NATURAL RESOURCES SYSTEMS PROGRAMME

***PROJECT REPORT*[1]**

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Demand assessment study of resource conserving technologies in Chivi and Zimuto communal areas in Masvingo province, Zimbabwe.

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NRSP Production System

Semi-Arid

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Abstract

The study was carried out in two sites, Chivi and Zimuto. It had three major objectives: to characterise adopters and non-adopters of on-farm resource management technologies related to soil and water conservation, soil nutrient management and plant genetic resources; to identify the major production constraints faced by both adopters and non-adopters; and finally to assess potential demand for these and similar technologies.

The field research began with a qualitative survey using PRA methods in the two areas. Focus group discussions, scored causal diagrams, personal interviews, key informant interviews and use of visual aids like flip chart were the main techniques used. The PRA was followed by a quantitative survey that aimed at estimating potential demand for the various resource management technologies.

From both the PRA and quantitative survey, adopters were found to be those with large families, have better resource endowment (with implements, livestock and land), have some of their family members who received training related to agriculture, earn more income, have heads of households who are more educated, relatively older and are risk takers, were very committed to their farm work and had almost no off farm work. Non adopters, by contrast, had heads of households who were relatively younger, less educated, had other off farm work like marketing produce, had poor resource endowments, and almost none of their family members had received agriculture-related training.

The research found that demand does exist for the various technologies. However, the demand is higher for soil and water conservation and soil fertility management technologies, while it is very low for plant genetic resource conserving technologies. Comparing individual technologies, improved compost manure had the highest demand from the households in the study.

Highlighted production constraints included poor soils, lack of implements, shortage of draught power, excessively high prices for inputs (such as seeds), lack of market for produce, poor road network, and lack of knowledge on soil erosion prevention methods.

The major recommendations were (a) that there is need for widespread promotion of the technologies if adoption rates are to be increased, rather than concentrating promotion on selected villages; and (b) that there is need for in-depth research on more options from which all farmers either rich or poor could choose so as to increase the adoption rates for the various technologies. The option of providing material benefits to encourage adoption of the technologies is not sustainable.

Table of Contents

List of Tables

List of Appendices

List of Acronyms

AGRITEX	Department of Agriculture Technical and Extension Services
CDCS	Center of Development Co-operation Services
CI	Care International
CIMMYT	Center for Maize and Wheat Research
COTTCO	Cotton Company of Zimbabwe
DFID	Department for International Development
DR&SS	Department of Research and Specialist Services
EU	European Union
FGD	Focus Group Discussion
FSR	Farming Systems Research
FSRU	Farming Systems Research Unit of DR&SS
GMB	Grain Marketing Board
GTZ	German Technical Co-operation
HH	Hand Hoeing
ICRAF	International Center for Research in Agroforestry
ICRISAT	International Center for Research in the Semi-arid Tropics
IES	Institute of Environmental Studies
IOPV	Improved Open Pollinated Varieties
ITDG	Intermediate Technology Development Group
IUCN	International Union for the Conservation of Nature
NR	Natural Region
NTS	National Tested Seed
OPFP	Open Plough Furrow Planting
OPHH	Ordinary Ploughing Hand Hoeing
OPV/IOPV	Improved Open Pollinated Varieties
PB	Participatory Budget
PGR	Plant Genetic Resource Conservation
PRA	Participatory Rural Appraisal
RIP	Rip in Plough
SADC	Southern Africa Development Community
SCD	Scored Causal Diagram
SFM	Soil Fertility Management
Soil Fert Net	Soil Fertility Network
SPRL	Soil Productivity Research Laboratory
SWC	Soil and Water Conservation
TFP	Third Furrow Planting
UZ	University of Zimbabwe

Chapter 1: Introduction

1.1 Background to the Study

The objective of the present study was to assess the likely demand for future research on natural resource conserving or management technologies among farmers in semi-arid areas. The research was conducted in 2000, in parallel with a similar study in Tanzania[1].

In Zimbabwe, the semi-arid zones cover up to 65% of the total land area and productivity in these areas is so low that it cannot support the 70% of the country's total population that inhabit them. In order to increase productivity, while at the same time ensuring sustainability of natural resources, there is a need for (a) action to be taken to conserve and enhance the resource base and (b) new more productive techniques to be introduced into farming systems. Such action and techniques need to focus on three things: (i) enhancement of the physical and nutrient status of the soil, (ii) making efficient use of the limited available rainfall, and lastly (iii) preservation and enhancement of plant genetic diversity and enabling households to benefit from new genetic material. However, even though research has shown that productivity and sustainability of resources can be improved through new and modified technologies, uptake of such technologies has been very limited.

Several problems have been encountered in research and development of technologies because semi-arid areas have a high degree of variability in farm conditions (soils, rainfall received, slope etc). Results are very site specific. Furthermore, variability in rainfall amount and patterns both within and between season leads most households to adopt strategies for minimising risk, rather than maximising output. It is therefore crucial that the household risk management strategies be analysed and taken into account in order to address the question why some technologies are tried, while some are not. Currently, soil erosion is widespread in Zimbabwe despite efforts over many years by research and extension organisations. Farmers in the semi-arid areas have not put much effort into halting it. Also, fertiliser use in the smallholder sector has been said to be generally very low and less effort has been put into management strategies for enhancing soil fertility. Research, however, has found out that a combination of both organic and inorganic fertilisers is essential to increase crop productivity. Farmers in the semi-arid regions are also noted for not making much use of improved plant genetic resources, despite the fact that some of these improved varieties could be very suited to the farmers' particular conditions and can increase productivity. It is important though to note that these three facets of on-farm resource management cannot be looked at in isolation since they interact with each other and with the other features of the farming system.

The major aim of the project was to provide information to assist in decisions about future investment in research on resource management technologies, with a view to contributing to the development and validation of new catchment strategies. The immediate objective was to improving understanding of decision making by households in relation to technologies that had been promoted and have a potential for maintaining or enhancing sustainability of natural resource use, while at the same

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time improving productivity. This in turn was expected to help identify factors that influence demand for such technologies by resource poor farmers.

1.2 Adoption of Technologies: Background

Traditional extension approaches have been a top down process where extensionists took the technologies developed by scientists as the "best" option for the farmers. These approaches were based on the model of innovation diffusion. Under this model, adoption is seen as a complex pattern of mental processes and activities occurring in the following stages: awareness, information, evaluation, trial and, in the end, adoption. Adoption is seen as normally distributed when graphed with frequency over time, and this has led to the identification of such farmer categories as innovators, early adopters, early majority, late majority and laggards. These categories, however, have been widely criticised as incorporating a technology bias and assuming that the innovation in question ought to be adopted by all farmers eventually. Several factors have been singled out by other researchers as affecting adoption of technologies and these can be classified under the following broad categories (Daberkow and Mcbride, 1998).

Factors related to attributes of the farmer

Number of years spent in school, learning styles, beliefs, values, socio-economic status, years of experience in farming, extent of off-farm employment, sources of information for the technology and risk preference are some of the attributes of the farmer that are believed to affect adoption of technologies. It is hypothesized that adoption rates increase with an increase in number of years in education, since it enhances farmers' understanding of the technology and also of how it can be implemented. High levels of off-farm employment were found to reduce adoption of technologies because it competes with the farmer's farm management time. Beliefs underlie attitudes towards various practices and if a farmer believes that adopting a certain technology would improve his or her production process, that farmer is likely to adopt it. Adoption of technologies therefore, is mainly associated with positive attitudes. However, also important is being prepared to abandon old ways that do not enhance better management strategies. In Australia older farmers of 40-50 years of age are believed to have more years of production experience, and are considered to be generally innovative and more willing to try out new technologies (Guerin and Guerin, 1994)

Also, some research has shown that lack of understanding about the nature of risks involved with an innovation that is being promoted is more likely to be associated with non-adoption. Knowledge on how much the innovation will cost, how it can be used, and what benefits can be expected by its use has been said to lead to adoption of technologies. This highlights the importance of appropriate information in reducing uncertainty for decision-makers..

Factors related to the physical attributes of the farm

Some studies (ibid.) have suggested that soil type, landscape, pests, and microclimate and many other location-specific factors affect a farmer's decision to adopt a given technology. Technologies for on-farm water conservation are mainly adopted by farmers in dry areas since they have inadequate water supply. Also, farmers with steep slopes are more likely to adopt stone terraces than those with flat fields.

Factors related to the structural and financial characteristics of the farm

Farm size, farm ownership and financial situation of the farm have been identified by some researchers (ibid.) as affecting adoption. Technologies that require large fixed costs are more likely to be adopted by large farms than small ones, while those linked to long term improvements to land are more likely to be adopted by land owners than non-land owners.

Factors related to the nature of the innovation and its development

Innovations that are simple and relatively easy to understand are more likely to be adopted than those that are complex. Also, technologies whose benefits are easy to see are more likely to be tried out than those whose benefits are not readily visible, at least in the short term. There is also the question of incentive: where the positive effects of implementing environmentally sound practices in situations are felt largely offsite, farmers may find it difficult to see why it is in their interests to adopt them. Technologies which farmers perceive to be relevant to their situation are more likely to be adopted than irrelevant ones. It is believed that farmers select technologies or practices that are consistent with their needs, socio-economic status and production goals.

Factors related to communication and the transfer process

For technologies promoted through demonstrations and field days, innovations with easily observed results are easier to communicate and more likely to be adopted. Also, adoption of technologies is associated with use of communication channels which are appropriate for the target group. For instance, use of television to promote a given technology in an area where the farmers for whom the technology is appropriate do not have access to television sets is more likely to result in non-adoption of the technology.

1.3 Objectives of the Study

Experience with innovations in on-farm resource management suggests that these are often not widely taken up by farmers, despite their apparent potential benefits in terms of both conservation and productivity. There is therefore a need to guide future research investment decisions by assessing the potential demand for such technologies, and suggesting how the process of their development might facilitate more widespread uptake in the future. The research set out to characterise adopters and non-adopters of resource conserving technologies [Soil and Water Conservation (SWC), Soil Fertility Management (SFM) and Plant Genetic Resource (PGR) conservation], identify the constraints to their adoption, and assess future potential demand for such technologies in the semi-arid areas of Zimbabwe.

1.4 Description of the Research Sites

Two research sites were chosen, based on the following criteria: high concentration of small-scale farm holdings, within Natural Zones 4 or 5 (i.e. semi-arid), where on-farm resource degradation is widely recognised as a problem, and where resource management technologies have been promoted for several years.

1.4.1 Chivi Communal Area

Chivi is one of the communal areas in Masvingo province in the southern part of Zimbabwe and covers a total area of 3 534 km^2. The total number of inhabitants in the area exceeds 150 000 people.

Soil Types
Soil types in Chivi range from heavy clays to granitic sands (Scoones et al, 1996). Heavy soils are usually associated with *Colophospermum mopane, Combretum species,* and on lower slopes, particularly in old field sites, *Acacia tortilis.* On the other hand, the sandy soils are typified by miombo woodland, with *Brachystegia spiciformis* and *Julbemadia globiflora* being key tree species (Scoones et al, 1996).

The response of crops to these different soils suggests fundamentally different ecosystem dynamics in these different environments. Low infiltration rates in the heavy soil area means that high rainfall levels must be received before effective crop production can occur. The relatively higher fertility in heavy soils means that potential production under good rainfall conditions or appropriate water management is higher than on sandy soils. However, because of low fertility in sandy soils, lack of significant inputs results in poor yields even in times when good rainfall conditions are experienced.

Rainfall
Annual rainfall is highly variable in Chivi. A maximum amount of 1160mm per annum was obtained in 1917-1918 and a minimum of 143mm per annum was obtained in the 1991-92 drought season (Scoones et al, 1996). The average annual rainfall between 1914 and 1992 was 548mm per annum (ibid.). Variation in amount of rainfall is experienced even within a given season, and mid season droughts are frequently experienced. Because of its unreliable rainfall, Chivi is considered to fall within the semi-arid areas in Zimbabwe.

Topography
Within the broad environment of the area, a range of microenvironments and landscape patches can be found. Variation in topography in the undulating landscapes is particularly important in forming this micro-level spatial variation (ibid.). Catenal sequences typically involve a gradation from upland areas through transition zones to sink areas at the bottom of the slope. Differential transportation and deposition of soil and water across slopes create different components of the landscape with differing agricultural potential (ibid.).

1.4.2 Zimuto Communal Area
Zimuto communal area is located to the north of Masvingo town, in Masvingo province. The area falls within Natural Region 4 (NR4) of the Zimbabwean ecological classification system. NR4 is considered highly suitable for extensive farming and receives an annual rainfall of 450-650mm per annum. It is characterised by sandy soils with low organic matter and humus content, and consequently low soil fertility. Farming activities in the area are considered risky because of highly variable rainfall that affects biomass production, fluctuating nitrogen fertilizer and farm output marketing prices and unreliable yields.

1.5 Layout of this paper
The rest of the paper is divided into four chapters. Chapter 2 presents the research methodology and limitations of the research. Chapter 3 discusses the qualitative field study (PRA) while Chapter IV discusses the quantitative data collection (sample

survey). Research findings are discussed under each section. The paper ends with Chapter 5, which highlights the major conclusion and recommendations of the study.

Chapter 2: Research Methodology

2.1 Introduction

The study involved both qualitative and quantitative methods of data collection. Qualitative data enabled the farmers to identify characteristics which distinguished between adopters and non-adopters of resource management technologies and to explore constraints to adoption, while quantitative data collection helped in estimating the distribution of these characteristics among the local population and hence the potential demand for the various technologies. Prior to primary data collection in the field, a desk review of published and grey literature was conducted, which helped in highlighting areas where technologies for soil and water conservation, soil fertility management and plant genetic resource conservation were promoted in the semi-arid regions of Zimbabwe. This review was supplemented by informal interviews with scientists who had been, or were currently, involved in researching the technologies. The findings of the review are given below.

2.2 Desk Review

This section discusses the various technologies that have been promoted in different areas, how they were promoted and evidence on adoption rates.

2.2.1 Soil Nutrient Management Technologies

(1) Chihota and Svosve Communal Areas

Extension workers and farmers conducted over 100 demonstrations in 1998/99 with farmer groups in Chihota and Svosve communal areas. These demonstrations were run by AGRITEX from Marondera district. Farmers were exposed to soil fertility technologies and were allowed to evaluate them. Soil Productivity Research Laboratory (SPRL) in Marondera assisted with soil analysis. The Rockefeller Foundation was the funding agency for the project.

The demonstrations covered the following technologies: application of lime and fertiliser to maize fields, herbicide on maize, soybean rotation, groundnut rotation, mbambara nut rotation, velvet bean green manure intercrop with maize, velvet bean green manure sole crop, sunhemp green manure intercrop with maize, sunhemp green manure sole crop. However, most of the demonstrations involved the liming of maize fields (The Soil Fert Net Coordinator, Nov. 1999).

Group interviews were conducted during about 30 field days with farmer groups in Chihota and Svosve communal areas in February 1999 to get farmers' opinions and feedback on the technologies. An end of season workshop was also held for all stakeholders in late June 1999 to discuss the results of the demonstrations.

Soil Fertility Network members reported that most of the farmers appreciated the benefits of applying lime and were interested in sunhemp and velvet bean green manures. However, it was felt that more simplified demonstrations would benefit the households. There was also a need for further research into profitability of the technologies. The issue of adoption of the technologies was not dealt with and remains outstanding.

(2) Soybean for Communal Areas

Soybean is largely grown by large scale commercial farmers in Zimbabwe who produce over 90% of the crop, mainly in rotation with wheat (Pompi, *et al.*, 1998). A Zimbabwe Soybean Promotion Taskforce comprising members from AGRITEX, University of Zimbabwe and others, was formed in 1996 to promote soybean production, marketing and consumption in communal areas. The Rockefeller Foundation and APPROMA (a European Union supported commodity organisation) funded the activities of the taskforce.

The taskforce promoted in 1996-97 the use of 'promiscuous' or naturally nodulating varieties such as Magoye and also the use of specific varieties such as Roan together with rhizobial innoculants from Grasslands Research station in Marondera. It also promoted maize growing in rotation with soybean crop and trained households in processing and preparation of several dishes from soybean. The taskforce subsidized inputs for the participating households.

The soybean technologies were promoted by the taskforce in areas already growing soybean. These included Kachuta in Guruve district, Chiweshe in Mazowe district, Hoyuyu resettlement in Mutoko district, Sadza in Chikomba district, Chikwaka in Goromonzi district, Mhondoro in Chegutu district, Kazangarare in Hurungwe East district and Chinyika in Makoni North district.

The soybean was successfully grown by smallholder farmers. The need for more training was identified in rhizobia innoculants, basal fertiliser and correct planting density. While the project is on- going, the issue of adoption has not been adequately addressed.

(3) Fertiliser-Based Soil Management Package

A fertiliser-based Soil Management Package was developed for variable rainfall in communal areas throughout the country (Piha 1996). The promotion of the package has been on-going since 1994 in all natural regions including areas of Mhondoro, Manyene 1 and 2, Nharira, Dora and Marange communal areas. The Rockefeller Foundation through the Soil Fert Net has been funding the project. The Soil Fert Net, Department of Soil Science and Agricultural Engineering have been involved with the project.

Extension workers were familiarised with the package and master farmers were selected in the project areas to participate. The recommended package is given in Box 1 below.

Adoption rates for the Soil Management Package by farmers have not been assessed. However, it is reported that average yield increases of between 54% and 101% and average profit increase for households of between 62% and 109% have been achieved by those farmers who have adopted it.

Box 1: Summary of the optimum fertiliser management approach and rates for Natural Regions II, III and IV

1. Estimate 'optimum' yield of maize for a given area, based on maximum yield attainable in an 'average' rainy season. For sandy Zimbabwean soils optimum yield estimates are: NR III-3.5 t/ha; NR IV-2.2 t/ha.

2. Estimate nutrient removal by the 'optimum' crop indicated above. Where residues are removed from fields, estimated nutrient removal per tonne of grain is: 20kg N; 18kg K; 4.5kg P; 4.5kg S; 4.5kg Mg; 4.5kg Ca.

3. Estimate generalised quantity of nutrients supplied by the soil. For inherently nutrient poor, low organic matter, sandy granite soils, which have been cropped continuously for many years, the estimated soil nutrient contributions are: negligible N, P, S; sufficient K for 75% of crop needs; sufficient amounts of all other nutrients to meet crop needs.

4. Estimate nutrient addition required to attain optimum yields i.e. amount required by crop minus amount supplied by soil (2-3). Calculated nutrient requirements (kg/ha) from above are:
   NR II: 106 N, 24 P, 24 S, 24 P
   NRIII: 70 N, 16 P, 16 S, 16 P
   NRIV: 44 N, 10 P, 10 S, 10 P

5. For nutrients which are 'stored efficiently' (i.e. P, K, S), these amounts are broadcast and incorporated annually as a pre- plant application. These rates can be approximated by use of Compound L fertiliser (5:18:10) at the following kg/ha rates: NR II 300; NRIII 200; NR IV 135.

6. Nitrogen fertiliser rates are adjusted according to the rainfall pattern during the on- going season.

7. Ammonium nitrate is broadcast on three occasions during the growing season (i.e. 10 DAE; 30 DAE; tasselling). The amount applied at 10 DAE is fixed at 50 kg AN/ha. For the subsequent applications, the rate applied varies, depending on the degree of visible drought stress experienced since the previous application. No nitrogen is applied if there has been severe wilting; a high rate is applied if there has been no stress; intermediate rates are applied for moderate stress situations.

8. In practice, the optional kg/ha rates of ammonium nitrate are: 0, 50, 100, 150 – NR II; 0, 50, 100 – NR III; 0, 33, 67 – NR IV. When used in combination with the small amount of N applied with Compound L (5% N) this results in the following total N rates: NR II 32- 132 kg/ha; NR III 27 – 95 kg/ha; NR IV 24 – 67 kg/ha.

Source: Piha, 1996

(4) Green Manures

The Farming Systems Research Unit (FSRU) of the DR&SS carried out from 1992 to 1996, on-farm experimentation with farmers in the Musami and Muchinjike wards of Mangwende communal area. It experimented with cowpeas, sunhemp and *dolichos* that were intercropped or rotated with maize to improve soil fertility, reduce striga (witchweed) infestation and improve maize yield (Chibudu, *et al.* 1998). The Rockefeller Foundation through the Soil Fert Net funded these farmer participatory green manure trials.

Maize yields improved where velvet bean was involved in rotation but not when intercropped with maize. Eleven farmers have volunteered to continue work with the FSRU team in year 2000.

The Rockefeller Foundation through the Soil Fert Net, starting in September 1998, carried out trials in Chiduku communal area in Rusape on velvet bean green manure within local cropping systems. The project subsidized velvet bean seed to one farmer group and is still on- going. The project generated interest in velvet bean. It was decided to provide in the 1999-2000 season some more *C. Grahamiana* seed to more farmers in the area.

The EU through the Institute of Environmental Studies at the University of Zimbabwe (UZ) supported pigeonpea growing in Domboshava Training Centre and Mukarakate area in Murehwa communal area between 1996 and 1997. The Soil Science department at UZ and SADC/ICRAF were involved in the project. The pigeonpea was intercropped with maize and cowpea as a traditional legume on twelve on-farm sites selected for the three short, medium and long varieties of pigeonpea.

The farmers preferred a pigeonpea crop that matures at the same time as most crops to avoid extra protection measures (Mapfumo, *et al.* 1999).

(5) Cattle Manure

A survey on farmer cattle manure practices was carried out in Mangwende communal area with funding from Rockefeller Foundation and the Soil Fert Net. The Chemistry & Soil Research Institute of DR&SS and Africa Centre of Fertiliser Development were the participating organisations in the survey.

The survey assessed the traditional farmer manure practices and came out with recommended cattle manure technologies (Nzuma, *et al.,* 1996). These technologies which are being promoted throughout the country include the following: use of crop residues to absorb nutrients from urine, pit storage of manure combined with the use of crop residues in summer and winter to reduce drying and leaching in hot and wet periods to enhance quality, anaerobic treatment of manure and improvement of pastures by planting legumes that leads to better dung quality. (Nzuma and Murwira, 2000). The adoption of these cattle manure technologies has not been assessed.

2.2.2 Soil and Water Conservation Technologies

(1) Chivi, Zaka and Gutu Districts

The Soil Science department at UZ and AGRITEX were involved in SWC technologies in the Chivi, Zaka and Gutu districts in 1993. GTZ funded the projects, which were co-ordinated by the Centre of Development Cooperation Services (CDCS) and Free University of Amsterdam. The technologies were tied ridges and fanya juu in the three districts, and mulch tillage, strip cropping and vetiver grass in ward 25 of Chivi. The farmers involved were free to adapt the technologies to suit their conditions. Adoption of these technologies has not been assessed.

(2) Tillage and Weed Management Technologies

The Government of Zimbabwe and DFID funded participatory on-farm research involving researchers, extensionists and farmers between 1995 and 1998 in the Zimuto communal area and Mshagashe small scale commercial farming area adjacent to Makoholi Experimental station in Masvingo. The Institute of Agricultural Engineering and AGRITEX Masvingo, Agronomy Institute at Makoholi Crop Production Unit, and Natural Resources Institute of UK were the organisations involved in the project.

The project experimented with several technologies. They included farmer practice of third furrow planing (TFP) into the plough furrow to be subsequently covered by the next pass of the plough; planting into a 0.2 to 0.3 metre deep rip line created by a tine mounted on a standard plough beam; and open plough furrow planting (OPFP) in which seed is planted into furrows opened with a single pass of a plough at the desired inter- row spacing, on previously ploughed land, and subsequently covered with a hand hoe.

2.2.3 Plant Genetic Resources Conservation Technologies

ENDA-Zimbabwe with the assistance of NOVIB, and organisation based in The Netherlands, promoted a small and coarse grains project in Chivi, Zvishavane, Mutare East, Makonde, Gokwe, Lower Gweru and Plumtree in the period 1988 - 1998. The project encouraged farmers to be seed producers of pearl millets (PMV1), sorghum (SV1, SV2) and cowpeas (T18). Adoption of these grains has not been assessed.

2.2.4 Recommended Sites

After the desk review, three sites were recommended and these were Zimuto, Chiota and Zimuto communal lands. However, since the focus of the study was on semi-arid areas, Zimuto and Chivi were finally selected since they fall within Natural Regions IV and V, which are considered semi-arid. The technologies promoted in each site are given in Table 1.

Table 1: Recommended Sites

Region	Site	Why choose site?	Promoter	Funding agent	Time when project started	Adoption
Natural Regions IV and V	Chivi, ward 25	Technologies fall under two of the three areas of interest – SWC[2] and PGR[3]				
		SWC	Soil Science Dept, UZ, ZFU, DR&SS	GTZ, ITDG	Mulch tillage and Fanja Juu: 1991–1995; Stripcropping and vetiver grass: 1996-present	Unknown
		PGR	ENDA Zimbabwe	NOVIB Holland	1988 –1998	Unknown
Natural Region III	Chihota communal lands	It has several technologies under SNM[4]	DR&SS, AGRITEX	Rockefeller	1994	Unknown
Natural Region IV	Zimuto Communal lands: Maraire, Marange, Mashagashe Sites	The project to promote the SWC technology has been completed and a soil fertility project has been initiated recently (first season 1999–2000)	DR&SS, CARE International	DFID	1992	Unknown

2.3 Qualitative Study

2.3.1 Research Design

Before going to the field, the participatory farm management research techniques Scored Causal Diagrams and Participatory Budgets (Galpin *et al.* 2000) were pre-tested in Chinamhora communal lands, and Focus Group discussions in Mahusekwa communal lands. This helped in equipping the researchers with the necessary skills required for conducting the qualitative research. The PRAs in the two sites were conducted in parallel by two teams of researchers, consisting of two researchers each.

In Chivi, discussions with farmers began with identification of technologies that have been promoted in the area and identification of adopters and non-adopters of the various technologies. This was followed by focus group discussions (FGD) with each of the groups. Scored Causal Diagram (SCD) and Participatory Budget (PB) exercises were conducted later on. The FGD yielded information on characteristics of adopters and non-adopters, production system constraints, advantages and disadvantages of the various technologies, household decision making process, prediction for future adoption rates and reasons for adoption and non-adoption of the various technologies. SCD were useful in ranking production system constraints, while at the same time

[2] SWC – Soil and Water Conservation
[3] PGR - Plant Genetic Resources
[4] SNM – Soil nutrient management

considering linkages between the various constraints. PBs helped to show resource deployment and returns for adopters and non-adopters.

In Zimuto the research team started with some key informant interviews. These generated an overview of the village scenario with regard to the history of SWC and soil fertility technologies introduced in the area, names of institutions involved in the promotion of the technologies, advantages and disadvantages of the technologies, characteristics of adopters and non-adopters and profitability of some of the technologies. The team used the key informants as their entry points to the villages.

2.3.2 Techniques

Participatory Rural Appraisal (PRA) is a useful approach to involving farmers in the diagnosis, implementation and evaluation of a technology. It involves the use of various tools, including group discussions, key informant interviews, resource mapping and pairwise ranking. Various PRA tools have been used widely and have helped in understanding farmer circumstances. The methods have demonstrated that rural people have the abilities to rank, score, diagram and map, if given an opportunity to do so, independent of their literacy level (Galpin *et al*., 2000). New techniques, in particular participatory budgeting (PB) and scored causal diagrams (SCD), have been developed to overcome the weaknesses of conventional farm management methods and these were used in this research. Also, focus group discussions (FGD) and visualisation techniques, such as use of flip charts, were used when conducting the PRAs. The following section presents a brief description for each one of these techniques.

SCD

According to Galpin *at al*, 2000, SCD "*help to examine in detail the causes and effects of problems and to identify the root causes which need to be addressed. The scoring procedure helps to analyse the relative importance of the problems and prioritise them*" (p.10). SCD enables a holistic approach to problem definition and analysis, and hence each problem is not analysed in isolation. The ranking process takes into account the linkages between the various problems and in many cases one problem could be a cause of other problems. However, it is important to know that a SCD is not a definitive statement: it is just a tool that helps an in-depth analysis of problems with farmers. In this study, SCD were constructed by different groups of farmers, adopters and non-adopters, and the problem ranking and scoring was later compared for the two groups. The method involves identifying, with a group of farmers, a focus problem (through a process of ranking among a list of problems articulated by the farmers); building up a cause-effect tree; and then scoring the various causes by distributing a set of points or markers among the various causes at each level.

PB

This is a very important tool for planning purposes. It encourages farmers to explore and articulate their use of the resources at their disposal. It involves quantifying resources, including those with no immediate cash value, and looking at their use over time. The method proceeds by drawing up a matrix on the ground or a large sheet of paper, with columns representing periods of time (e.g. months) and rows representing different categories of resources and outputs. Through discussion with farmers (either individually or in groups), entries are made in the cells of the matrix, and row and column totals or summaries derived as appropriate. PBs are mainly used for (a) analysing the farmer's production process, activities and use of resources, (b) exploring the impact of change of enterprise on resource availability, (c) comparing viability of different enterprises, and finally (d) planning for new enterprises on the farm. In the study, PBs were used for analysing production processes, resource use and returns for adopters and non-adopters of the focus technologies.

FGD

This involves facilitating a group of farmer representatives to air their views on given issues. The facilitator uses an interview checklist to guide the discussion, and participants are free to give their views, mostly for people they represent and not their individual opinions as such. A facilitator of the FGD should be able to create an environment which involves all participants in the discussion. Such an environment can be achieved by making sure that those who are quiet or shy are given the opportunity to speak, rather than having one person dominate the discussion. In the FGD, visualisation techniques like flip charts can help to make the discussion livelier. Discussions can also be captured by use of tape recorders. Tape recording, however, has its own advantages and disadvantages.

2.3.3 Selection of study areas

The desk review showed that soil and water conservation technologies, plant genetic resource conservation and soil fertility management technologies have been extensively promoted in Chivi and Zimuto. As indicated above (section 2.1), Chivi and Zimuto were chosen for this research because all categories of the technologies under study were found in the two areas, and had been widely promoted for a long time. The areas were also near to each other, and this helped to reduce transport costs[5].

2.3.4 Selection of villages

According to AGRITEX, Ward 25 in Chivi consisted of five villages, A, B, C, D and E. However, farmers did not even know the boundaries of these five villages and used their own traditional method to demarcate the area into villages. According to the farmers, there were 35 villages in Ward 25 and these are listed in Box 2 below. The researchers decided to use the farmers' perception of villages rather than the administrative boundaries recognised by government agencies. Choosing the villages was mainly determined by accessibility. Most roads in Chivi were very bad and many of the places were virtually unreachable. We therefore decided to select those villages that were nearer to the main roads and these were Mbaimbai, Gomana, Nduna and Pedzisai 1.

In Zimuto, promotion of technologies was site specific and this influenced the selection of villages. The targeted villages for promotion were the ones selected and these were Maraire, Maranda, Chikato and Mahoto. These have been targeted for promotion of soil fertility management technologies that had been introduced in the area.

[5] The fieldwork in Chivi and Zimuto took place during a period of acute fuel shortages in Zimbabwe (April – June 2000)

Box 2: Villages in Ward 25

Pedzisai 1	Mavuraya	Gwanema
Mbaimbai	Runesu	Mutiri
Guti	Tawanda	Mhaka
Imbayago	Mupandawana	Richard
Puche	Sauro	Gwaendepi
Mukwazvure	Tarusarira	Mazhata
Nduna	Tarusarira	Mandirera
Mutote	Mupfigo	Taperesu
Zvirikure	Dhobhani	Pfidza
Mataya	Makuvire	Sivindani
Musenderi	Musikavanhu	Chitofu
Chindege	Vengai	

2.3.5 Limitations

Some of the problems and limitations faced when conducting the PRAs in Chivi were:

- Attempts to organise meetings with farmers through AGRITEX failed to yield expected results. The AGRITEX worker only invited adopters who were in one group, and left out all the non-adopters. Also, when the research started, it was just before a public holiday and the AGRITEX extension worker was not willing to help us. Later on, we resorted to organising meetings through the traditional leaders, and this was very successful in bringing both adopters and non-adopters.
- Most roads were unreachable by car and hence only the areas near a motorable road were selected. This was partly because of the need to keep the fieldwork costs within budget, but also because of the uncertain security situation in rural areas of Zimbabwe at the time of the research.
- Farmers refused to be divided into male and female groups, and women complained that this would make them fear men. Sometimes after scheduling to meet with only women, their husbands would also come, and it would have been rude if they were dismissed. We later on discovered that this was based on their past experiences: some researchers required every person to bring his/her spouse to any organised meeting.
- Since we were meeting the different groups, adopters and non-adopters, on different days, it was difficult to let both groups draw up one diagram to be scored separately. Most farmers had to walk long distances to come to a meeting, and it was time consuming on their part to come on two consecutive days, to the organised meetings.

2.4 Quantitative Survey

The overall research design required the estimation of the distribution in the population of characteristics which distinguish adopters from non-adopters of the three types of NRM technology, and of the critical constraints to adoption of the technologies. The characteristics were identified through the participatory qualitative study. A sample survey was then carried out, to collect data on the distribution of these characteristics in a random sample of farming households in the study areas. A questionnaire for the survey (Appendix 4) was designed using information from the PRAs. The survey sample was made up of 265 households. The distribution within the population of the constraints to adoption was crucial in estimating and quantifying potential demand for the various technologies by non-adopters and also the percentage of the population that are unlikely to adopt the technologies.

2.4.1 Selection of Villages

The survey was conducted in five villages in each site. The selected villages in Chivi were Guti, Taperesu, Mazhata, Mandirera and Pedzisai 1. The villages in Zimuto were, Marongere, Chinyan'anya, Gorejena, Musenda and Chiwenga.

2.4.2 Selection of Households

The target sample for each site was 130 households, and these were equally distributed across the five villages and 26 respondents were interviewed in each village. However, in some cases, the total number of households in the village was less than 26. There was a random selection of households in villages where the total number exceeded 26 and the households were close together. In villages where households were scattered all over the place and it would have been time consuming for the enumerators to walk to the remote areas in the village which were inaccessible by vehicle, the sample frame was restricted to those households which were readily accessible. This inevitably biased the sample towards households which have more access to means of transport; however given the budget constraints for the survey and the unstable political situation, it could not be avoided. For the random sampling, the number of households was obtained from the village head and enumerators interviewed respondents from every third household they came across in a straight line until the target number was reached.

2.4.3 Selection of Respondents

The person actively involved in farming and decision-making processes was interviewed at each household. In that regard, the chosen respondents were either (1) husband and wife (treated as a single response) or (2) husband or wife or (3) the eldest child in a family where the parents were deceased or lastly (4) the workers, at homesteads where the owners of the homesteads stayed in town.

2.4.4 Survey management

Questionnaires were pre-tested in Chinamhora communal lands (where some of the technologies under study were promoted by the Institute of Agricultural Engineering) before going to the field. The survey was conducted in series by the research team, starting with Chivi and finishing with Zimuto. It took two weeks to complete the survey in each site, and a day was set aside at each site for training the enumerators. A total of five enumerators from five different villages were selected and each one collected data from his or her own village. This made the whole process much faster since the enumerators did not have to walk long distances during data collection. Meetings were held at the end of each day with all the enumerators to discuss the problems encountered. The meetings facilitated learning from each other's experiences among the enumerators and also between the enumerators and the researchers.

Completed questionnaires were checked/ inspected for errors at the end of each day and the whole process was monitored by the researchers.

2.4.5 Limitations of the Research

The following limitations were faced when conducting the survey.

- The selection of villages was limited due to inaccessibility of other villages and was therefore biased to some extent (for both the PRA and the quantitative survey)

- Because of the unstable political situation during the time of the survey, most respondents were not free to air their views as they were suspicious of the motives behind the study
- Enumerators collected data from their own villages and this could have had some effect on the data collected. It is possible that some respondents could not take the enumerators seriously since they were relatives, or that they would not give a frank answer to questions posed by someone they knew.

Chapter 3: Qualitative Study

3.1 Chivi PRA Findings

3.1.1 Technologies promoted in Chivi, Ward 25

Discussions with farmers revealed that several technologies have been promoted in the four villages in Chivi and these are presented in Table 2. The inventory of the technologies helped in grouping farmers as adopters or non-adopters. It was agreed that an adopter was any one of the farmers using at least one of the technologies promoted during or after 1980.

Table 2: Technologies Promoted in the Four Villages

Village	Technology		Year Promoted	Promoter
Pedzisai 1	Strip Cropping		1991 1996	Contil (Hagman) IES (Chuma)
	Fanja Juu		1991	Contil
	Tied Ridges		1991	Contil
	Mulching		1991	Contil
	Potholes		1998	IES
	Vetiver grass		1988	IES
Gomana	Maize Open Pollinated Varieties (OPVs)	NTS 88 NTS 103 NTS4404 NTS 9405 NTS 9407 TEXAPANO KALAHARI	1993-1994 season	ITDG and DR&SS
	OPVs – Sorghum	SV2	1993-1994 season	SEEDCO
	Pearl Millet	Chibuku Chimugabe	1993-1994	SEEDCO
Nduna	Construction of contours		1961	AGRITEX
	Vetiver and runner grass		1996	IES
	Tree planting (gum trees, indigenous trees)		1980s	IES
	Infiltration pits (very few people adopted them)		1996	IES
	Mulching		1996	IES
	Strip Cropping		1996	IES
	Stone traps in roads and fields (terraces)		1996	IES
	Improved composts (D and AN)		1996	IES
	Fanja Juu		1996	IES
	Dams for irrigation		1996	IES
Mbaimbai	Contour Ridges		1980	FSR
	Tree planting		-	ZIRCON
	Infiltration Pits		1993	IES
	Fanja Juu		1998	IES
	Improved Cattle manure		1985	FSR

Source: PRA fieldwork

Table 2 shows that technologies promoted in Pedzisai 1 village were mainly for soil and water conservation, while those in Gomana were related to plant genetic resources. However, those promoted in Nduna and Mbaimbai were for both soil and water conservation and soil fertility management.

3.1.2 Description of each technology: perceived advantages and disadvantages.

3.1.2.1 Soil and water conservation technologies

1 Strip cropping
This involves planting several crops in different strips, in the same field. According to the farmers, the major crops that were promoted for this kind of production were maize, groundnuts and pearl millet in that order. This technology was said to be very good in reducing soil erosion, minimising risk of crop failure due to pest attack since different crops are grown which are affected by different pests and helping to conserve soil moisture especially in the groundnut and pearl millet strips which reduce the velocity of water as it flows. They said water first passes through the maize strip at a very fast speed, resulting in a high rate of erosion. However, as the water passes through the groundnut strip, the speed is reduced since the space between the plants is much smaller than between the maize plants and hence soil particles are deposited. The speed is further reduced by the roots of the pearl millet plants, helping to prevent further soil erosion, and encouraging water infiltration. The other advantage pointed out was that it helps those with small plots to obtain diversified products. No disadvantages were cited.

2. Fanja Juu
Farmers described this as a modified contour bund. The main difference between Fanja Juu and the normal contour bund is that it collects water and channels it inside the field, rather than outside. Conservation of water is mainly enhanced by the availability of potholes that are put along the pegged modified contour. The cited advantages were that it helped in conserving soil moisture, trees can also be planted in the field, and it helps to prolong the production season. However, its disadvantage was that it can not be applied in wet fields and requires a lot of labour for construction.

3. Tied ridges
According to the farmers, these were made by constructing ridges, and cross-tying them at regular intervals to make small dams. The basins formed between the ties prevent water from flowing off the field. After establishment of the ridges, the area is not ploughed for up to five years. However, the only tillage operation that can be done after making the ridges, is re-ridging. Tied ridges were said to help in soil and water conservation, and also to improve soil fertility since leaf debris collects in the ridges and later rots.

4. Stone terraces in the field
These were said to be effective in reducing soil erosion and helping to conserve water and to reclaim gullies.

5. Potholes/infiltration pits (*Matura emvura/ zvikodobo*)
These are pits that are dug in various parts of the field in which rainwater collects, hence helping in conserving water. Their disadvantage was that small children and young animals, like puppies, could drown.

6. Vetiver grass
This grass was grown mainly in places where there are gullies or where gully encroachment was inevitable or any other place where there are signs of erosion. It was also grown around the homestead by most farmers. The grass can be used for thatching, preventing soil erosion, killing lice and crop storage pests, feeding animals, mulching and compost making; and it was believed that it also prevented witches from coming to homesteads where it was grown. No disadvantage was cited for this technology.

7. Contour ridges
Contours were said to prevent soil erosion and provide grass for thatching, and also to act as a habitat for mice and rabbits which could be used as relish. However, farmers said that these take a lot of the arable space, can also house poisonous snakes, and trap leaf debris thereby hence preventing it from getting into the field. They also require a lot of labour for construction.

8. Tree planting
Trees were said to provide poles for fencing or sale, contribute to air for breathing, act as wind breaks and helps in reclaiming gullies and preventing gully encroachment. However, the trees were also said to reduce growth of crops in areas where they grow, and in some cases the areas were said to become dry.

9. Small dams in the field
These dams can be used as cattle watering points, and help to conserve water for irrigating crops. However, like the infiltration pits, small animals like puppies and chickens could drown in the water.

3.1.2.2 Soil fertility management technologies

1. Improved compost manure
The compost was made from locally available materials: cattle manure, maize stover, leaf debris from indigenous tree like *gavakava*, ash, and water. Different proportions of the various inputs would be mixed up to come up with a range of different compost products. The manure was said to be a very good substitute for the real AN and Compound D fertilisers. The farmers said that it was a good technology since it encouraged use of locally available material like leaves and cattle manure and finally farmers said that it greatly improves soil fertility. However, only a small quantity can be made since the farmers do not have enough cattle manure and leaf debris. No disadvantages were cited.

2. Mulching
Mulching involves putting leaves, stover or grass on the soil surface in a field with crops. The farmers said that mulching helped to conserve soil moisture, added to soil fertility when materials were broken down by ants and termites, reduced the incidence of crop attack by ants and termites since they become concentrated in the mulch, reduced weeds and acted as a habitat for mice which could be used as relish. Disadvantages of mulching included the following: (a) there is a chance that the pests in the mulch can also eat crops; (b) when the mulching material is put on too early, it can reduce growth of crops; and (c) the material for mulching was available in small

amounts that are only enough for a small part of the field.

3.1.2.3 Plant genetic resource conservation technologies

1. Improved open pollinated varieties (IOPV)

These were mainly maize open pollinated varieties that had been improved by researchers. The IOPV were said to have an effective rooting system and hence could withstand excessive amounts of water. The cobs were said to be bigger than those from hybrid seeds. The farmers also said that these varieties produced cobs that were closed and did not open at the end like hybrids. When cobs open at the end, they were more likely to rot especially in wet seasons. Other cited advantages were that they are not easily affected by storage pests and have a good seed emergence rate. However, the farmers said that they were facing stiff competition from established seed companies like SEEDCO and there was no established market for their seed. Also, the improved open pollinated varieties take a long time to mature and need fertile soils for them to produce better yields.

3.1.3 Farmers' characterisation of adopters and non-adopters

Adopters in this study were defined as those who used at least one of the technologies promoted in the area during or after 1980, and farmers divided themselves into adopters or non-adopters after the first general meeting held in each village. During the separate FGDs, adopters and non-adopters each gave their perceptions of characteristics of the people they represented and these are discussed below under various headings. It is important to note that the characteristics of adopters were obtained through a discussion with representatives of adopters in one FGD, while those for non-adopters through discussion with representatives of the non-adopters in a separate FGD.

1. Age of household head

Adopters were said to be relatively young people, with a majority falling between the age of 30 to 70. Farmers in this category were said to be more active and had ambitions to accomplish. They also were said to have children in school and had many financial obligations such that adoption of technologies was mainly to increase income. Very young farmers, those below the age of 30, were said to have many constraints that hindered them from adopting technologies since they do not possess necessary implements and cattle as they are just starting in their independent farming life. Most non-adopters were said to be either very young (falling under the age of 30) or very old (those of above 70 years of age).

2. Gender of household head

In the past, male heads of households were predominant among adopters. However, it was said that recently there has been an increase in the number of females who are also adopting the various technologies. This increase has been attributed to the approach used in promoting technologies. Unlike in the past where only men attended meetings in the villages, some technology promoters in the early 1990s demanded that farmers bring their spouses to any meetings held so that both partners would gain knowledge about the technology. This meant more women farmers could get an exposure to the technologies being promoted.

3. Household income levels

According to the farmers, income level was not an important factor in determining adoption of the various technologies since farmers of different income levels, whether rich or poor, were adopting the technologies. However, it was clearly pointed out that those who adopted the technologies had their income level increased. This increase in income had enabled adopters to afford a good life and good health facilities, and enabled them to send their children to school. Non-adopters were said to earn low incomes and therefore found it difficult to send their children to school

4. Off-farm employment for household head

According to the farmers, adopters of the various technologies were mainly full time farmers who had never looked for employment elsewhere. One of the reasons why this is so was said to be their commitment to farm work which had made them more willing to make a living out of farming. Non-adopters were said to be very much involved in off-farm work like marketing produce and this is consistent with literature. Off-farm work takes most of the non-adopters' time such that less time is put into farm activities and hence this could explain non-adoption of technologies.

5. Risk preference by household head

Adopters were said to be risk takers who are more willing to try out new things. Non-adopters were said to be risk averse and pessimistic people who always look at the negative side of adopting a technology. For instance they are always afraid to try new things for they consider the chances of failure to be much higher than success.

6. Exposure to information and/or training

Adopters were said to be those who attend most meetings organised in the villages. These meetings then enable them to get a lot of information concerning the various technologies, and also facilitate sharing of information between farmers themselves as well as between them and the researchers. They were also said to be members of farming clubs and most have received agriculture related training from various institutions and obtained certificates. Adopters were also said to be those who have witnessed success of adoption by other farmers, for example their neighbours, or through attending field days. Non-adopters were said to be those who rarely attended meetings, and lack knowledge about the various technologies. Most non-adopters were said to have received no agriculture related training and hence did not have certificates.

7. Culture/ beliefs

Adopters of open pollinated varieties were said to be those willing to keep up their tradition by doing what their ancestors used to do: for instance, keeping seed from their harvest for the next season and passing it on to the next generation. Vetiver grass was said, among other things, to be good at preventing witches from coming to a homestead - therefore some of its adopters were those who believed in witchcraft.

8. Resource endowment

Adopters were said to have at least two cattle, especially for improved compost manure where the number of cattle owned by the farmer determines the amount of cattle manure produced which is important in adopting the improved compost manure technology. In the case of tied ridges, access to tie-making equipment was said to be an important factor in adoption of the technologies. Adopters were said to be those that either own the equipment, or have access to the equipment. Non-adopters were said to be resource poor and to have no or only one cattle.

9. Family Size
Considering their age group, adopters were said to have big families ranging from 4 to 10 children. Those with small families of less than four children were usually the young farmers of below 30 years of age who, as discussed above, lack the resource endowment necessary to adopt the various technologies. Non-adopters therefore had small families of less than four children.

10. Soil type
Adopters of Improved Open Pollinated Varieties (IOPV) were said to have rich red soils that encouraged growth of the crop, while non-adopters had poor sandy soils. The IOPV were said to have a lower growth rate as compared to hybrids, and also required fertile soils, otherwise with unfertile soils, farmers would incur a lot of expense through purchase of fertilisers. Adopters of fanja juu were said to have dry soils while non-adopters had wet soils, and those of stone terraces were said to have sloping fields and non-adopters had flat fields.

11. Commitment to work
Non adopters were said to be lazy people who do not want to work in their fields. By contrast, adopters were said to be industrious people who were hard working and committed to farm work.

A summary of these characteristics, drawn from the adopter and non-adopter FGDs in the fours villages, is given in Table 3.

Table 3: Characterisation of Adopters and Non-adopters by Chivi farmers

Characteristics	Adopters	Non-adopters
Age	30-70 years	<30 and >70 years
Gender	Majority males	Majority females
Income Levels	Earn more income	Earn less income
Off farm employment	Full time farmers	Part time farmers
Risk preference	Risk takers	Risk averse
Exposure to information/ Training	Attended several meetings and majority received agricultural related training	Rarely attend meetings and few received agricultural related training
Culture/ Beliefs	For IOPV, want to keep traditions, for Vetiver, want to prevent Witches from visiting their homesteads	Those not concerned about keeping tradition, and those not afraid of witches
Resource endowment	Own at least 2 cattle, have access to necessary equipment	Own less that 2 cattle and do not have access to the necessary equipment
Family size	4 – 10 children	Less than 4 children
Soil Type (Technology specific)	For IOPV, had rich red soils, for Fanja Juu had dry soils	For IOPV, had sandy soils of poor fertility, for fanja juu, had wet soils
Commitment to work	Very committed to farm work	Not committed to farm work

Source: FGDs with adopters and with non-adopters of technologies

3.1.4 Production system constraints and problem ranking

Scored Causal Diagrams (SCDs) were used to identify and rank the production constraints faced by farmers[6]. This section begins by briefly describing the way the SCDs were constructed. This was similar for both Zimuto and Chivi. SCD were part of the PRA techniques that were used during the qualitative study and began with

[6] See Appendix 1 for the SCDs drawn by the farmers

farmers identifying the major problems they face in their production processes. After identifying a major constraint, the farmers were encouraged by the researchers to think through the causes of this constraint, and the process goes on as they also look at the causes of the identified immediate causes. For instance, farmers might identify lack of transport as a major constraint and then identify two major causes of this constraint as poor roads and too expensive fares. Expensive fares could, in turn, arise from lack of diesel and lack of vehicles, and poor roads could be caused by lack of money to repair the road network. The process continues until a set of root causes has been identified. The SCD is constructed in the form of a diagram on the ground and farmers used various symbols to represent the identified causes: this helped those who were illiterate also to understand the diagram. After constructing the diagram, the farmers went on to score it. For scoring, farmers allocated seeds or stones between the causes at each level in the diagram, in proportion to the perceived relative importance.

SCDs were created separately with adopters and non-adopters. In Chivi, the main production constraint faced by the non-adopters was shortage of cattle. The adopters, in addition to shortage of cattle, also cited the following other problems: infertile soils, and shortage of cash. The results for the different types of constraints are discussed separately.

1. Shortage of Cattle

For non-adopters, the most important causes for shortage of cattle were diseases, lack of cattle dipping, lack of money, drought and poor representation by AGRITEX. However, for the adopters, the most important causes were poor representation by councillors and Members of Parliament, shortage of cattle loans and also of cash.

2. Infertile Soils

The root causes of this problem as cited by the adopters are lack of knowledge, traditional practices and high population density. The most important of the causes was lack of knowledge, and the least, traditional practices and use of fertilisers. The non-adopters cited the problem of too old fields as just one of the other causes of shortage of cattle. According to the non-adopters, the most important cause of this problem was the small size of their fields that resulted in farmers planting crops year after year without leaving a fallow period, and the least important cause was lack of cattle manure.

3. Shortage of Cash

Adopters cited poor representation by AGRITEX as the major cause of shortage of cash since, according to them, poor representation results in poor transport networks, unavailability of fertilisers, and lack of market for produce, all of which results in them failing to get money. The least important cause of shortage of cash was selfishness among farmers, which results in them not sharing information about production processes or lack of unity when selling produce. Lack of unity was said to be the main cause of stiff competition between sellers, which result in others reducing prices to the point where they make losses. For non-adopters, shortage of cash was pointed out as just one of the other factors leading to shortage of cattle, and its main causes were low selling prices, unemployment of children and poor crop yields.

3.1.5. Input-output relationships for adopters and non-adopters [7]

As alluded to earlier, Participatory Budgets were used in this study to assess the different input-output relationships for adopters of technologies and non-adopters.

Central to technology adoption is the need to have the relevant inputs, i.e. land, labour, capital and knowledge. The participatory budgets have shown that one of the most limiting production factors is the quality of the soils. This also came out in the scored causal diagrams. The most widely adopted technologies were those relating to soil fertility. In most participatory budgets, a high proportion of farmers' labour time was spent trying to process manure. Though variations existed in the periods when the making of improved compost manure was started, it was noted that August was generally the time when most households started their cattle manure preparations. Those without cattle preferred using leaf litter and also started collecting the leaf litter during the same period. This period required more household labour hours for both adopters and non-adopters.

There was no great difference in the amount of labour used by adopters and non-adopters. Adopters (mainly of soil fertility technologies) tended to concentrate their efforts on processing of manure whereas non-adopters applied fertilizers. The total cost of the two options tended to favour the adopters of technologies. However, we can observe from the participatory budgets that the outputs from a field where organic fertilizers are applied was almost the same as the one where inorganic fertilizers were applied.

The production processes for adopters and non-adopters were almost the same. The cropping season was similar for both early and late maize crops. The early maize crop was planted in October whilst the late maize crop was planted in December. Adopters spent less time in weeding than non-adopters.

One of the most striking aspects of the participatory budgets was labour valuation by the farmers. Most groups regardless of their production system valued labour inputs for men and women as equal. However, the contribution of young children was invariably given a fraction of the value for adults.

The participatory budgets for farmers involved in plant genetic resource technologies, namely IOPVs, were slightly different from those applying soil and water conservation techniques. The growing season for IOPVs was longer than that of hybrids. The labour requirements for IOPVs were less than those for hybrid seeds. Due to their strong stems and ability to withstand harsh conditions, IOPVs received used less organic and inorganic fertilizers than hybrids. Farmers using IOPVs used very limited external resources, relying mainly on locally available inputs. This reduced their dependence on volatile agricultural markets in the area. The maize crop harvested from IOPV was not sold, as it had good storage properties. Overall, the margins for IOPV farmers were much higher than those who used hybrid seeds. It was also evident that farmers adopting OPVs were more likely to adopt organic soil improvement methods like the application of manure, further reducing the average input cost.

[7] See Appendix 3 for the PBs constructed by the farmers

From the participatory budgets we observe that the input cost required for non-adopters was higher than that for adopters. However the outputs from both production systems were almost similar (this applies to farmers using organic fertilizers). Hence, the general observation is that adopters of these technologies had higher gross margins than non-adopters.

3.1.6 Reasons why people adopt and later reject the technology

Farmers gave the following reasons why people adopt and later reject a technology.

1. Material benefits associated with adopting a technology

In the discussions with farmer adopters, it was said that some people adopt technologies so as to get the material benefits associated with doing so. Some projects gave adopters things like donkeys for draught power, and those who just come to get the material benefits normally dropped out when putting the technology into practice. For instance after a demonstration of how to make ridges, several people were convinced that they could not manage to repeat the procedure because they did not have the equipment used during the demonstration, and hence they dropped out.

2. Lack of knowledge by some other members of the family

When only one member of the family learns about the new technology, farmers said that it is difficult for the person to get support from other family members and also, when the person who knows about the technology is away, no one is able to take over.

3.1.7 General Production Constraints for Farmers in Chivi

The farmers in Chivi faced the following problems in their production processes.

1. Soil and water conservation technologies were said to prolong the production season and this enabled farmers to grow two crops in one season. However, the problem came in the second crop - at that time, most farmers would no longer have a crop in their fields and therefore leave their cattle loose, and there is a chance of the second crop being eaten by the animals. Also, it was said that there is a higher risk of the second crop being stolen.
2. A problem was faced also when using the small dams in the field. It is difficult to irrigate those crops that are far away since farmers do not have suitable equipment for doing so.
3. Most hybrid maize varieties were said to be susceptible to stalk borer attack, and this was one of the main problems faced especially with the second crop.
4. Lack of market for the produced crop. Most farmers felt that this was indeed a major problem in Chivi. For instance, those producing the improved open pollinated varieties had no market for the seed and faced high competition from established seed producing companies like PANNER and SEEDCO.
5. Low market prices paid by the Grain Marketing Board (GMB). It was said that GMB always collects produce very late after harvesting. The main reason why they do so, according to the farmers, was to make sure that the produce is very dry when collected. However, those who harvest their crops early incur high storage costs and sometimes the quality of the produce would have deteriorated by the time GMB collects it and hence the farmers get lower prices. The farmers also

complained that they are price takers and do not have any influence on the prices of their produce.

6. Poor road network system in the village. This made it difficult to transport the produce to the market.
7. There is no banking facility at the growth point servicing the villages and there were several instances when the farmers' money was stolen by thieves after selling their crops.
8. The fields were said to be infertile and this has resulted in yields declining each and every year.
9. In seasons when the rains come late, farmers said that they experienced a serious problem of weeds, especially witch weed.
10. Lack of production system implements like hoes, wheelbarrows, and scotch carts to carry produce to the market, shortage of labour and draught power and cash were some of the identified constraints to production.
11. Poor seed varieties. Some farmers said that the hybrid varieties they use produce small cobs and are easily affected by weevils and other storage pests.

3.1.8 Prediction of future adoption rate, and decision making process in the adoption of the various technologies

Future adoption Rate

Adopters of improved open pollinated varieties predicted an increase in the number of adopters in future. They said that they only use little amounts of fertiliser or even none at all, and a possible reason why they can get good yields is because most of them have rich red soils that are very fertile. In addition to the little amounts of fertiliser applied, the farmers said that they also use compost manure and clay to improve the fertility of their fields. They predicted an increase in adoption rate because it is less costly to produce the IOPVs.

Also farmers predicted an increase in the number of those using the following technologies; tree planting, improved compost manure, and vetiver grass. The farmers pointed out that this could be made possible if (a) the number of trainers who go around and train people is increased and (b) meetings with trainers are arranged in various places in different communities so that more people are exposed to the information, and do not have to walk long distances to get to the meeting places.

The decision making process in adoption of technologies

In all the discussions held with farmers, both adopters and non-adopters, farmers made it clear that decisions are made jointly by both husband and wife, in families with both parents. According to them, a consensus has to be reached by both parties in order to come up with a decision of either adopting or not adopting a given technology. However, in cases where the husband is non-resident on the farm and stays in town, it was said that the wives make most of the decisions to adopt technologies that do not require major changes in the production pattern of the farm, such as improved compost manure. For technologies requiring major changes, the wives wait for their husbands to come home and the two of them discuss the issue.

3.2 Zimuto Findings

3.2.1 Technologies Promoted in the four villages

Technologies promoted in Zimuto are shown in Table 4. Soil fertility management dominated the technologies promoted in the four villages and a reason why this is so could be the poor soil fertility of the soils. However, plant genetic resources were also promoted in Maraire. Soil and water conservation technologies were promoted in all the villages, and this is due to the semi-arid nature of the area.

Table 4: Technologies Promoted in Zimuto

Vill.	Technology	Source	Year	Vill.	Technology	Source	Year
Maraire	**Tillage**			Chikato	**Tillage**		
	OPFP	DR&SS	1990s		OPFP	DR&SS	1990s
	RIP	DR&SS	1990s		RIP	DR&SS	1990s
	TFP	DR&SS	1990s		TFP	DR&SS	1990s
	Weed control				**Weed control**		
	HH	DR&SS	1990s		HH	DR&SS	1990s
	OPHH	DR&SS	1990s		OPHH	DR&SS	1990s
	HH	DR&SS	1990s		HH	DR&SS	1990s
	Soil fertility and other practices				**Soil fertility and other practices**		
	Pegging of contours	AGRITEX	pre-1980		Pegging of contours	AGRITEX	pre-1980
	Plant spacings	AGRITEX	1980s		Plant spacings	AGRITEX	1980s
	Land preparation	AGRITEX	1980s		Land preparation	AGRITEX	1980s
	Fertiliser use and quantities				Fertiliser use and quantities		
	Anthill use	AGRITEX	1980s		Anthill use	AGRITEX	1980s
	Leaf litter	AGRITEX	1980s		Leaf litter	AGRITEX	1980s
	Cattle manure	AGRITEX	1980s		Cattle manure	AGRITEX	1980s
	Compost	AGRITEX	1980s		Compost	AGRITEX	1980s
	Crop rotations	AGRITEX	1980s		Crop rotations	AGRITEX	1980s
	Ash	AGRITEX	1980s		Ash	AGRITEX	1980s
	Low N-maize varieties	AGRITEX	1999		Green manures	CIMMYT	1999
	OPVs	AGRITEX	1999		Seed priming	DR&SS	1999
	Seed priming	AGRITEX	1999		**Soil and water conservation**		
	Soil and water conservation				Vetiver grass	IUCN	1996
	Vetiver grass	IUCN	1996		Banner grass	IUCN	1996
	Banner grass	IUCN	1996		Stone checks	IUCN	1996
	Stone checks	IUCN	1996		Dams, irrigation garden,	CI	1998
	Dams, irrigation garden, runoff orchards	Care Int- ernational (CI)	1998	M	**Soil fertility and soil and water conservation**		
M	**Development work**				Vetiver grass	IUCN	1999
	Dams	CI	1998		Fertiliser use	AGRITEX	late 80s
	Wells	CI	1998		Composting	AGRITEX	mid-80s
	Boreholes	DDF	1991		Tied ridges	U.Z.	1999
	Runoff orchards	CI	1998		Banner grass	IUCN	1998
	Fruit trees	CI	1998		Anthill soil	AGRITEX	mid-80s
	Gum tree plantations	AGRITEX	mid-80s		Crop rotations	AGRITEX	mid-80s
	Soil fertility and soil and water conservation				Omnia L and CAN	U.Z.	1999
	Vetiver grass	IUCN	1999		Contour ridges	AGRITEX	pre-1980
	Gardening	CADEC	1983				
	Fertiliser use	DR&SS	late80s				
	Composting	DR&SS	mid-80s				
	Tillage	DR&SS	1990s				
	Contour ridges	AGRITEX	pre-1980				

	Green manure	ICRISAT/DR&SS	1999				
	OPVs	ICRISAT/DR&SS	1999				
	Low rates of N	ICRISAT/DR&SS	1999				

Source: PRA in four study villages

3.2.2 History of promotion, and advantages and disadvantages, of the various technologies

3.2.2.1 Soil and Water Conservation Technologies

1. Vetiver Grass

Vetiver was promoted by IUCN in 1998. IUCN promotion strategy was to give the grass to the headman for distribution to other villagers. They did not however make any follow ups to check whether people were growing the Vetiver grass or not. According to one villager, IUCN "just dumped" the grass on people. The reasons why the grass was introduced were to control soil erosion and create pastures for livestock. This initiative did not take off as expected because livestock grazed all the Vetiver before it could be transplanted to other areas. The farmers did not have any fencing material hence it was difficult for them to protect the Vetiver from livestock. Cited advantages for the grass included: reducing gully formation, it can withstand drought conditions, and can be used as animal feed and thatching. No disadvantages were identified.

2. Contours, winter ploughing and general farming practices

AGRITEX started promoting contours, winter ploughing and general farming practices before Independence. According to one of the kraalheads, making of contour ridges was promoted although it was not appropriate due to the semi-arid conditions of the area. General farming practices were also being promoted, for example, appropriate planting dates, number of weedings, plant spacings and so on. These started in the 1980s although they are still being promoted through the Master Farmers training programme.

3. Banner grass

This grass was first introduced by AGRITEX in 1985. Later on, in the mid 1990s, IUCN also promoted banner as a fodder crop for livestock. The grass grows to a height of over three metres and its vegetative form can be mistaken for sugarcane. Banner grass, according to farmers, has the following advantages: it can be used as a livestock feed and as a hedge.

4. Dams, afforestation, irrigation gardens, runoff orchards

The NGO CARE International introduced its dam rehabilitation programme in the area in 1998-99. CARE has a dam in Zimuto called Chengwe, which it rehabilitated and is about to be completed. In addition, irrigation gardens were set up for the farmers who were involved in the project and various catchment management options such as making runoff orchards, gully reclamation and the crop establishment method of ripping (including the use of a contill tool bar) were also practised. The idea behind all these innovations was to reduce the siltation levels in the dam. The CARE programme borrowed its technologies heavily from research institutions in and outside Zimbabwe.

5. Tied Ridges
The cited advantages of tied ridges were that they help to maintain soil moisture, increase water seepage and hence encourage fertilisers to dissolve. However, they have a disadvantage that a lot of labour is required to construct the ridges.

3.2.2.2. Soil Fertility Management Technologies

1. Leucaena
Again IUCN introduced Leucaena as a fodder for cattle after realising that grazing areas were being overgrazed. Leucaena also enhances soil fertility since its leaves can add nutrients to the soil if livestock do not browse them

2. Fertiliser use on maize
These trials were being conducted by DR&SS-Makoholi Research Station in conjunction with AGRITEX. The farmers were taught about the right quantities of fertilisers to apply and also the timing of fertiliser application.

3. Lime
Most farmers heard about lime but were not exposed to how the input works or the right quantities of lime for their soils. It was mentioned that sometime in the 1990s, researchers from DR&SS took soil samples from some farmers' fields for testing but never came back. Most farmers knew that their soils were 'sour' and that lime could be used but they lacked knowledge on the amounts required for their soils. Even though Master Farmers in the area were taught about the importance of lime, there was no supply of the input in the area.

4. Green manures (velvet bean, sunhemp) and soybean
Green manures and soybean technologies have recently been introduced in the area by CIMMYT's Risk Management project (1999-2000). Green manures were being tried as either sole crops or intercropped with maize. Promiscuous soybean varieties were also being promoted. Soybean varieties were being tried after realising the success of the U.Z. soybean project in other parts of Zimbabwe such as Hurungwe. Since the project was less than one year old in Zimuto at the time of the present study, it is too early to assess the impact of these interventions. Some farmers have however noted that some green manures did not perform very well partly because of excessive rains.

5. Anthill Soil
Soil from anthills was said to be very good at improving soil moisture and fertility. However, collecting and spreading the soil is labour intensive. If too much of it is put in the field, it prevents water from penetrating into the soil particles, and also, by taking the soil, the natural habitat for ants, which are also used as food, is destroyed.

6. University of Zimbabwe Omnia Fertiliser
This was said to be good in supplying lime and nutrients to the soil, increase crop growth, require less labour since it is broadcast, and reduce soil acidity. However, the cited disadvantage was that it requires a lot of water for it to dissolve.

3.2.3 Characteristics of Adopters and Non-adopters

Education Level
Adopters were said to be educated and knowledgeable about the various technologies, and had an ability to grasp new ideas quickly, while non-adopters were those with little knowledge about the technologies promoted.

Risk preference
According to the farmers, adopters of these technologies were industrious, ambitious and innovative. It was also said that adopters are keen to try out new things. Non-adopters however were risk averse and were not keen to take up any new things.

Exposure to information and training
Adopters were said to be those who normally attend field days and belong to soil fertility groups, while non-adopters did not attend field days and did not belong to any group.

Resource endowment
Adopters of any one of the promoted technologies were said to own necessary implements required for implementing the technology. Examples of such implements include ox-ploughs and cultivators. Adopters of vetiver grass and Leucaena for example, were those who have fencing material needed to protect the grass and hedges from being eaten by animals, especially during the very early stages of establishment. Adopters of tillage and weed control technologies have at least two cattle, own ploughs and cultivators and have adequate amounts of labour (an average of 5 people). Adopters were also said to be able to purchase inputs.

Household Size
Adoption of tillage and weed control technologies was said to be by those who have an average household size of five people, and adopters with fewer people were those who were able to hire labour from elsewhere.

Commitment to work
Adopters were said to be very committed to their work, while non-adopters were lazy and had very little or no commitment to their farm work. It was also said that non-adopters do not care much about their agricultural production process. The characteristics are summarised in Table 5 below.

Table 5: Characterisation of adopters and non-adopters in Zimuto

Characteristics	Adopters	Non-Adopters
Education level	Well educated	Less educated
Risk preference	Innovative and risk takers	Risk averse
Exposure to information/ training	Attend field days, belong to groups	Do not attend field days, do not belong to groups
Resource endowment	Own necessary equipment required for adopting technologies	Do not posses the necessary equipment
Family size	average of 5 family members	less than 5 family members
commitment to work	very committed to farm work	Lazy and not committed to farm work

Source: FGDs with adopters and with non-adopters in four study villages

3.2.4. Production constraints identified by farmers

From the SCD discussion (Appendix 2), soil fertility emerged as the major problem faced in Mahoto and Chikato villages. The causes of low soil fertility for Chikato were, in order of importance, shortage of manure, lack of fertilisers, over-cultivation, monoculture and soil erosion. The villagers in Chikato cited lack of cattle as the only cause of shortage of manure, while those in Mahoto cited, in addition to shortage of cattle, lack of money and poor pastures. Drought was cited in both villages as the major cause of shortage of cattle. However, other causes of shortage of cattle were pointed out by the Mahoto villagers and these are lack of grazing land and lack of breeding knowledge. Shortage of cattle was, however, the major problem for Maraire village and the causes highlighted were drought, diseases, poor pastures, and small grazing areas in order of their importance. For Maraire the major cause of poor pastures was overgrazing, while for Mahoto it was poor soils.

During the FGD with both adopters and non-adopters, the following production constraints were identified by the farmers.

1. Poor soil fertility

Soils in Zimuto were said to be very old and, due to continuous cultivation, to have been depleted of the nutrients essential for plant growth. In addition, the farmers in the area use little or no fertiliser (with the majority not using any) which compounds the problem of soil infertility. Use of cattle manure to improve soil fertility was minimal and limited to cattle owners.

2. Lack of draught animal power (DAP)

Draught animal power was also mentioned as another major problem in the area. Draught animal power shortages were said to have a bearing on activities such as tillage, weed control, manure use and so forth. Most villagers in Zimuto lost their beasts during the devastating 1991-92 drought. This has led to a decrease in crop production in the area. In addition, ownership of tractors by households in the area is non-existent and some households (especially the poor) have resorted to the use of hand hoe tilling ***(kurima ne chibhakera)***. Although farmers help each other in terms of draught power sharing, they usually conduct their operations late resulting in a decrease in crop production.

3. Lack of knowledge on Soil Erosion Prevention Measures

Gullies are a common sight in Zimuto and some farmers said that they lacked knowledge of preventing soil erosion. However, in some area, IUCN gave villagers Vetiver grass to prevent erosion and also reclaim areas affected by soil erosion.

4. Overgrazing

It was said that there were no areas allocated for grazing purposes in some villages. Villagers thus were letting their cattle graze on any area including land adjacent to streams. Overgrazing has also been one of the contributory factors to the problem of soil erosion.

5. Weeds

The following weeds were said to be the most problematic in Zimuto: "*pfende*" - *cyperus esculentus*, "*Jekacheka*" *– cyperus digitatus*, "*Chodhongi*" *– acathospermum hispidum*, *Chinzungu – Richadia spp.*. In addition, due to the problem of a lack of implements such as cultivators and the non-use of herbicide technology, most farmers are left with no other option but use of hand hoes for weeding.

6. Inputs
Cost and availability of inputs such as seeds and fertilisers were also cited as major production constraints. The local shops in the area usually run out of these inputs and when available, were said to be very costly. Some local stockists in the area packed fertilisers into smaller bags, like 5kg packs to cater for those who can only afford to purchase small amounts of fertilisers. However, these small packs were said to be very costly. Also, in some cases, seed varieties that farmers used to grow, like R215, had been phased off the market and hence the farmers said that it would be much better if they can get improved seed varieties which they can keep in their homes.

3.2.5. Enabling factors for adoption

The farmers identified some factors that can enable adoption of the various technologies and these were: improvement in the delivery system for inputs, availability of technologies whose benefits can be realised immediately, favourable environmental conditions, availability of credit and market facilities, provision of information to farmers through training, field days, workshops and favourable institutional support.

3.3 Conclusion

The chapter has clearly highlighted that the technologies promoted in the two areas were dominated by those for soil and water conservation and soil fertility management.

Adopters in Chivi characterised themselves as those who are between the age of 30-70, earn more income from their farming, are full time farmers and risk takers, have received some agriculturally related training and are well informed about the various technologies, have at least two cattle, have relatively large families with more than 4 children, have suitable soils for the technology in question, and are very committed to their work. The Chivi non-adopters characterised themselves as those who are either below the age of 30 or above 70, are part-time farmers who are mainly involved in off-farm work, are risk averse, lack knowledge on the various technologies, generally have poor or wet soils, have less than 4 children, earn less income because of high input costs, are not very much concerned about keeping traditional values (in the case of IOPV), own less than 2 cattle, and not very much committed to farm work.

Adopters in Zimuto, like those in Chivi, characterised themselves as educated, risk takers, industrious and innovative; they attend organised meetings, belong to groups and own necessary equipment, have an average family size of 5 people and are very much committed to their farm work. Also, like in Chivi, the non-adopters in Zimuto characterised themselves as less educated, risk averse, not members of any group, with an average family size of less than 5 people, less committed to farm work, and never having attended organised meetings related to agriculture.

Reasons why people adopted and later reject technologies were identified as being associated with material benefits that are associated with a technology and lack of knowledge by other members of the family. Concerning future adoption rates, most farmers were very optimistic and said that adoption rates of the various technologies were bound to increase in future, the main reason being that the technologies encouraged use of locally available materials and hence made cost of production relatively cheap.

In general, household decision making processes concerning adoption of technologies were said to be based on consensus from both husband and wife in situations where the household consisted of husband and wife.

The chapter has also highlighted the general production constraints in the two areas. For Chivi these included: susceptibility of hybrid varieties to storage pest and stalk borer attack, lack of market for the produce, lack of production implements, low market prices, poor transport network, lack of banking facilities, weeds, and eating of the second crop by animals. For Zimuto, they included: infertile soils, shortage of draught power, lack of knowledge on soil erosion prevention measures, overgrazing, weeds, expensive and unavailable inputs.

Chapter 4: Quantitative Survey Findings

4.0 Introduction

The survey results are presented in two different sections. Section 4.1 discusses the general demographic features of the sample (age, education level, sex of head of household etc.) while section 4.2 tries to link the demographic features to adoption or non-adoption of the various technologies.

4.1 General Characteristics of Farmers in the Case Study Areas

Age of head of household

The sample consisted of 265 households, 132 in Chivi and 133 in Zimuto. In both sites, the highest proportion of heads of households fell in the age group 41 to 65 (50% in Chivi and 52% in Zimuto). This was followed by age group of 26-40, with 32% of the head of household in Chivi and 17% in Zimuto. Only a few heads of households fell in the age group of above 76, with 5% for Chivi and 7% for Zimuto. These figures are shown in Table 6 below.

Education level of household head

The highest proportions of household heads in Chivi (37%) and Zimuto (42%) had received secondary education and fell within the category of 8-11 years of education (Table 6). However, 37% of the heads in Chivi were poorly educated and fell in the lowest category of 1-4 years of education. In both sites, the lowest percentage (2%) of household heads was highly educated and fell under the category of greater than 11 years of education.

Gender of Household head

The majority of household heads in Chivi were males while most of those in Zimuto were females. For Chivi, 62% of the heads of households were males and 38% females, while in Zimuto, 47% of them were males and 53% females (Table 6).

Marital status of household head

The majority of the household heads in both sites (69% for Zimuto, and 75% for Chivi) were married. However, 20% of the household heads in Chivi and 21% of those in Zimuto were widowed, while only a few were either divorced or single (Table 6).

Number of oxen owned by household

The majority of households in Chivi (74%) had only one or no oxen at all, while the highest percentage of those in Zimuto (47%) possessed 2-4 oxen. In Chivi, no household had eight or more oxen, while in Zimuto, 3% of households owned 8-10 oxen and 7% more than 10 oxen (Table 6).

Land ownership

The highest proportion of households in Chivi (37%) had 2-4 acres of land. The highest proportion in Zimuto (45%) had 5-7 acres of land (Table 6).

Table 6: Distribution of characteristics of heads of households

Characteristic		Chivi		Zimuto		Aggregate	
		N	%	N	%	N	%
Marital Status of household head	Married	99	75	92	69	191	72
	Widowed	25	20	28	21	53	20
	Divorced	8	5	7	6	15	6
	Single	-	-	6	4	6	2
Age of Household head	15 – 25	3	2	10	8	13	5
	26 – 30	10	8	3	2	13	5
	31 – 40	31	24	19	15	50	19
	41 – 65	65	50	68	52	133	51
	66 – 75	15	12	21	16	36	14
	> 76	6	5	9	7	15	6
Years Spent in school by head of household*	1-4	44	37	21	18	65	27
	5-7	29	24	45	38	74	31
	8-11	45	37	50	42	95	40
	>11	2	2	4	2	6	3
Marital status of household head***	Married	99	75	92	69	191	72
	Widowed	25	19	28	21	53	20
	Divorced	8	6	7	5	15	6
	Single	-		6	5	6	2
Gender of household head**	Male	82	62	62	47	144	54
	Female	50	38	71	53	121	46
Total number of oxen owned by household*	0-1	97	74	39	29	136	51
	2-4	32	24	62	47	94	36
	5-7	3	2	18	14	21	8
	8-10	-	-	4	3	4	1
	11 and above	-	-	10	7	10	4
Total arable land owned by household (acres) *	0-1.99	29	22	3	2	32	12
	2-4.99	48	36	34	25	82	31
	5-7.99	39	30	59	45	98	37
	8-10.99	4	3	23	18	27	10
	11 and above	12	9	14	10	26	10

* - Difference between Chivi and Zimuto statistically significant at 1% level
** - Difference between Chivi and Zimuto statistically significant at 5% level
*** - Difference between Chivi and Zimuto statistically significant at 10% level
Source: *Sample survey in ten villages*

4.2 Characteristics distinguishing adopters from non-adopters[8]

4.2.1 Farm structural characteristics and livestock ownership

1. Total arable land owned by household.
Adopters tend to own more arable land than non-adopters in both study sites, though Chivi farmers own smaller amounts of arable land on average than those in Zimuto (median < 5 acres in Chivi but > 5 acres in Zimuto). The majority of adopters in Chivi own five acres or more, while the majority of non-adopters own less than five. In Zimuto, 76% of adopters and 68% of non-adopters own five acres or more. (Table 7).

[8] Adopters were defined as those who reported having adopted one of the technologies that had been promoted in the area.

2. Total Number of Livestock owned by household

More non-adopters than adopters in both sites own 0-1 oxen, while more adopters than non-adopters own 2-4 oxen. This means that adopters are more able to cultivate their fields in time while non-adopters might need to hire draught power from elsewhere (Table 7). Also, more adopters than non-adopters own 3-7 cows, calves, goats and sheep. Adopters therefore have access to manure for making compost, while non-adopters do not have such access. In general, adopters have more livestock than non-adopters in both sites.

Table 7: Farm characteristics and livestock

Characteristics		Chivi (%)			Zimuto (%)		
		Adopters (n=80)	Non-adopters (n=52)	Aggr-egate	Adopters (n=72)	Non-adopters (n=61)	Aggr-egate
Total Arable land owned by household (Acres)	0-1.99	18	28	22	-	5	2
	2-4.99	30	47	36	24	27	25
	5-7.99	38	17	30	39	51	45
	8-10.99	3	3	3	24	10	18
	11 + above	11	6	9	13	7	10
Total No of oxen owned by household	0-1	71	77	74	24	36	29
	2-4	28	19	24	50	43	47
	5-7	1	4	2	15	12	14
	8-10	-	-	-	4	2	3
	11 + above	-	-	-	7	8	7
Total No of cows owned by household	<3	65	74	68	47	56	51
	3-7	32	19	27	50	38	44
	>7	4	8	5	3	7	5
Total No of calves owned by household	<3	91	94	92	81	85	83
	3-7	9	6	8	19	15	17
	>7	0	0	0	0	0	0
Total No of goats owned by household	<3	64	72	67	46	64	54
	3-7	23	19	21	39	25	32
	>7	13	9	11	15	12	14
Total No of sheep owned by household	<3	99	100	99	96	98	97
	3-7	1	0	1	4	2	3
	>7	0	0	0	0	0	0

Source: sample survey in ten study villages

4.2.2. Household Characteristics

1. Household Size

For the household size of 1-4 members, the percentage of non-adopters is higher than that of adopters in both sites, and this could be explained by the fact that those with a small number of children are very young farmers who have not yet acquired the necessary equipment required to adopt the various technologies. Unlike Chivi, a higher percentage of adopters than non-adopters in Zimuto (64%, compared to 46%) have 5-10 members (Table 8). However, 13% of adopters in Chivi are in households with more than 10 members as compared to only 6% of the non-adopters. Chi-square tests show that the differences between adopters and non-adopters are not significant at the 0.05 level.

2. Marital status of head of household
In Chivi, the percentages of married, widowed and divorced heads of households were equal for both adopters and non-adopters. In Zimuto however, there were more adopters who were married than non-adopters; and also there were more widowed heads of households among non-adopters than adopters. The difference is not statistically signficant.

3. Gender of household head
A higher percentage of adopters (77%) than non-adopters (53%) in Chivi were males and this was similar for Zimuto (Table 8). The percentage of female non-adopters was higher that female adopters in both sites. The difference is significant at the 0.1 level in Chivi, but not in Zimuto.

4. Years spent in school by head of household
A higher percentage of non-adopters than adopters in both sites have never been to school. The highest percentage of adopters (43%) in Chivi have spent 8-11 years in school (Table 8) while the majority of non-adopters had received less than five years of school education. In Zimuto, however, the pattern was not the same: 39% of adopters have 8-11 years of education while the majority of non-adopters have five or more years of schooling. The differences in Chivi are statistically significant at the 0.01 level; those in Zimuto are not statistically significant. Thus, while the Chivi data seem to confirm the finding in other studies that those with more education are more likely to understand promoted technologies, those for Zimuto do not.

5. Current occupation of household head
The majority of household heads in both sites were full time farmers and have no other jobs elsewhere. In both Chivi and Zimuto, the percentage of adopters who are full time farmers is lower than that of non-adopters, while in Zimuto, a higher percentage of adopters (96%) than non-adopters (90%) are full time farmers (Table 8). Although the differences are not significant at the 0.1 level, the data do not support the suggestion that full time farmers are more likely to adopt new technologies than those whose livelihood strategies are more broadly based.

6. Former occupation of household head
More non-adopters than adopters in both sites had never worked elsewhere other than the farm, and this does not tally with the PRA findings where adopters were said to be those that were never employed elsewhere while non-adopters were more likely to have had jobs or enterprises outside farming. More adopters than non-adopters in both sites were formally employed as teachers.

7. Residence status of head of household
The majority of both adopters and non-adopters were full time resident on the farm in both sites. Although the proportion of non-adopters who were full time resident on the farm was slightly higher than that of adopters in both sites, these differences were not statistically significant.

8. Total household income
The highest percentage of farmers, both adopters (41%) and non-adopters (49%), in Chivi earn a relatively low average annual income of $7000 or less. The percentage of

adopters in Chivi who earn an average income of $70001-15000 and greater than 50000 is more than that of non-adopters (Table 8).

9. Group membership by any person in a household

The majority of farmers, both adopters and non-adopters in both sites belonged to groups associated with AGRITEX. However, a higher percentage of non-adopters than adopters in both sites belonged to groups associated with AGRITEX. In Chivi, all non-adopters belonged to a group associated with AGRITEX and adopters belonged to other groups associated with IES, IUCN and University of Zimbabwe, in addition to AGRITEX (Table 8). Unlike groups associated with Makoholi research station, higher percentages of adopters than non-adopters in Zimuto belonged to groups associated with the UZ, IUCN and ICRISAT. In general, adopters in the two sites belong to many other groups in addition to those associated with AGRITEX, and non-adopters mainly belong to groups associated with AGRITEX. This may suggest that the technologies which have been more widely adopted are those which have been promoted through groups other than those associated with AGRITEX.

10. Risk preferences

A higher percentage of adopters than non-adopters in both sites opted to adopt any promoted technology even if no-one did so, suggesting that adopters are high risk takers (Table 8). Very few respondents said they would not adopt it at all, although the proportions of non-adopters in this category were slightly higher than adopters at both sites. Most respondents indicated they would eventually adopt a technology that seemed to be successful on other farms in the area. The differences between adopters and non-adopters were significant at the 0.05 level in Zimuto, but not significant in Chivi.

11. Exposure to agricultural training by any member of household

Family members from adopters' families in both sites received more agriculture related training than those from the non-adopter families (Table 8).

12. Homestead type

The majority of adopters in both sites (50% for Chivi, and 65% for Zimuto) had "brick under asbestos" houses, while the majority of non-adopters (60% for Chivi and 50% for Zimuto) had "brick under thatch" houses. Very few had "pole and dagga" houses (Table 8). The differences between adopters and non-adopters are not statistically significant.

Table 8: Household Characteristics

Characteristics		Chivi %			Zimuto %		
		Adopters (n=80)	Non-adopters (n=52)	Aggregate (n=132)	Adopters (n=72)	Non-adopters (n=61)	Aggregate (n=133)
Household Size	1-4	20	23	21	35	49	41
	5-10	66	72	68	64	46	56
	>10	13	6	10	1	5	3
Marital status of household head	Married	75	75	75	74	64	69
	Widowed	19	19	19	17	26	32
	Divorced	6	6	6	6	5	5
	Single	-	-	-	4	5	5
Gender of head of household	Male	69	53	62	49	44	47
	Female	31	47	38	51	56	53
Age of head of household	15-25	1	4	2	4	12	8
	26-40	30	33	31	18	15	17

Characteristics		Chivi %			Zimuto %		
		Adopters (n=80)	Non-adopters (n=52)	Aggregate (n=132)	Adopters (n=72)	Non-adopters (n=61)	Aggregate (n=133)
		51	47	50	58	46	52
		14	8	11	13	20	16
	>76	3	8	5	7	7	7
No of years spent in school by head of household	0	3	6	4	4	12	8
	1-4	22	55	33	17	16	16
	5-7	30	12	22	37	33	35
	8-11	43	25	34	39	38	38
	12-highest	1	2	2	3	2	2
Current Occupation of Household head	None	65	77	70	81	87	84
	Student	-	-	-	2	-	1
	Teacher	5	2	4	2	-	1
	Headman/ Kraalhead	-	6	2	-	-	-
	Church leader	1	-	1	5	4	4
	Nurse/health worker	1	4	2	2	-	1
	Trader/retailer	1	2	2	6	4	5
	Others	26	10	19	5	6	6
Former occupation of head of household	None	64	75	63	73	84	59
	Student	11	4	8	2	-	1
	Teacher	4	-	2	5	2	3
	Nurse/health worker	1	2	2	2	-	1
	Headman/kraalhead	-	2	1	-	-	-
	Trader/retailer	-	4	2	2	4	2
	Others	20	13	16	16	8	8
Residence status of head of household	Full time resident	82	89	84	93	95	94
	Not full time resident	18	11	15	7	5	6
Total household income ($)	0-7000	41	49	44	18	34	26
	7001-10000	15	6	11	3	8	5*[9]
	10001-15000	14	9	12	8	12	10*
	15001-30000	13	17	14	23	36	29*
	30001-50000	10	15	12	17	5	11*
	>50000	7	4	6	31	5	19*
Households with at least one member belonging to a group associated with different organisations	AGRITEX	56	100	63	79	82	80
	IES	41	0	34	-	-	-
	ICRISAT	-	-	-	16	0	10
	DR&SS + Makohohi	-	-	-	5	9	7
	IUCN	4	0	3	11	0	7
	UZ	4	0	3	11	9	10
Reaction if a new crop is introduced (Risk preference)	Adopt even if no one does	42	32	38	19	17	18
	Adopt if many people are doing so	14	17	15	6	15	10
	Wait until I see someone who successfully adopted	18	17	18	49	37	44
	Wait until I see several people who successfully adopted	23	30	26	24	17	21
	Will not adopt at all	3	4	3	3	14	8
Form of Agric training received by any of the household members (*row percentages*)	University	67	33		50	50	

[9] * categorisation significant at 1% level of significance

Characteristics		Chivi %			Zimuto %		
		Adopters (n=80)	Non-adopters (n=52)	Aggregate (n=132)	Adopters (n=72)	Non-adopters (n=61)	Aggregate (n=133)
		86	14		100	0	
		61	39		62	38	
		0	100		70	30	
		100	0		0	0	
	Others	75	25		71	27	
Homestead type	Brick/asbestos	50	39	45	65	48	58
	Brick/thatch	49	60	53	33	50	41
	Pole and dagga	1	2	2	1	2	2

Note: one-tailed chi-square probabilities are (adopters v. non-adopters):	*Chivi*	*Zimuto*
household size	*0.34226*	*0.08387*
marital status	*0.99210*	*0.58321*
gender of head of household	*0.08331*	*0.61640*
age of head of household	*0.81363*	*0.35558*
years of schooling	*0.00041*	*0.45766*
current occupation	*0.14527*	*0.32760*
former occupation	*0.17512*	*0.16421*
residence status	*0.35061*	*0.62430*
total household income	*0.44815*	*0.00014*
membership of AGRITEX group	*0.00000*	*0.68488*
reaction to new technology	*0.74711*	*0.03274*
homestead type	*0.42339*	*0.11804*

4.3 Production constraints identified by adopters and non-adopters

In both areas, infertile soils and shortage of draught power were the two most important production problems as they have the highest percentage of responses (Table 9). For adopters in Chivi, the three most important production constraints in order of importance are infertile soils (53%), lack of draught power (21%), and water logging (20%). For non-adopters the order is: infertile soils (44%), soil erosion (18%) and water logging (9%). A comparison of the sequence of importance of the problems reveals that for adopters draught power is more important than soil erosion and for non-adopters the converse is true. An explanation for this observation could be that adopters in Chivi have reduced the problem of high erosion due to steep fields by using stone terraces.

In Zimuto the three most important production constraints for adopters in order of importance are pests (44%), infertile soils (43%) and labour shortage (26%). For non-adopters the sequence is infertile soils (44%), pests (42%) and then seed shortage (25%), poor plant growth (25%) and lack of draught power (25%). This implies that for adopters in Zimuto draught power is relatively less important that labour shortage. This is so probably because most adopters in Zimuto have adequate draught power, as they own more oxen than non-adopters. Non-adopters face additional problems of lack of seeds, poor plant growth and lack of draught power and these were mentioned with equal frequency (Table 9).

Table 9: Production Problems faced by adopters and non-adopters

Production problem	Chivi				Zimuto			
	Adopters		Non adopters		Adopters		Non adopters	
	No.	%	No.	%	No.	%	No.	%
Infertile soils	41	53	20	44	30	43	26	44
Lack of draught power	16	21	1	2	9	13	16	25
Land shortage	6	8	5	11	2	3	0	0
Unsuitable seed varieties	1	1	0	0	1	1	1	2
Lack of capital	7	9	1	2	2	3	1	2
Water logging	15	20	4	9	5	7	5	9
Scarcity of markets	3	4	1	2	4	6	4	7
Soil erosion	8	10	8	18	0	0	1	2
Shortage of fertilizers	7	9	3	7	7	10	7	12
Pest	2	3	0	0	31	44	25	42
Seed shortage	3	4	2	4	11	16	15	25
Land degradation	2	3	0	0	3	4	7	12
Lack of farm implements	0	0	1	2	3	4	7	12
Labour shortage	3	4	1	2	18	26	10	17
Lack of knowledge	1	1	0	0	3	4	1	2
Poor plant growth	1	1	0	0	10	14	15	25
Sloppy fields	6	8	3	7	0	0	0	0
Late planting	2	3	0	0	5	7	1	2
Weeds	0	0	3	7	6	9	11	19
Wind damage	0	0	1	2	0	0	0	0
Drought	1	1	2	4	9	13	6	10
Crops Destruction by animals	1	1	2	4	16	23	5	9
Lack of information	1	1	0	0	0	0	0	0
Livestock diseases	0	0	0	0	1	1	1	2

4.4 Characteristics of adopters and non-adopters (whole sample)

Farm characteristics

Table 10 compares livestock and implement ownership between adopters and non-adopters in Chivi and Zimuto. In general, adopters own more oxen, goats, sheep, donkeys, pigs and poultry than non-adopters. This could suggest that adopters have more resource endowment in terms of livestock than non-adopters. However, for all livestock except for poultry, the difference is not statistically significant at 10% (0.1) level.

Farm implements are important for the various farm tasks. Most technologies require use of equipment: for example to dig a simple compost pit, hoes, shovels and wheelbarrows are used. Thus lack of farm equipment can hinder adoption of a technology. Table 10 indicates that in general, adopters own more equipment than non-adopters, except for ripper ownership. A t-test shows that the difference of the mean number of implements owned is significant for ox-plough (at 10% level), harrow (at 1% level), wheelbarrow (1% level) and hoe (at 5% level). Therefore adopters are better endowed in terms of farm implements than non-adopters. Implement ownership could partly explain why some farmers adopt a technology while others do not. However, caution should be taken in making such a deduction because implement ownership could be confounded by other factors such as income level of farmers. Also, as shown in the PRA phase of the study, farmers are able to borrow draught animals and equipment from others.

Table 10: Livestock and Implement Ownership

		Adopters mean	Non-adopters mean	T test P value
Livestock	Oxen	2.4	2.2	0.741
	Goats	3	2.5	0.202
	Sheep	0.1	0	0.297
	Donkey	0.6	0.5	0.799
	Pigs	0.4	0.3	0.8
	Poultry	15.7	10.4	0.08
Implements	Ox plough	0.26	0.157	0.041*
	Harrow	0.52	0.342	0.005***
	Planter	0.026	0.026	0.994
	Ridger	0.032	0	0.219
	Ripper	0	0.0087	0.251
	Wheelbarrow	1.03	0.71	0.005***
	Hoe	6	4.99	0.017**
	Scotchcart	0.589	0.5175	0.468

*** significant at 1% level , ** significant at 5% level and * significant at 10% level

Crop Production Patterns

Table 11 shows area planted to various crops and output produced for adopters and non-adopters in 1994/5 and 1999/2000 growing seasons. In general, adopters had more acreage and output for most crops than non-adopters.

In 1994/5, adopters cultivated greater areas of maize, cotton, sorghum, rapoko, groundnuts and bambara nuts. However the difference was only statistically significant for sorghum and groundnut. On the other hand, non-adopters cultivated more pearl millet and finger millet. It is important to mention that these two crops are traditional crops. Adopters produced more for all crops except finger millet and pearl millet, with the differences only significant at the 10% level for maize, sorghum and bambara nut. Thus in conclusion adopters were more productive in producing maize, grew more area and produced more sorghum, grew more area of groundnuts, and were more productive in producing bambara nut in 1994/5.

In 1999, adopters cultivated significantly more maize and groundnut area and produced significantly more bags of maize and groundnut than non-adopters. Adopters planted 67% less land to sorghum than in the earlier season and had increased their mean cotton acreage by 280% (compare to a 67% drop in cotton area for non-adopters).

Table 11: Differences in crop production between adopters and non-adopters, for 1994-95 and 1999-2000 (1)

Crop		Adopters (mean) 1994	1999	Non-adopters (mean) 1994	1999	T test P value 1994	1999
Maize	Area	2.9	2.9	2.6	2.4	0.194	0.028**
	Output	20.1	18.8	14.2	14.2	0.005**	0.015**
Cotton	Area	0.3	1.2	1.0	0.3	0.149	0.208
	Output	0.6	2.1	0.8	0.7	0.572	0.241
Pearl millet	Area	0.1	0.1	0.1	0.1	0.767	0.515
	Output	0.3	0.1	1.0	1.0	0.472	0.360
Sorghum	Area	0.5	0.2	0.1	0.1	0.014**	0.472
	Output	4.5	1.1	0.8	0.5	0.041**	0.272
Finger millet	Area	0.0	0.1	0.0	0.0	0.33	0.128
	Output	0.1	0.2	0.0	0.0	0.574	0.149
Rapoko	Area	0.5	0.5	0.5	0.9	0.764	0.369
	Output	1.9	1.7	1.4	1.9	0.349	0.668
Ground nut	Area	1.0	1.1	0.8	0.8	0.095*	0.014**
	Output	3.2	2.9	2.2	1.5	0.139	0.050**
Bambara nut (Nyimo)	Area	0.6	0.7	0.5	0.7	0.465	0.836
	Output	1.8	1.6	1.1	1.1	0.043**	0.406

Note (1): area is in acres and output in 50-kg bags except for Cotton, which is in bales; figures rounded to one decimal place.
** difference between adopters and non-adopters significant at 0.05 level
* difference between adopters and non-adopters significant at 0.1 level

Characteristics distinguishing adopters of specific technologies from non-adopters

Vetiver grass and fanja juu had two of the highest response rates in terms of adoption among those who had heard of them (section 4.5 below). The survey data were analysed to explore the factors affecting their adoption.

1. Vetiver grass

Livestock ownership
Except for sheep and donkeys, the average numbers of livestock (oxen, cows, calves, goats, pigs and poultry) per household for adopters were higher than that of non-adopters (Table 12). However, the differences were not statistically significant.

Crop type and cropping area
The types of crops grown by both adopters and non-adopters of vetiver grass are almost similar. However, non-adopters did not grow finger millet in either the 1994-1995 or the 1999-2000 production seasons. Except for sorghum area in 1999-2000 and pearl millet and cotton areas in 1994-95, the average area planted for all the other crops was higher for adopters than non-adopters for the whole sample (Table 12). Again, the differences are not statistically significant.

Implements
Except for number of planters, the average number of all implements (ox-ploughs, harrows, ridgers, wheelbarrows, hand hoes and scotch carts was higher for adopters

than non-adopters. The difference in the means for number of harrows was statistically significant.

Table 12: Characteristics distinguishing adopters of Vetiver from non-adopters

	mean values	
	Adopters	Non adopters
Total No of oxen owned by household	3.2	2.4
Total No of cows owned by household	2.9	2.6
Total No of calves owned by household	1.4	1.1
Total No of goats owned by household	3.7	3.1
Total No of sheep owned by household	0.2	0.2
Total No of donkeys owned by household	0.6	0.6
Total No of pigs owned by household	0.8	0.0
Total No of poultry owned by household	20.1	12.2
Maize area in 1994-95 season	3.3	3.0
Cotton area in 1994-95 season	0.3	0.5
Pearl millet area in 1994-95 season	0.0	1.7
Sorghum area in 1994-95 season	0.3	0.1
Finger millet area in 1994-95 season	0.1	0.0
Rapoko area in 1994-95 season	0.6	0.4
Groundnut area in 1994-95 season	1.0	0.6
Mbambara nut area in 1994-95 season	0.7	0.6
Maize area in 1999-2000 season	3.3	2.3
Cotton area in 1999-2000 season	0.5	1.8
Pearl millet area in 1999-2000 season	0.0	0.0
Sorghum area in 1999-2000 season	0.1	0.1
Finger millet area in 1999-2000 season	0.1	0.0
Rapoko area in 1999-2000 season	0.7	0.3
Groundnut area in 1999-2000 season	1.1	0.8
Mbambara nut area in 1999-2000 season	0.9	0.4
Total No of ox-ploughs	0.3	0.2
Total No of harrows*	0.7	0.3
Total No of planters	0.0	0.1
Total No of Rigders	0.0	0.0
Total No of Rippers	0.0	0.0
Total No of Wheelbarrows	1.2	0.8
Total No of hand hoes	7.2	4.9
Total No of scotchcarts	0.7	0.6

* - Significant at 1% level of significance
Note: area in acres; all figures rounded to one decimal place

2. Fanja Juu

Livestock ownership

There is no consistent pattern in the differences in livestock ownership between adopters and non-adoperts of fanja juu (Table 13). The average numbers of poultry, cows and oxen are higher for non-adopters than for adopters, while for calves, goats, donkeys and pigs the numbers were higher for adopters than for non-adopters. The difference in the mean number of donkeys was statistically significant.

Cropping area

Non-adopters of fanja juu planted higher average areas of maize, pearl millet, sorghum, groundnut and bambara nut in the 1994-95 season than adopters. Average areas for rapoko and cotton were higher for adopters than non-adopters in the same season (Table 13). In the 1999-2000 season, adopters had higher average areas for cotton, finger millet, rapoko and mbambara nut than non-adopters, but lower average areas of sorghum, maize and groundnut.

Implements

The average number of all implements, (ox-ploughs, harrows, planters, ridgers, rippers, wheelbarrows, hand hoes and scotch carts) for adopters was higher than for the non-adopters of fanja juu.

Table 13: Characteristics distinguishing adopters of Fanja Juu from non-adopters

	mean values	
	Adopters	Non adopters
Total No of oxen owned by household	1.4	1.8
Total No of cows owned by household	2.7	2.7
Total No of calves owned by household	1.0	0.9
Total No of goats owned by household	4.0	3.4
Total No of sheep owned by household	0.0	0.0
Total No of donkeys owned by household*	1.3	0.5
Total No of pigs owned by household	0.8	0.0
Total No of poultry owned by household	10.4	11.2
Maize area in 1994-95 season	2.0	2.9
Cotton area in 1994-95 season	0.8	0.7
Pearl millet area in 1994-95 season	0.0	0.3
Sorghum area in 1994-95 season	0.4	0.8
Finger millet area in 1994-95 season	0.0	0.0
Rapoko area in 1994-95 season	0.5	0.4
Groundnut area in 1994-95 season	0.6	1.1
Mbambara nut area in 1994-95 season	0.5	0.5
Maize area in 1999-2000 season	1.7	2.7
Cotton area in 1999-2000 season	2.2	1.1
Pearl millet area in 1999-2000 season	0.0	0.0
Sorghum area in 1999-2000 season	0.0	0.1
Finger millet area in 1999-2000 season	0.3	0.0
Rapoko area in 1999-2000 season	0.2	0.1
Groundnut area in 1999-2000 season	0.7	1.1
Mbambara nut area in 1999-2000 season	0.5	0.4
Total No of ox-ploughs	0.4	0.2
Total No of harrows	0.4	0.2
Total No of planters	0.0	0.0
Total No of Rigders	0.1	0.0
Total No of Rippers	0.0	0.0
Total No of Wheelbarrows	1.1	0.8
Total No of hand hoes	7.1	5.5
Total No of scotchcarts	0.6	0.4

* = significant at 1% level

Note: area in acres; all figures rounded to one decimal place

4.5 Is there a demand for resource conserving technologies?

Farmers' response to currently promoted technologies provides one indication of potential demand for future NRM technologies. Demand for technologies which perform better, in farmers' eyes, than current ones is likely to be higher. Actual demand will therefore depend largely on the characteristics and performance of the technologies themselves. Data on adoption rates for the various technologies promoted in the study sites are presented in Table 14. This shows the number and proportion of survey respondents who said they had heard of each technology, those who had used it and those who were still using it.

The figures indicate a wide variation between technologies in awareness, use and continued use. Vetiver grass, tree planting and tillage have the highest levels of use, with between 20 and 30 percent of respondents having used them and between 18 and 25 percent still using them. A striking feature of the data is the low level of awareness of some of the technologies. The final column of Table 14 suggests that investing in wider promotion of technologies, or at least the provision of information about them, could result in much higher levels of trial, evaluation and use. Of the twenty technologies listed, twelve were still being used by more than 50 percent of those who said they had heard of them.

Table 14: Awareness, use and adoption of promoted NRM technologies

Technology	Respondents from combined sample (Chivi and Zimuto) who:								
	have heard of it (1)		have used it (2)		have stopped using it (3)		are still using it (4)		
	n	%[1]	n	%[2]	n	%[3]	n	%[4]	%[5]
vetiver grass	96	36.2	79	29.8	22	27.8	57	21.5	59.4
fanja juu	33	12.5	18	6.8	2	11.1	16	6.0	48.5
infiltration pits	30	11.3	11	4.2	3	27.3	8	3.0	26.7
improved compost manure	55	20.8	40	15.1	5	12.5	35	13.2	63.6
small dams	34	12.8	23	8.7	1	4.3	22	8.3	64.7
strip cropping	31	11.7	20	7.5	1	5.0	19	7.2	61.3
mulching	63	23.8	49	18.5	10	20.4	39	14.7	61.9
tree planting	78	29.4	64	24.2	1	1.6	63	23.8	80.8
stone terraces	42	15.8	35	13.2	4	11.4	31	11.7	73.8
tied ridges	21	7.9	14	5.3	1	7.1	13	4.9	61.9
improved OPVs	6	2.3	3	1.1	1	33.3	2	0.8	33.3
banner grass	15	5.7	10	3.8	0	0.0	10	3.8	66.7
runoff orchards	18	6.8	17	6.4	3	17.6	14	5.3	77.8
tillage	64	24.2	58	21.9	9	15.5	49	18.5	76.6
velvet beans	4	1.5	2	0.8	0	0.0	2	0.8	50.0
sunhemp	2	0.8	0	0.0	0	0.0	0	0.0	0.0
cowpea	2	0.8	0	0.0	0	0.0	0	0.0	0.0
soyabean	4	1.5	1	0.4	0	0.0	1	0.4	25.0
low rate of fertiliser	10	3.8	7	2.6	0	0.0	7	2.6	70.0
Soil Management Package	4	1.5	1	0.4	0	0.0	1	0.4	25.0

Notes: [1 - 4] = percent of total sample
[5] = percent of those who have heard of the technology (column (1))

4.5.1 Demand for at least one of the three types of technology

Adoption is a process, not a single event. Some farmers who have heard about a technology may be in the early stages of the process of moving from awareness to eventual integration of the technology into their farming system. There may, in other words, be latent demand for currently promoted technologies which will be made up of those who have not yet heard about the technologies and those who have not yet made up their minds whether or not to try them. Respondents who had heard about a technology but had not so far adopted where therefore asked about their intention to use it. When asked about their intention to use at least one of the technologies promoted after 1980, 68% of responses in Chivi and 100% in Zimuto were positive.

Also, 68% of respondents in Chivi and 100% in Zimuto intended to use at least one of the soil and water conservation technologies. For soil fertility management technologies, 44% of respondents in Chivi and 100% in Zimuto intended to use at least one of the promoted technologies they had heard of. However, the percentage of responses for those intending to use the plant genetic resources in was very low, with 7% in Chivi and 0% in Zimuto (Table 15).

Table 15: Intention to use technologies by respondents who have heard of them

Intention to use at least	Chivi		Zimuto	
	N	% of response[1]	N	% of responses[1]
One of the technologies promoted after 1980	56	68	26	100
One of the soil and water conservation technologies promoted after 1980*	56	68	26	100
One of the soil fertility management technologies promoted after 1980*	27	44	14	100
One of the plant genetic resource conservation technologies promoted after 1980	3	6.5	0	0

Note: [1] Percent of those who said they had heard of the technologies

4.5.2 Demand for each promoted technology

The distribution of those who said they intended to use each specific technology is given in Table 16. "Adopters" refers to those who had adopted at least one of the promoted technologies. In each cell, the base figure for calculating percentages is the number of respondents (adopters or non-adopters) who had heard of the specific technology.

Table 16: Intention to use each technology, by those who have heard but are not currently using it

Technology	Respondents intending to use the technology				Total	
	Chivi		Zimuto			
	Adopters	Non - Adopters	Adopters	Non - Adopters	N	% (of total sample)
	N (%)	N (%)	N (%)	N (%)		
Vetiver Grass	13 (27)	2 (12)	12(75)	-	27	10
Fanja Juu*	18 (34)	1 (6)	2 (100)	-	21	8
Infiltration pits	7 (16)	1 (8)	4 (100)	-	12	5
Improved compost manure	19 (37)	5 (31)	13 (100)	-	37	14
Small dams					8	3
Strip Cropping	6 (14)	1 (7)	8 (57)	-	15	6
Mulching	11 (23)	3 (21)	4 (33)	-	18	7
Tree Planting	12 (22)	1 (6)	5 (50)	1 (50)	19	7
StoneTarraces	17 (30)	5 (29)	0 (0)	-	22	8
Tied Ridges	2 (5)	3 (21)	0 (0)	-	5	2
Improved OPV	3 (9)	-	0 (0)	-	3	1
Banner grass	3 (9)	1 (8)	4 (100)	1 (100)	9	3

Technology	Respondents intending to use the technology				Total	
	Chivi		Zimuto			
	Adopters	Non - Adopters	Adopters	Non - Adopters	N	% (of total sample)
	N (%)	N (%)	N (%)	N (%)		
Run-off orchards	2 (6)	-	2 (100)	-	4	2
Tillage	25 (45)	6 (38)	1 (50)	-	32	12
Velvet bean	0 (0)	0 (0)	0 (0)	-	0	0
Sunhemp	2 (6)	-	0 (0)	-	2	1
Cowpea	2 (6)	-	0 (0)	-	2	1
Soyabean	1 (3)	-	0 (0)	-	1	0
L.R.F.	3 (8)	1(8)	1 (50)	-	5	2
Soil management package	2 (6)	-	1 (100)	-	3	1

Note: in each column, N = number of respondents in the category who have heard about the technology, are not currently using it, and said that they intend to use it within the next three years; percentages in parentheses are N as a proportion of those in the category who had heard of the technology.

Except for velvet bean, there were some farmers who intended to use each of the technologies that were promoted. The highest percentage of responses was for those intending to use improved compost manure. This was followed by tillage, vetiver and Fanja Juu and stone terraces. It is important to note that a higher proportion of adopters than non-adopters intended to use each of the promoted technologies of which they had heard. In Zimuto, only two non-adopters intended to use any of the technologies - tree planting and banner grass.

4.5.3 Farmer Perception on Technologies to solve their Production Constraints

Table 17 shows solutions and technologies suggested by farmers for overcoming the production constraints they face. The frequency distribution of the solutions and technologies suggested was a reflection of the importance of the problems faced. Overall, applying manure and applying fertilizer had high response percentages highlighting that infertility of soils is the most widespread problem in both Chivi and Zimuto. An interesting observation is that only three (Vetiver grass, Fanja Juu and infiltration pits) of the recently promoted soil and water conservation technologies were suggested by farmers as relevant for solving their production constraints.

Table 17: Solutions and Technologies to counter production problems

Solutions and technologies proposed	Chivi				Zimuto			
	Adopters		Non adopters		Adopters		Non adopters	
	No.	%	No.	%	No.	%	No.	%
Burning and digging	2	3	1	2	0	0	0	0
Applying manure	36	50	17	41	23	33	26	45
Fanja Juu	4	6	0	0	0	0	0	0
Hiring tractors	8	11	0	0	9	13	13	22
Find more fertile soils	1	1	1	2	0	0	0	0
Hiring labour	2	3	1	2	10	14	6	10
Crop rotations	1	1	1	2	0	0	0	0
Applying fertilizer	14	19	7	17	41	59	31	53
Vetiver grass	5	7	5	12	0	0	1	2
Planting trees	4	6	2	5	0	0	0	0
Dam construction	1	1	1	2	8	11	5	9
Pesticides	2	3	2	5	27	39	16	28
Improved seed	2	3	3	7	5	7	3	5

Solutions and technologies proposed	Chivi				Zimuto			
	Adopters		Non adopters		Adopters		Non adopters	
	No.	%	No.	%	No.	%	No.	%
varieties								
Infiltration pits	3	4	1	2	0	0	0	0
Stone terraces	3	4	2	5	0	0	0	0
Irrigation schemes	0	0	1	2	1	1	2	3
Provision of livestock	0		2	4	0	0	0	0
More land	2	3	0	0	1	1	0	0
Drainage of soils	14	19	5	12	0	0	1	2
Fallowing land	5	7	5	12	0	0	0	0
Early cropping	4	6	2	5	0	0	0	0
Mulching	4	6	0	0	0	0	0	0
Wind breaks	0	0	1	2	0	0	0	0
Smoking	1	1	0	0	0	0	0	0
Improved tillage	10	14	4	10	0	0	0	0
Infrastructure provision	2	3	0	0	0	0	0	0
Fencing	0	0	0	0	16	23	6	10
Dosing	0	0	0	0	2	3	1	2

Note: percentage figures are the number of those proposing each solution as a percentage of those in the category (adopter, non-adopter) who gave response to the question (second column of question 14 in the questionnaire in Appendix 4)

4.6 Conclusions from the survey

The survey provides some evidence of differences in household and farm characteristics between those who have adopted and those who have not adopted natural resource management technologies which have been promoted since 1980. Adopters owned more land and more livestock, had bigger families, earned higher incomes in Zimuto, and had better houses than non-adopters. The heads of households from adopter families were more educated, relatively older and full time farmers, and higher percentages were formally employed as compared to non-adopters. Members from adopter families belonged to other groups in addition to those associated with AGRITEX, like IUCN and the University, while non-adopter members belonged to only groups associated with AGRITEX. Also, more adopter families had more members who received agriculturally related training as compared to the non-adopters. Adopters also possessed more implements than non-adopters and therefore were better able to use the various technologies that were promoted.

However the differences between the study sites is at least as great as that between adopters and non-adopters of the technologies. Few of the characteristics suggested by informants in the qualitative phase were able to distinguish with any statistical significance between adopters and non-adopters. In particular, the relative importance of farming in the household's livelihood strategy is not, by itself, significantly associated with the likelihood of adoption of one or more of the promoted technologies.

It is clear from the analysis above that there is potential demand for NRM technologies. For those asked whether they intended to use at least one of the technologies promoted after 1980, the positive response was very high. Also, those intending to use at least one of the SWC and SFM technologies had a high percentage. However, those intending to use PGR conservation technologies were very few. The technology with the highest percentage of farmers intending to use it was tillage.

More generally, the survey confirms clearly that the production constraints uppermost in farmers' minds are those which currently promoted technologies are designed to address. Production constraints for adopters and non-adopters were not much different; however, of more importance was the way they ranked them. For adopters in Zimuto, the most important problem was pests, while for non-adopters, it was infertile soils. The reason why this was different could be that adopters were using some of the promoted technologies for soil fertility management and hence soil fertility was no longer such a big problem to them. The problem of soil erosion in Chivi was ranked very high by non-adopters, the reason being that they did not make use of the promoted technologies designed to reduce erosion.

The availability of information about the technologies in question comes across as an important factor in the extent of their uptake by farmers. It is obvious that people cannot form an opinion about a technology that they have not heard about. What is striking from the survey is the high proportion of farmers who have heard of technologies who have gone on to use them.

Chapter 5: Conclusions and Recommendations

5.0 Conclusions

The paper has characterised adopters and non-adopters, identified the major constraints to production for adopters and non-adopters of the various technologies, and explored the relevance of promoted NRM technologies to farmers' production constraints. In this final section we discuss what we can infer from the study about the level of demand for technologies for on-farm natural resource management.

On characterisation of the farmers, the findings from the PRA and the quantitative survey were similar in many cases, but there were a few instances where they contradicted each other. Both suggest that adopters have the following characteristics. They have big families of 4-10 children and own more livestock (cattle goats, sheep etc) than non-adopters and their heads of households are more educated and older. According to the quantitative survey, heads of households of adopter households had been formally employed elsewhere unlike the non-adopters. This latter finding was contradictory to that from the qualitative phase of the study, where the farmers said that adopters had never been employed outside their farms. The production constraints for both adopters and non-adopters were similar but ranked differently. It is however important to note that non-adopters of technologies requiring inputs like cattle manure and draught power identified lack of cattle as their major problem. Non-adopters in Chivi had problems with infertile soils and this was because they did not (or could not) make use of the soil fertility management technologies such as improved compost manure and use of anthill soils which were used by the adopters. Also, the problem of soil erosion was ranked very high by non-adopters who were not using the soil and water conserving technologies such as stone terraces. Adopters in general had higher acreages for crops grown, and obtained higher output than non-adopters. Members from adopter families tended to belong to several groups associated with organisations like the UZ, IUCN and ICRISAT, only to mention a few, in addition to the ones associated with AGRITEX. Members from non-adopter families, on the other hand, tended to belong only to the groups associated with AGRITEX, the national public sector extension agency. Also, heads of households from adopter families attended most of the organized meetings in the village, while those from non-adopter families did not.

However the findings from the survey are much less clear cut than those from the qualitative study: the only characteristics which distinguished significantly (at 0.05 level) between adopters and non-adopters were years of formal education of head of household, average household income and membership of AGRITEX groups. Even here, the differences were only significant in one of the two study sites, indicating that the factors most closely associated with adoption are location and technology specific.

General production constraints faced by the farmers in the sample included lack of market for their produce, weeds, infertile soils, shortage of draught power, lack of knowledge on soil erosion prevention measures and expensive and unavailable inputs.

Concerning demand assessment for the various technologies, the research has shown:

- currently promoted NRM technologies, particularly for SWC and SNM, do address production constraints which are of high priority for farmers

- a high proportion of those who have heard of NRM technologies but are not currently using them expressed an intention to use them within the next three years
- farmers recognise lack of cattle as a key production constraint, and one that also limits the ability of many of them to adopt currently promoted SWC and SNM technologies
- a key factor in low rates of usage and adoption of technologies is the lack of awareness and knowledge of specific technologies; the strong association in one study site between membership of certain groups and level of adoption highlights the importance of the institutional structures through which promotion of technologies and dissemination of information takes place
- the weak statistical association between household characteristics and adoption makes any quantitative assessment of the potential size of the market for new NRM technologies unreliable.

5.1 Recommendations

The major recommendations arising from this research are:

a) Since demand exists for resource conserving technologies, it is important for the technologies to continue being promoted. However promotion needs to be more widespread instead of just concentrating on a few villages as has happened in Zimuto. Those who were outside the promotion focus area had no clue of the existence of some of the technologies. Without knowledge of the existing technologies, farmers cannot adopt them, even though they are appropriate for their particular situations.

b) Though enticing farmers to adopt technologies by providing material benefits, such as providing ridgers to encourage adoption of tied ridges, has proved effective, it could be a very unsustainable way of promoting adoption of technologies. The farmers who adopt the technology for such benefit are more likely to abandon it when the benefits are terminated. Provision of material benefits that are later on withdrawn was cited by farmers as one of the major causes of dis-adoption of technologies.

c) Adoption of some technologies is very much related to the farmers' resource endowment. An obvious example is that those with no cattle are less likely than others to be able to make use of improved compost manure technology. It would therefore be appropriate that a basket of technologies aimed at tackling the same problem be promoted to farmers so that every farmer, whether rich or poor, can afford to pick up at least one of the technologies to address his/her problems. For instance, several methods of making tied ridges can be promoted so that those who do not have the tie-making equipment can also adopt the technology by using the other promoted methods.

d) This research has focused on technologies which have been developed on the basis of external knowledge and research, albeit with the participation of farmers in several cases. From discussions with farmers during the study, it is clear that they have several other indigenous ways of conserving soil and water and plant genetic resources, and of soil fertility management. Such technologies are usually very appropriate for the farmers' conditions and there is need for more research to be done in identifying and improving and promoting such indigenous technologies for there is a great potential for their adoption.

Bibliography

AGRITEX/ ZFU, *A Guide for Farmers on Good Land Husbandry: Conservation tillage option 1 – No Till Tied Ridging*. Harare. Agritex. (n.d.)

Chibudu, C., Waddington, S. R., Murwira, H. K., Kumwenda, J. D. T., Hikwa, D., and Tagwira, F. (1998) Green manuring crops in a maize based communal area, Mangwende: experiences using participatory approaches. In *Soil fertility research for maize-based farming systems in Malawi and Zimbabwe.* Proceedings of the Soil Fertility Network Results and Planning Workshop, Africa University Mutare, Zimbabwe, 7-11 July 1997. 87-90. Harare. DR&SS.

Daberkow S. G., and Mcbride W. D., 1998**.** "Socio-eonomic Profiles of Early Adopters of Precision Agriculture Technologies." *Journal of Agribusiness* **16**(2) 151-168

Galpin M., Dorward P. and Shepherd D., 2000. *Participatory Farm Management Methods for Agricultural Research and Extension: A training manual*. University of Reading/ DFID, UK.

Guerin L. J. and Guerin T. F., 1994. "Constraints to the adoption of innovations in agricultural research and environmental management: a review" *Australian Journal of Experimental Agriculture* **34** 549-571.

Mapfumo, P., Giller, K.E., Mpepereki, S. and Mafongoya, P. L., 1999. "Dinitrogen fixation by pigeonpea of different maturity types on granitic sandy soils in Zimbabwe" *Symbiosis* **27** (3 & 4) 305-318.

Nzuma, J. K., Mpepereki, S., and Murwira, H. K., 1996. Using participatory methods to develop manure options: a case study in Mangwende Communal Area, Zimbabwe. Paper presented at a Risk Management Project workshop, Kadoma, Zimbabwe. http://www.cimmyt.org/worldwide/CIMMYT_Regions/CIMMYT_Africa/RiskMngtKadoma/UsingRisk.pdf

Nzuma, J. K., and Murwira, H. K., 2000. Improving the management of manure in Zimbabwe. Drylands programme: Managing Africa's Soils Discussion Paper no. 15. London. International Institute for Environment and Development.

Piha, M. I., 1996. Verification of a soil management package for smallholder maize in Zimbabwe. In *Soil Fertility Network for maize-based farming systems: research results and network outputs in 1994 and 1995. Proceedings of the Second Meeting of the Network Working Group, Kadoma, Zimbabwe, 18-21 July 1995* pp. 1-9

Pompi, I., Mpepereki, S. and Gwata, E., 1998. Zimbabwe soybean taskforce: Objectives, achievements and agenda for the future. http://www.cimmyt.org/Resources/Library/publications/staffpub98_99/Staffpubs9899a.htm

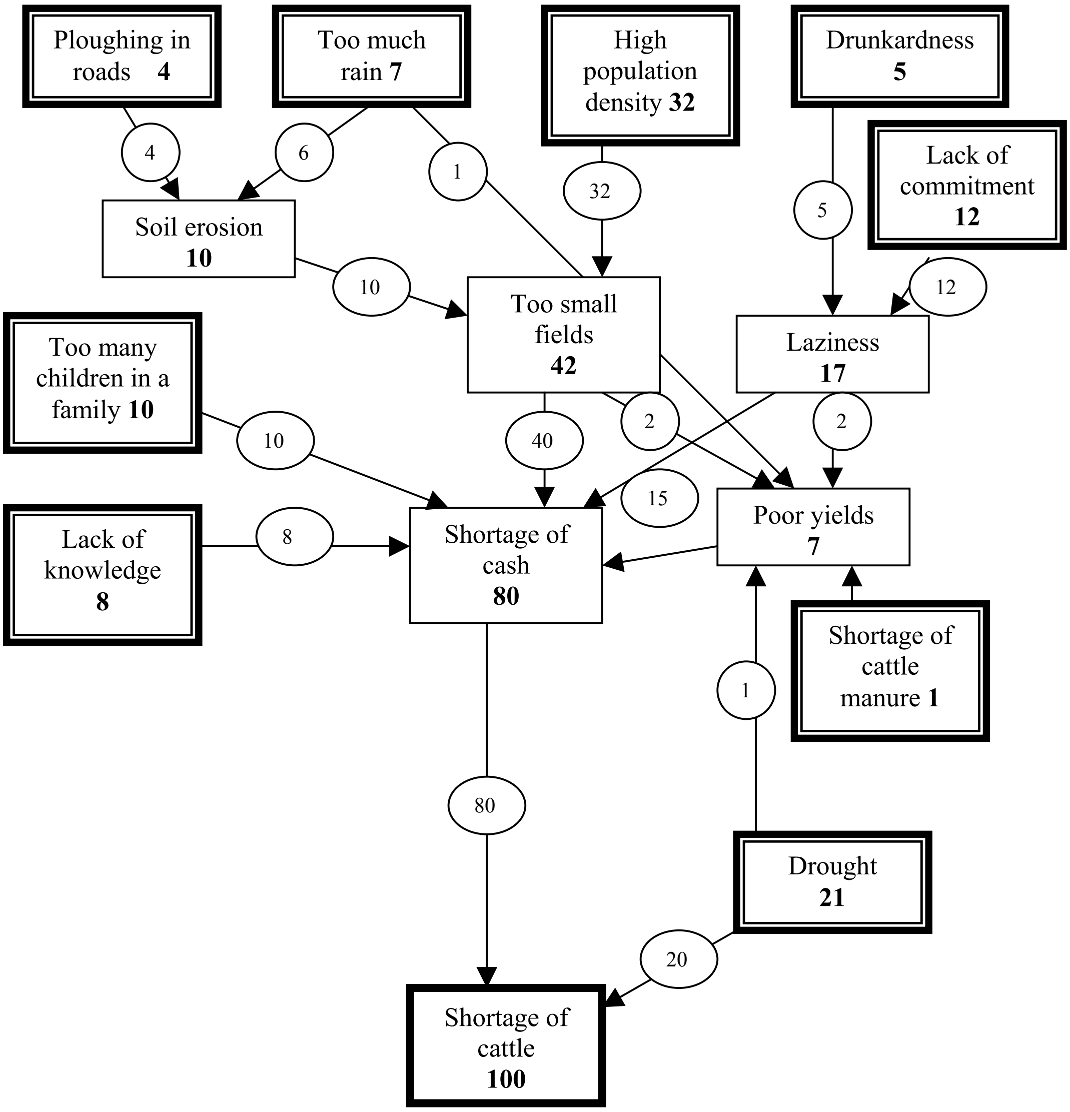
Scoones, I, with Chibudu, C, Chikura, S, Jeranyama, P, Machaka, D, Machanja, W, Mavedzenge, B, Mombeshora, B, Mudhara, M, Mudziwo, C, Murimbarimba, F, Zirereza, B (1996) *Hazards and Opportunities. Farming livelihoods in dryland Africa: Lessons from Zimbabwe***.** London. Zed Books.

Vanclay F. and Lawrence G., 1994. “Farmer rationality and the Adoption of Environmentally Sound Practices; A critique of the assumptions of traditional agricultural extension.” *European Journal of Agricultural Education and Extension* **1**(1) 59-90

Appendices

Appendix 1: Scored Causal Diagrams (SCD) for Chivi

SCD: Non-adopters of cattle manure



Key to SCDs

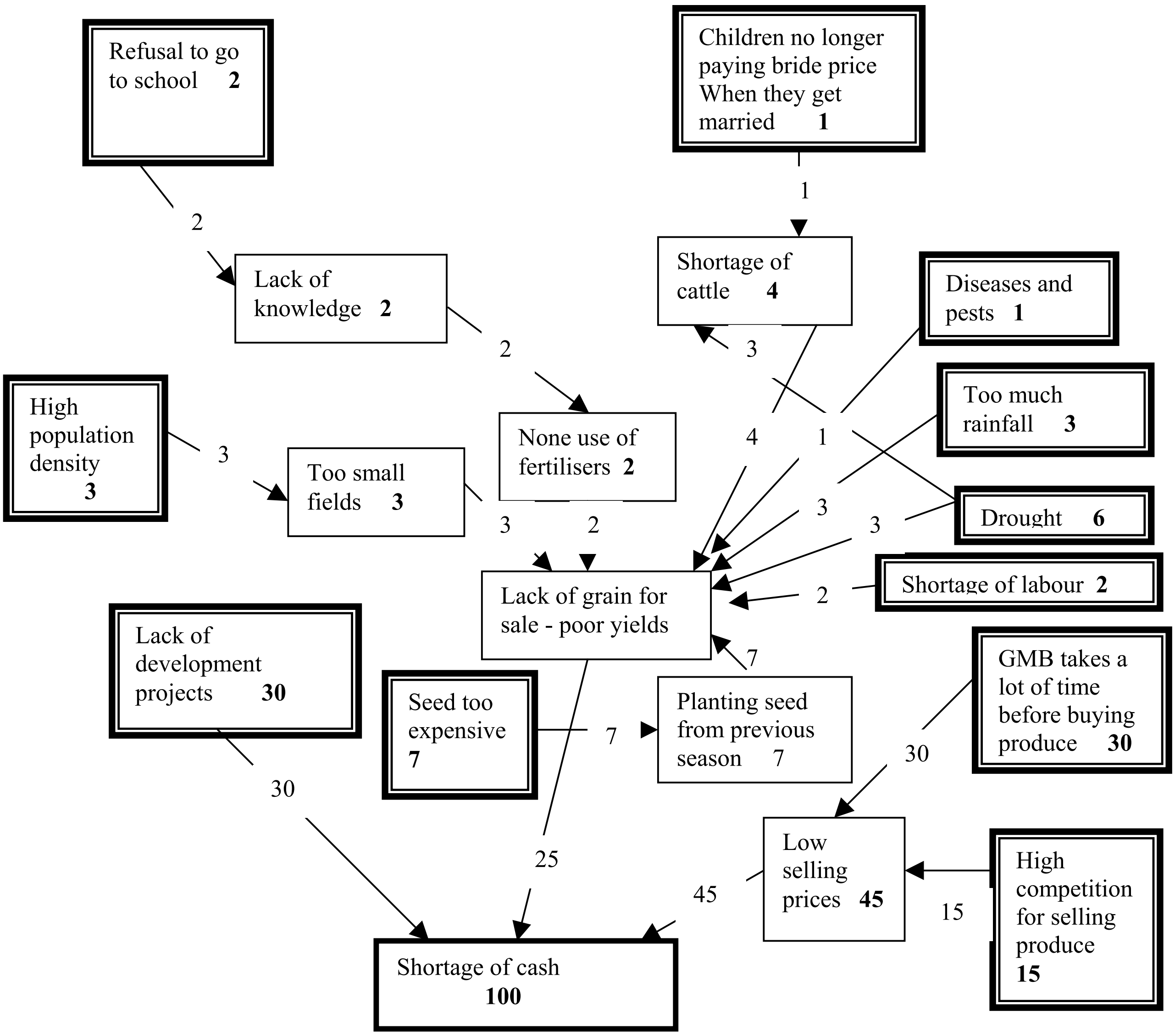
Root cause:

Intermediate cause:

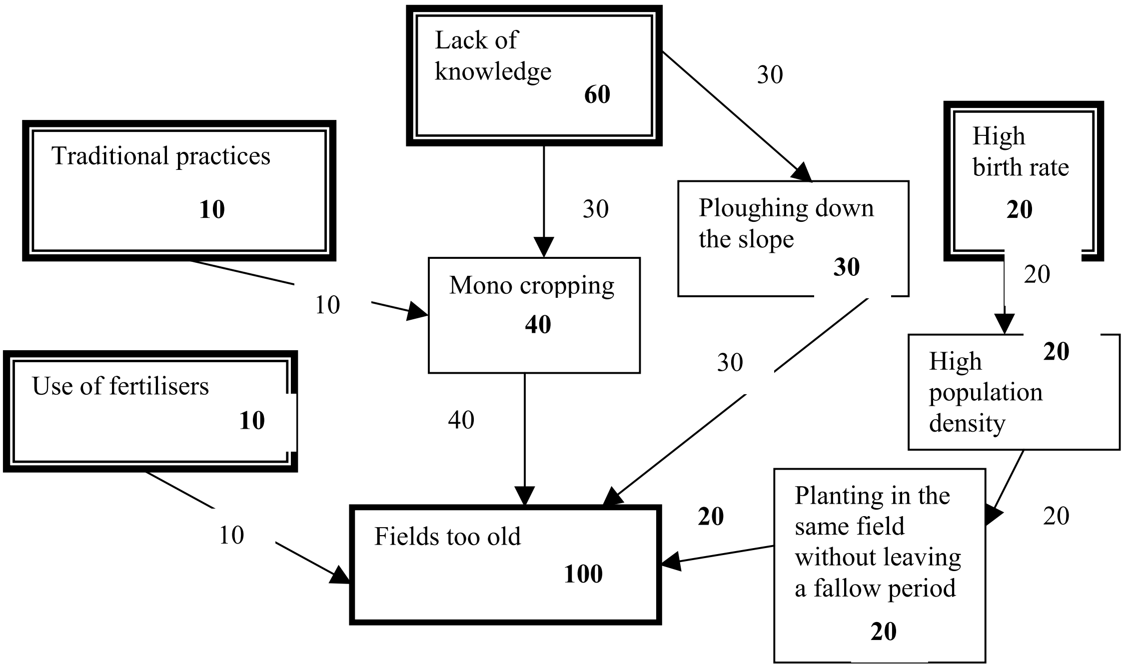
Core problem:

Numbers in boxes and on arrows show how the participants allocated the initial score (usually 100) between the contributing causes, at each stage in the construction of the SCD.

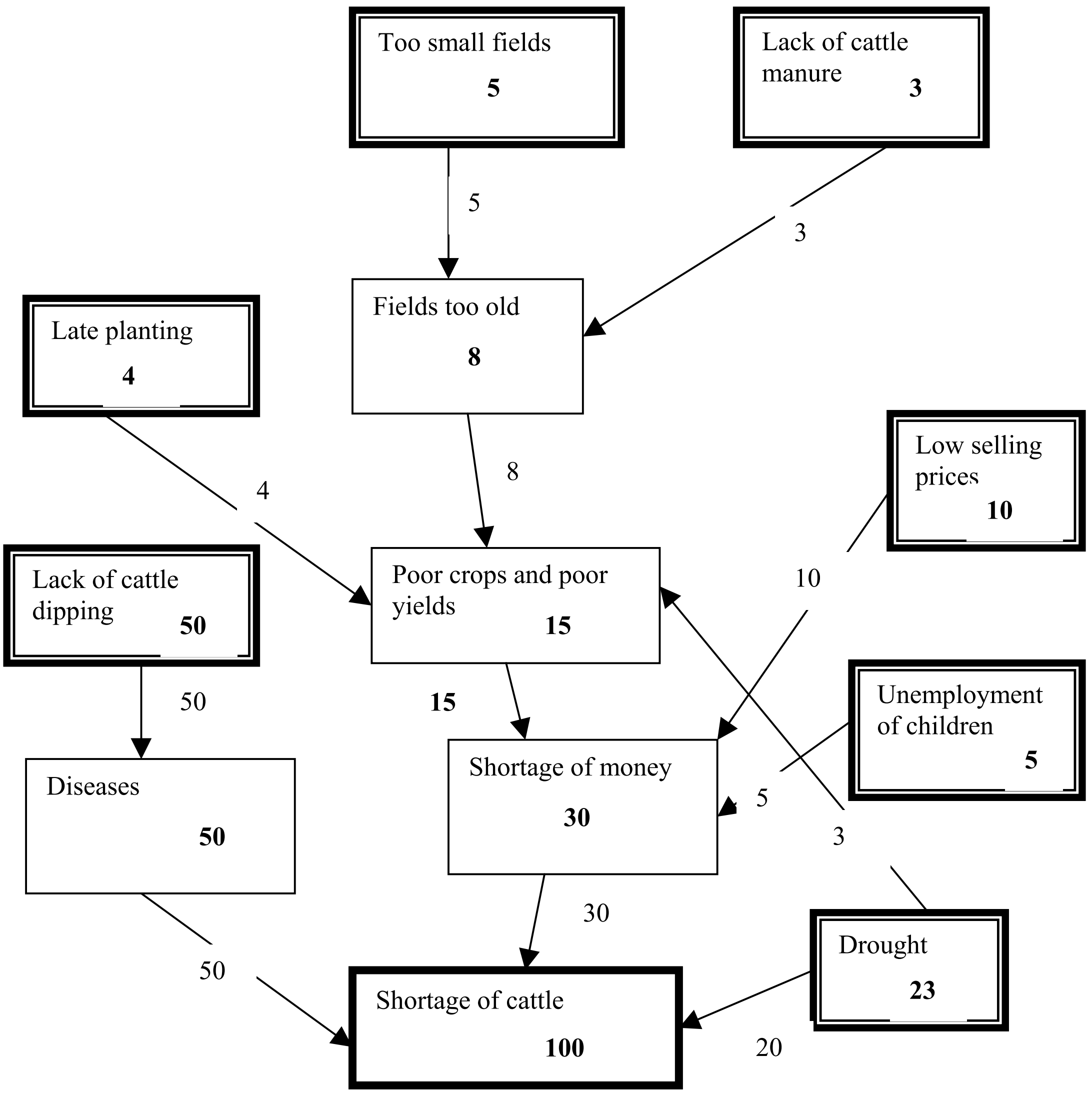
SCD for Adopters of Cattle manure



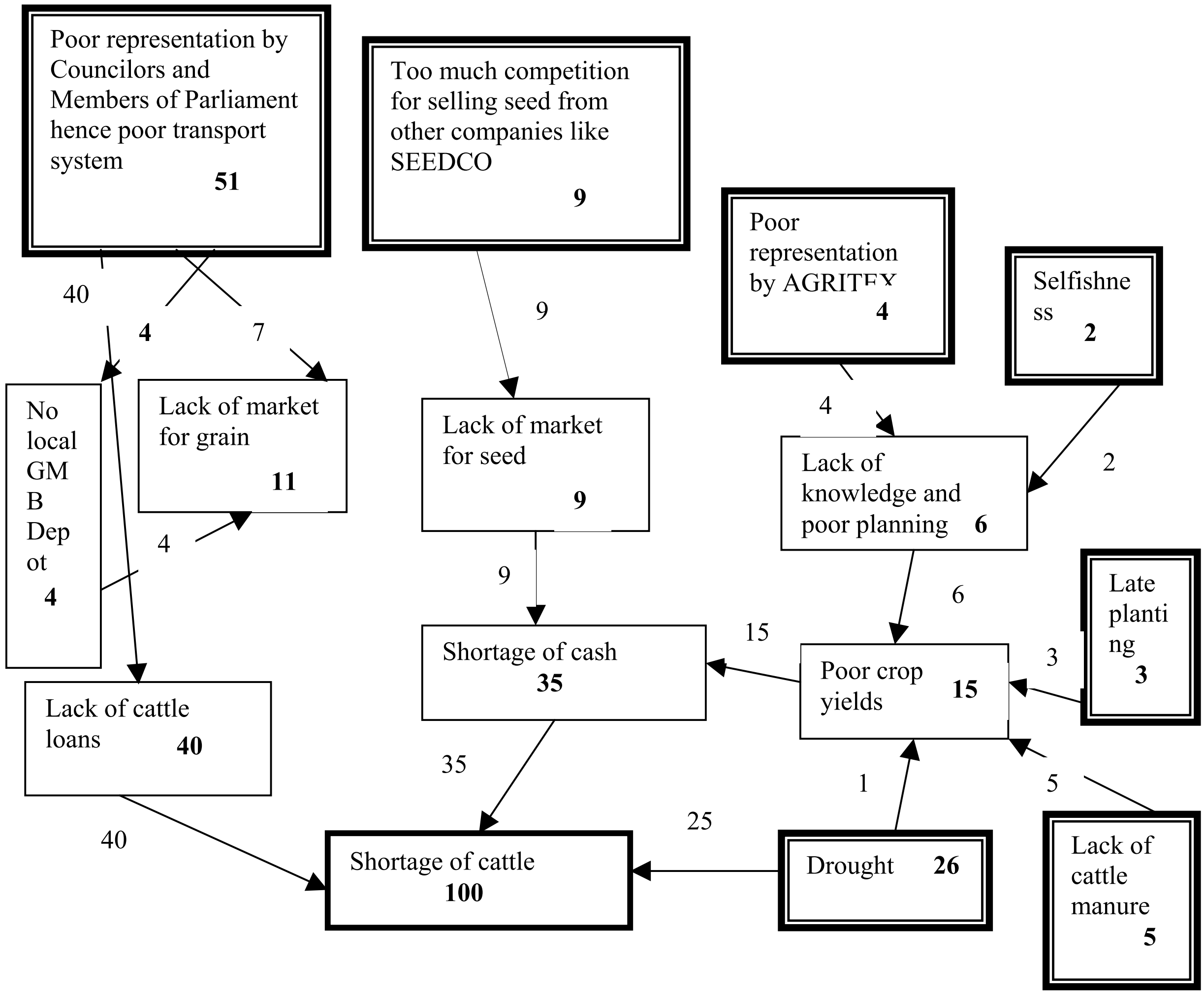
SCD for Adopters in Nduna village



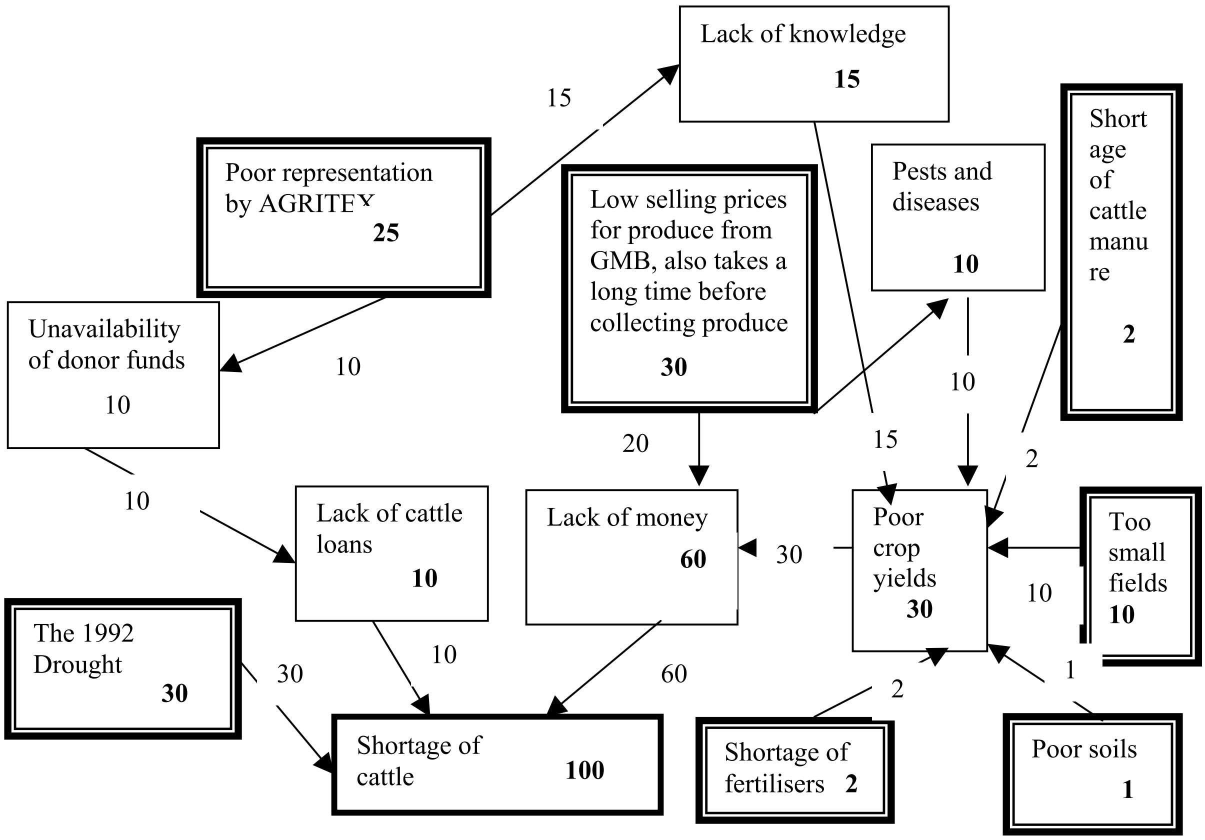
SCD for Non adopters in Nduna village



SCD for Adopters of OPVs in Gomana village

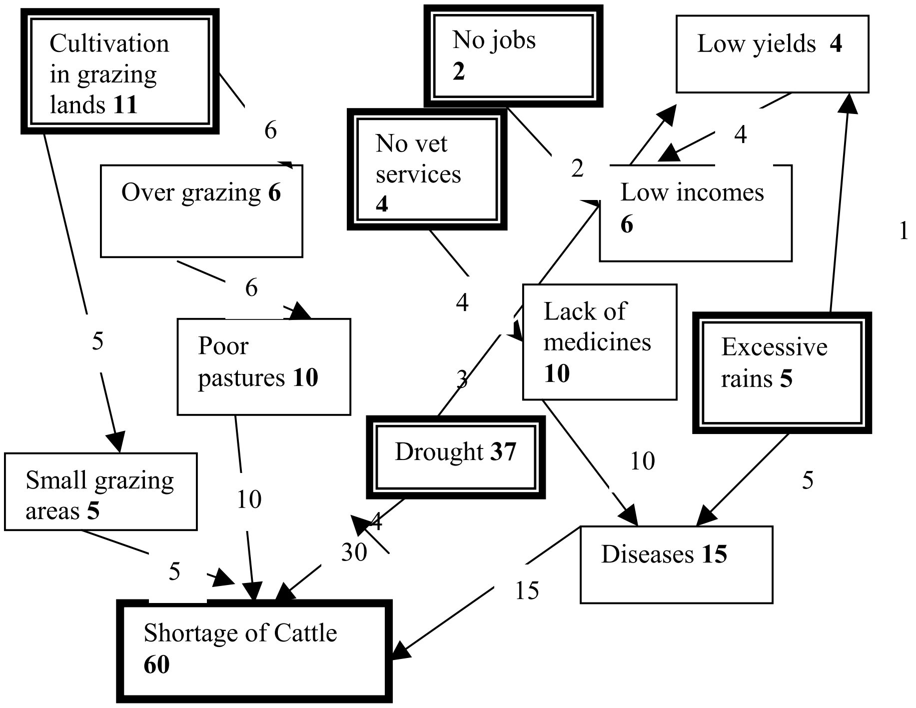


SCD for Non Adopters of OPVs in Gomana Village

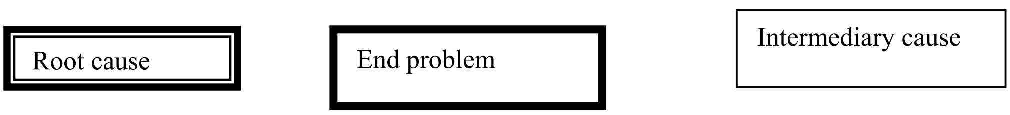


Appendix 2: SCD for Zimuto

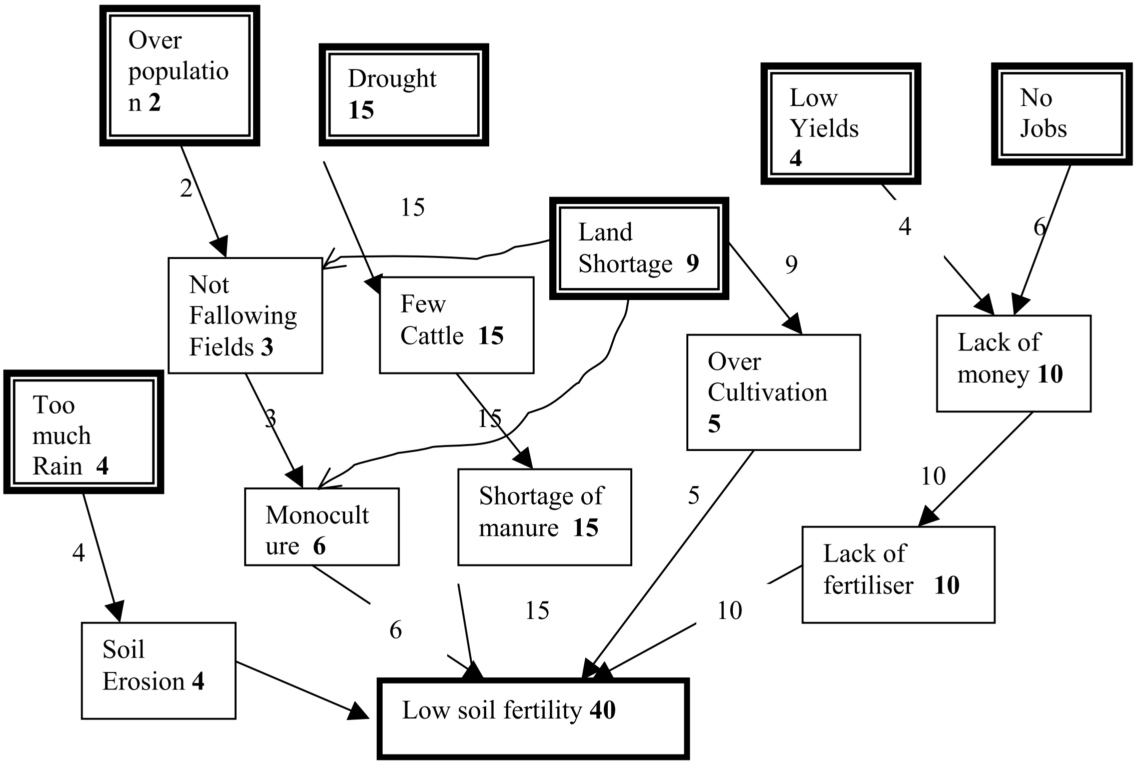
SCD by Maraire Villagers



Key



SCD by Chikato Villagers



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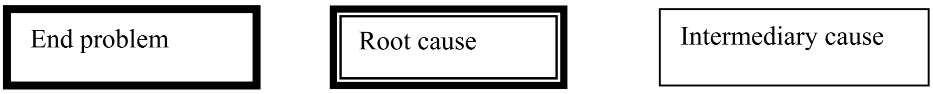
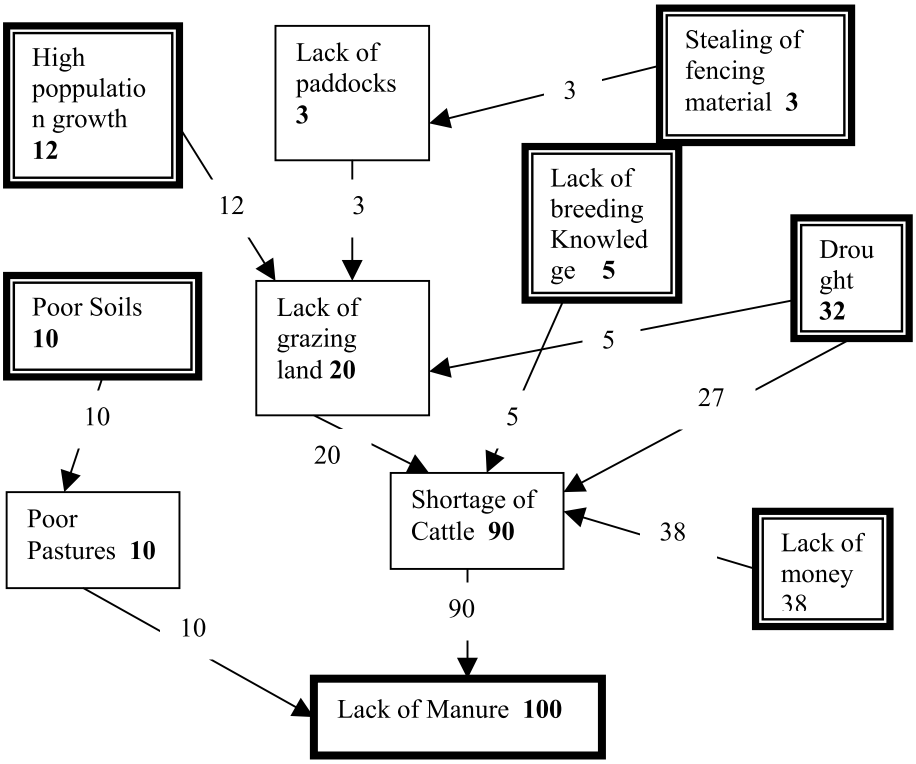


SCD by Mahoto Villagers



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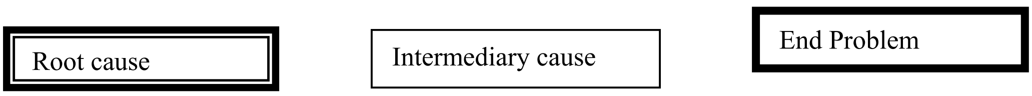
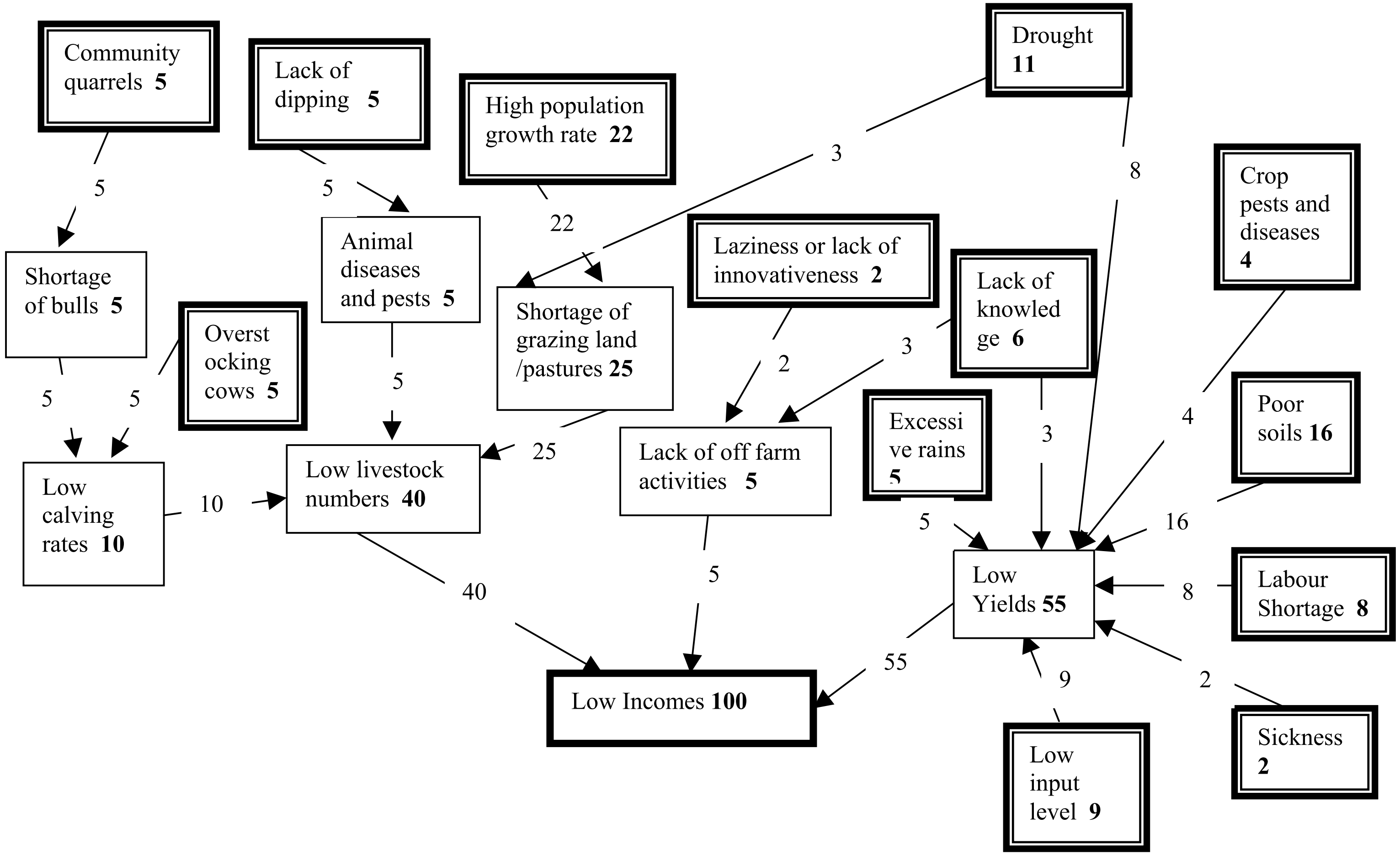


SCD For Maranda



Appendix 3: PBs for Chivi

PB by Adopters of Technologies Promoted in Nduna Village

	May	June	July	August	September	October	November	December	January	February	March	April	Total
Activities	Winter ploughing			taking cattle manure from the kraal, shelling the harvested maize	Taking manure to the field, applying it, buying seed, selling output	Ploughing and planting	weeding	Topping (AN)	Harvesting green mealies		Harvesting into stacks	Drying	
Inputs				10kg seed	10 S Carts 10kg Sed								
Number of people working	2 adults (A) 1 child (C)			2 (A) 3 (C)	2 (A) 3 (C)	1 (A) 2 (C)	2 (A) 3 (C)	2 (A) 3 (C)	1 (A)		2 (A) 3 (C)		
Time spent in Hrs	10hrs (A) 6hrs (C)			(36 +9) =45hrs (A) (27 + 54) = 81 hrs (C)	16hrs (A) 16hrs (C)	4hrs (A) 8hrs (C)	24hrs (A) 36hrs (C)	4hrs (A) 6hrs (C)	14hrs (A)		40hrs (A) 60hrs (C)		
Cost of inputs	$14.56			$79.56	($24.96 +) = $296.96	$7.28	$40.56	($6.76 + $420) = $426.76	$18.20		$67.60		**$ 951.48**
Revenue					$3280				$1925				**$5205**
Gross Margin													**$4253.52**

Important Notes

- Both females and men receive the same amount per hour of work = $1.30/hr ($400/month, working 10hrs/day for 30days)
- Children are paid $0.26/hour of work
- Transportation to the GMB takes 4hours (2 Adults and 1 child)
- Fertiliser costs $242/50kg bag
- Amount of cobs ate was obtained by the following calculations;
  5.5buckets in 1*90kg bag
  2bags = 11 Buckets
  70cobs = 1 Bucket
  770 in 11 Buckets
  1 cob cost $2.50
  Hence 770 cobs = $1925
- Price of maize at GMB = $4500/ tonne
  1 tonne = 11 bags
  1 bag = $410/bag

PB by non-adopters of Technologies Promoted in Nduna Village

	June	July	August	September	October	November	December	January	February	March	April	May	Total
Activities	Winter ploughing	Shelling and selling	Taking cattle manure out from kraal, buying seed		Putting manure into the field	Ploughing and planting + application of Comp D	Weeding and top dressing	Putting Thygone to control maize stalk borer		Harvesting green mealies	Harvesting into stacks	Removing cobs from the stacks and carrying produce to homestead	
Inputs			6 S Carts 2kg Thygone			[3 people = 12 hrs (planting)+ 2 people = 4hrs (D) + 4 people = 16hrs (spreading manure)] = 32hrs							
Number of people working	2 people	5 * (10hrs/day *2days) + (3 GMB = 2 * 1hr +[1hr +36hrs]) = 139hrs			4people		[2 people cultivating = 4hrs + 6people weeding = 18hrs] = 22hrs	2people		1 person	3people	6people	
Time spent in Hrs	10hrs		8hrs		16hrs			2hrs		28hrs	18hrs	60hrs	
Input cost	$20	$278	$16		$32	$64	$44	$4		$56	$36	**$120**	**$2570**
Output		4 * 90kg								3 * 90kg			
Revenue		$2545								$5250			**$7795**
G. Margin													**$5225**

Important Notes

Additional Costs include;

- Children, females and men receive the same amount per hour of work = $2/hr ($500/month, 5day/week, 12hrs/day)
- 10kg seed = $270
- 50kg Compound D = $420
- 50kg AN = $430
- Thygone = $60
- 5sacs = $50
- Thread = $550
- Scale = $75
- Cost of labour for those who carry the bags at the GMB ($3/bag * 15bags) = $45 : Total Additional Costs = $1900
- Amount of cobs (Green Mealies) ate was obtained by the following calculations;
  5 buckets in 1*90kg bag
  15 buckets = 3bags
  70cobs = 1 Bucket
  1050 cobs = 3bags
  1 cob cost $5
  Hence 1050 cobs = $5250

- Price of maize at GMB = $7000/ tonne
  1 tonne = 11*90kg bags
  1 bag = $2545/bag

PB by Adopters of IOPVs Promoted in Gomana Village

	April	May	June	July	August	September	October	November	December	January	February	March	Total
Activities	Shelling	Taking cattle manure out of the Kraal	Winter ploughing		Selling seed	Selling seed	Application of cattle manure	Planting	Weeding	Weeding	Harvesting Green Mealies	Harvesting into stacks	
Inputs		10 scotch carts											
Number of people working	2 adults (A) and 3 children (C)	1 (A) 3 (C)	2 (A)				1 (A) 3 (C)	2 (A) 1 (C)	2 (A) 3 (C)	1 (A) 3 (C)	1 (C)	2 (A) 3 (C)	
Time spent in Hrs	2hrs (A) 3hrs (C)	6hrs (A) 18hrs (C)	6hrs (A)				3hrs (A) 9hrs (C)	2hrs (A) 1hr (C)	10hrs (A) 15hrs (C)	3hrs (A) 9hrs (C)	3.5hrs (C)	4hrs (A) 6hrs (C)	
Cost of inputs	$3.80	$4.80	$16.80				$9,30	$2.60	$19	$9.30	$2.10	$7.60	**$75.30**
Output	15bags				2.5 bags	2.5 bags							
Revenue	$3075				$4200	$4200					$3150		**$14 625**
Gross Margin													**$14 549.70**

Important Notes

- Selling price of maize grain $205/bag
- Selling price of maize seed $1680/bag
- Children were given $0.60 / 1hr of labour
- Adults (both males and females) were given $1/ hour of labour

PB by Non adopters of IOPVs in Gomana Village

	October	November	December	January	February	March	April	May	June	July	August	Total
Activities	Planting and cattle manure application		Weeding	Weeding	Top-dressing	Harvesting Green mealies	harvesting into stacks	ploughing the fields and shelling	Removing manure from kraal	Buying seed and fertiliser	Selling grain	
Inputs **Number of people working** **Time spent in Hrs (each person)**	2 adults and 6 children 2hrs		1 adult and 6 children	2 adults 15hrs	6 children 0.5hrs	1 adult 2hrs	1 adult and 6kids 3hrs	1 adult and 1 kid (ploughing) and 1 adult 6 kids (shelling) (6 + 4)=10hrs	2 adults and 6 kids 2.5 hrs	50kg * 2bags AN ($?@)+ 10kg seed		
Cost of inputs	$1000		$270	$700	$60	$200	$300	(200+500) = ($700)	$200	($1000+300)= $1300		**$4730**
Output						450 cobs @ $7.00 each					15 * 50kg bags@ $210 each	
Revenue						$3150					$3150	**$6300**
Gross Margin												**$1570**

Important Notes

1. The farmers refused to pay labour according to labour hours. They decided to just give a certain amount of money in relation to the type of work being done
For instance, 1.The labour for planting seed in 1 acre normally is worthy $1000
2. The normal rate for weeding is given per acre is per line weeded. Assuming that there were 70 lines, a hired labour gets 70 * $10/line = $700
** However, the rate of weeding after cultivation drops to $3/line and 70lines in the acre costs $210
2. For application of fertiliser, each kid was given $10/30minutes, giving a total of $60 for fertiliser application. The same applies to harvesting.
3. AN cost $500/50kg bag, and seed costs $300/ 10kg

PB by Adopters of Improved Compost Manure in Mbaimbai Village

	May	June	July	August	September	October	November	December	January	February	March	April	Total
Activities		Winter ploughing and buying seeds		taking cattle manure from the kraal, shelling the harvested maize	taking the manure to the field, applying it, ploughing buying seed, selling output (18 bags)	planting	Weeding with cultivator	Weeding with hoes	Harvesting green mealies (600 cobs)	Harvesting into stacks	Drying	Drying	
Inputs People working Time Hrs		Cattle and plough 2 adults (A) 1 child (C) 4hrs (A) 2hrs (C)		12 carts 2 (A) 1 (C) 100hrs (A) 24hrs (C)	Cattle, cart and plough 2 (A) 1 (C) 2hrs (A) 1hr (C)	Cattle and plough 1 (A) 2hrs (A)	Cattle and cultivator 2 (A) 1 (C) 6hrs(A) 4 hrs(C)	hoes 2 (A) 1 (C) 2hrs (A) 1hr (C)	Hoes (4bags) 1 (A) 10hrs	Hoes 2 (A) 2 (C) 8hrs (A) 8hrs (C)	 2 (A) 2 (C) 5hrs (A) 5hrs (C)	 2 (A) 2 (C) 5hrs (A) 5hrs (C)	
Cost of inputs		$12		$248	$6	$4	$20	$6	$20	$32	$20	$20	**$438.00**
Revenue					$4500				$4200				**$8700.00**
Gross Margin													**$8312.00**

NOTES

- The agreed cost of labour was $2 per hour for every one involved in the production system, namely, adults and kids (males and females)
- The total crop output was 22 bags, of which 4 were eaten as green mealies and the remaining 18bags sold or stored.
- The Price per cob for each harvested green maize was estimated to be $7, based on the selling price of green mealies at the local market
- The 18 bags were not sold to the GMB but were sold as buckets in the local market, at $100/bucket, for 45 buckets

PB by Non-Adopters of Improved Compost Manure in Mbaimbai Village

	September	October	November	December	January	February	March	April	May	June	July	August	Total
Activities	Load of ash and leaf litter	hoes ploughing, planting and ashing	Weeding	Weeding	green mealies	green mealies	Harvesting into stacks	Shelling	sell	sell	sell	Buying seed	
Inputs	2 carts	1 acre	Hoes	Hoes								10kg	
People working	4	4	4	4	1	1	4	4					
Time spent	4hrs	420hrs	112hrs	84hrs	2.5 hrs	1hr	68hrs	90hrs					
Cost of inputs	$100	$1000	$350	$300	$50	$20	$350	$500				$400	**$3070**
Output					2 bags or	275cobs		12 bags					
Revenue					$825	$825			**$1000**	**$1000**	**$1000**		**$4650**
Gross Margin													**$1580**

Notes
1) When planting the ash is placed together with the seed in the same hole, not broadcasted.
2) These farmers have no cattle, they use hoes to dig their fields.
3) The work manly involves a 4-member working party
4) Hiring a cart costs $50/load
5) All bags refer to 50kg bags
6) They apply dry planting
7) One bucket of maize is sold at $100
8) 55 cobs constitute a bucket
9) 1 bag = 2 ½ buckets
10) Selling price for shelled dry maize= $250/50kg bag and for green mealies = $6/cob

PB by Adopters of Technologies Promoted in Pedzisai 1 village

	October	November	December	January	February	March	April	May	June	July	August	September	Total
Activities	Compost manure application (D)	Ploughing and planting	Weeding	Topping (Application of AN)	Harvesting green mealies	Harvesting Green mealies	ploughing the fields and harvesting into stacks	ploughing the fields	Ploughing and shelling	Shelling	Selling grain	Buying seed	
Inputs	Compost manure			AN									
Number of people working		3 people	2 people										
Time spent in Hrs		4hrs		2hrs	2hrs	2hrs	6hrs	6hrs	6hrs	4hrs	4hrs		
Cost of inputs	$60	$16	$16	$8	$8	$8	$24	$24	$24	$16	$16	$300	520
Output					$450	$450				$2250	$2250		5400
Gross Margin													4880

Appendix 4: The questionnaire

Questionnaire: Demand Assessment for Resource Conserving Technologies

Enumerators Name…………………………………….

Date………………………………………………….

Area…………………………………………………

Name of Village……………………………………….

Case Number…………………………………………..

Enumerator's Notes

Only the key household head who is actively involved in farming activities should be interviewed. However, some members of the household can help in answering questions which respondent does not remember.

Introduction

Greetings. I am carrying out a survey for the UZ and would be very grateful if you can spare some time going through this questionnaire with me. The survey focuses on use of various technologies by farmers.

Section A: Household Details

Q1:Homestead type Brick-asbestos/tin (1), Brick-thatch (2), Pole & dagga (3)…………………….
(To be observed by the enumerator)
Q2: Name of the head of the household………………………………
Q3: Position of the respondent(s) in the household? Husband 1, Wife 2, Both 3…………
Q4: Size of the household …………………………………………...
(People who live on the homestead)

Please complete the table below:

Family Member	Relationship with household head. [R]	Marital Status [M]	Age (years)	Sex 1 male 2 female	Is the person full time resident on the farm 1 yes 2 no	Occupation O excluding agriculture		Years in School
						Former	Current	
Household head								

R =Daughter (1), Son (2), Daughter in law (3), Grand child (4), Wife (5), Husband (6), Other – Specify (7)

M =Married (1), Widowed (2), Divorced (3), Single (4)

O =None (1), Student (2), teacher (3), headman/kraalhead(4), Church leader (5), nurse/health worker(6) Trader/retailer(7) Other – specify (8)………………………..

Q5: Size of the farm

Field	**Area (Acres)**	**Soil Type** [s]
Main Field	Top Land	
	Vlei	

Home field	Top Land	
	Vlei	
Garden	Top Land	
	Vlei	

S =chidhaka(1) jecha(2) shapa(3) kangarahwe(4) gokoro(5) gova(6)

Q6: Did any member of the household receive any agricultural related training? Complete the following table.

Household Member	Type of agricultural training [T]
Husband	
Wife	
Grand child	
Daughter	
Other (Specify)	

T = University 1, Agricultural College 2, AGRITEX 3, Makoholi 4, Cottco 5, Other specify.

Q7: Give details of livestock ownership in the following table

Livestock	Total number owned by the household	Number owned by respondent
Oxen		
Cows		
Calves		
Goats		
Sheep		
Donkeys		
Pigs		
Poultry		
Other		

Q8: Give details of your cropping system in the following table

1994 – 1995 Production Season			1999 – 2000 Production Season		
Enterprise	Area	Total Output (50kg bags)	Enterprise	Area	Total Output (50kg bags)
Maize			Maize		
Cotton		**Bales**	Cotton		**Bales**

Pearl millet			Pearl millet		
Sorghum			Sorghum		
Finger millet			Finger millet		
Rapoko			Rapoko		
Groundnuts (shelled)			Groundnuts (shelled)		
Bambara (nyimo)			Bambara (nyimo)		
Other enterprises			Other enterprises		

Q9: Give details of implement ownership in the following table

Implement	Number	Implement	Number
Plough		Other (please specify)	
Ox-cultivator			
Harrow			
Planter			
Ridger			
Ripper			
Wheelbarrow			
Hand hoe			
Scotch cart			

Production System Information

Q10: Have you ever heard about any one of the following technologies? (**If 'No' to all technologies, go to Q15**)

Technology	Have you heard of the technology? Yes 1 No 2	If Yes							
		Source of information ?**S**	When did you hear about and start using the technology?		Are you currently using the technology?			Who took greater responsibility in adopting (using) the technology *	If No, do you intent to use in the coming 3 years Yes No 2
					If No, Why **R**	If Yes			
			Year heard	Year started		What are its advantages?	What are its disadvantages?		
Vetiver Grass									
Fanja Juu									
Infiltration pits									
Improved Compost Manure									
Small dams for Irrigation									
Strip Cropping									
Mulching									
Tree planting									
Stone terraces in the field									
Tied Ridges									

* = Daughter (1), Son (2), Daughter in law (3), Grand child (4), Wife (5), Husband (6), Other (Specify)

S = AGRITEX(1) IES (2) CIMMYT(3) ICRISAT(4) DR&SS/ Makoholi(5) ITDG(6) IUCN(7) UZ(8) Other(9) (Specify)…………………………….

A = conserves soil(1) conserves moisture(2) improves soil fertility(3) improves yield(4) cheap(5) easy to do(6) others(7)specify…………………………………………..

D = not relevant (1) laborious(2) requires draught power(3) expensive to do(4) does not work(5) benefits not exclusive(6) too risky(7) others (8)specify……………………………………

R = not beneficial at all(1) benefit insignificant(2) lost interest(3) lack of labour (4) lack of money(5) lack draught power /no cattle(6)
had achieved its purpose (7) the donor left(8) other specify…………………………………………………..

Technology	Have you heard of the technology? Yes 1 No 2	If Yes							
		Source of information ?**S**	When did you hear about and start using the technology?		Are you currently using the technology?			Who took greater responsibility in adopting (using) the technology *	If No, do you intent to use it in the coming 3 years Yes 1, No 2
					If No, Why **R**	If Yes			
			Year heard	Year started		What are its advantages?	What are its disadvantages?		
Improved Open Pollinated Varieties									
Banner grass									
Runoff orchards									
Tillage									
Green Manures: Velvet Been									
Green Manures: Sunnhemp									
Green Manures: Cowpea									
Green Manures: Other									
Soyabean									
Low rates of fertiliser									
Soil management package									
Other									

* = Daughter (1), Son (2), Daughter in law (3), Grand child (4), Wife (5), Husband (6), Other (Specify)

S = AGRITEX(1) IES (2) CIMMYT(3) ICRISAT(4) DR&SS/ Makoholi(5) ITDG(6) IUCN(7) UZ(8)

Other(9) (Specify)………………………….

A = conserves soil(1) conserves moisture(2) improves soil fertility(3) improves yield(4) cheap(5) easy to do(6)

others(7)specify…………………………………………..

D = not relevant (1) laborious(2) requires draught power(3) expensive to do(4) does not work(5) benefits not exclusive(6) too risky(7) others (8)specify……………………………………

R = not beneficial at all(1) benefit insignificant(2) lost interest(3) lack of labour (4) lack of money(5) lack draught power /no cattle(6)
had achieved its purpose (7) the donor left(8) other specify……………………………………………………..

11: Did you ever use any one of the above listed technologies at some point and later stopped?
Yes (1), No (2)…………………………………

If yes why?

Technology		Reason(s) for disadopting technology R
Vetiver Grass		
Fanja Juu		
Infiltration pits		
Improved Compost Manure		
Small dams for Irrigation		
Strip Cropping		
Mulching		
Tree planting		
Stone terraces in the field		
Tied Ridges		
Improved Open Pollinated Varieties		
Banner grass		
Runoff orchards		
Tillage		
Green manures	Velvet Been	
	Sunnhemp	
	Cowpea	
	Other	
Soyabean		
Low rates of fertiliser		
Soil management package		
Other		

R= not beneficial at all(1) benefit insignificant(2) lost interest(3) lack of labour (4) lack of money(5) lack draught power no cattle(6) head achieved its ends(7) the donor left(8) other specify…………………………………………………………..

Q12: What was the form in which you obtained the information?

Technology	Source **	**Form of Information about the technologies** Written material 1, Training 2, Demonstrations and trials 3, Radio 4, TV 5, Field days 6, workshops 7, Other (specify)
Vetiver Grass		
Fanja Juu		
Infiltration pits		
Improved Compost Manure		
Small dams for Irrigation		
Strip Cropping		
Mulching		
Tree planting		
Stone terraces in the field		
Tied Ridges		

**= AGRITEX(1) IES (2) CIMMYT(3) ICRISAT(4) DR&SS/ Makoholi(5) ITDG(6) IUCN(7) UZ(8) Other(9) (Specify)…………………………

Technology		Source **	**Form of Information about the technologies** Written material 1, Training 2, Demonstrations and trials 3, Radio 4, TV 5, Field days 6, workshops 7, Other (specify)
Improved Open Pollinated Varieties			
Banner grass			
Runoff orchards			
Tillage			
Green	Velvet Been		
	Sunnhemp		
	Cowpea		
	Other		
Soyabean			
Low rates of fertiliser			
Soil management package			
Other			

**= AGRITEX(1) IES (2) CIMMYT(3) ICRISAT(4) DR&SS/ Makoholi(5) ITDG(6) IUCN(7) UZ(8)
Other(9) (Specify)…………………………

Q13; Does any one of the family members part of a group(s) belonging to any one of the following organisations?

Organisation	Yes (1) / No (2)
AGRITEX	
IES	
CIMMYT	
ICRISAT	
DR&SS/ Makoholi	
ITDG	
IUCN	
University of Zimbabwe	
Other (Specify)	

Q14: Which production system constraints do you face and which technologies can solve them?

Production system constraints	Technologies that can solve the constraint	Enabling factors necessary for technology to solve the problem
Production system constraints	Technologies that can solve the constraint	Enabling factors necessary for technology to solve the problem

Q15: Sources of Income

Source of Income	Total Amount per year (Z$)
Crops	
Livestock	
Remittances	
Off-farm part time employment	
Petty Trading (selling clothes, sweets, paraffin etc)	
Hiring out draught power	
Hiring out labour	
Beer Brewing	
Brick making	
Other, Specify	

Q16: If a completely new type of crop were introduced in this area, what would be your reaction? Choose any of the following answers…………………………………………….
I would adopt it immediately even if no-one does (1),
I would adopt it immediately if many other people are doing so (2),
I would wait until I see someone who has successfully adopted it (3),
I would wait until I see several people who have successfully adopted it (4),

I would not adopt it at all (5).

Q17: Game for risk averseness

> Suppose you are faced with the following situation. I can give you a sure amount of $20 dollars or we toss the coil and if you win you get $500. You have to make a choice between the two, you can choose the first option and get your $20 dollars or the second one and you stand a chance to win or lose a higher amount.

Repeat this game by lowering the amount to be won until the respondent makes a choice of the first option. Note the mount of at which this switch is made.

The amount of money for which respondents switches to the sure amount $……………..

Thank you for your time