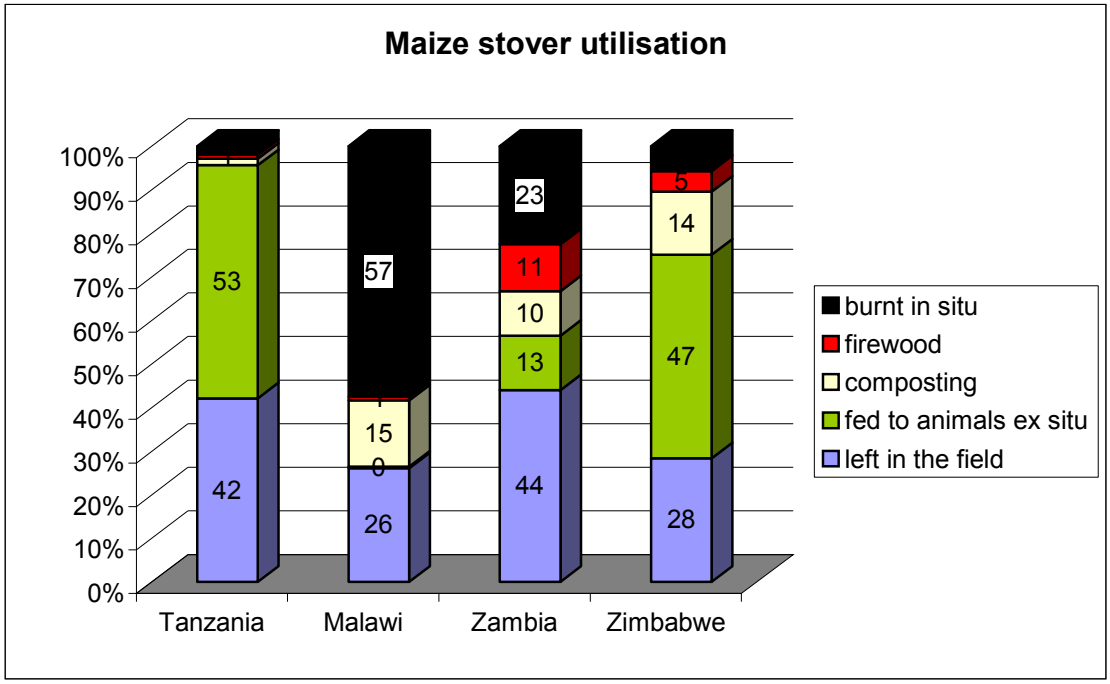
Source survey data, 2005

Conclusions

The survey attempted to document the knowledge, perception and understanding of the various components of CA such as erosion control methods, tillage methods used, crop residue

management strategies and constraints Smallholder farmers in the region are generally poor relative to other developing regions of the world. Analysis of the reported income, sources, distribution and asset ownership reveals significant differences among households in the study districts. This demonstrates the need to develop a suite of specific CA practices that are compatible to farmers' resource endowments. The poor households with limited asset base may be constrained to invest in CA equipment and practices. Hence a policy instrument targeted to support and enhance adoption of CA by smallholders in the region is suggested.

Fig. 3. Maize Stover Utilization



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