

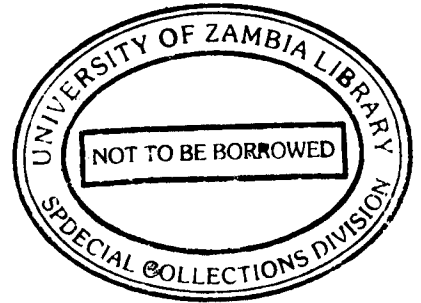
**FACTORS AFFECTING THE ADOPTION OF CONSERVATION FARMING  
AMONG SMALL SCALE FARMERS IN MAPANZA AND NANGOMA.**

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**A Thesis Presented to the Department of Agricultural Economics and Extension  
Education of the University of Zambia**

**By**

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**In Partial fulfillment of the requirements for the Degree of Bachelor of Agricultural  
Sciences**

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# TABLE OF CONTENTS

ACKNOWLEDGEMENT .....	i
TABLE OF CONTENTS .....	ii
LIST OF TABLES.....	iv
LIST OF ABBREVIATION .....	v
ABSTRACT .....	vi
CHAPTER 1:INTRODUCTION .....	1
1.1Background.....	1
1.2 Problem Statement.....	4
1.3 Objectives of the Study.....	4
1.3.1 General Objective .....	4
1.3.2 Specific Objectives .....	4
1.4 Rationale .....	5
1.5 Limitation of the Study.....	6
1.6 Organization of the Thesis.....	6
CHAPTER 2: LITERATURE REVIEW .....	7
2.1 Introduction .....	8
2.2. Adoption of CF/CT Recommendations.....	8
2.2.1 Personal Characteristics (Demographics).....	8
2.2.2 Incentives Availability.....	9
2.2.3 Extension support such as training. ....	10
2.2.4 Perception of Profitability of CF/CT .....	10
2.2.5 Cattle ownership .....	10
2.2.6 Agro-ecological region. ....	11
2.2.7 Agronomic benefits .....	11
2.3. Non-Adoption of CF/CT Recommendations.....	12
2.3.1 Culture and Preference .....	12
2.3.2 Lack of Materials.....	12
2.3.3 Limited Access to Legumes .....	12
2.3.4 Lack of Markets.....	13
2.3.5 Disqualification .....	13
2.4 Adoption Theory: .....	13
2.4.1 Profitability of a Technology.....	13
2.4.2 Acceptability of a Technology .....	14
2.4.3 Complexity of a Technology .....	14
2.4.4 Congruity of a Technology.....	14
2.4.5 Divisibility of a Technology.....	14
2.4.6 Laggards .....	15
2.4.7 Innovators .....	15
CHAPTER 3: METHODOLOGY .....	16
3.1 Introduction .....	16

3.2 Study Area .....	16
3.3 Data Collection Procedure .....	16
3.3.1 Sample Selection .....	17
3.3.2 Survey Process and Type of Data Collected .....	17
3.3.3 Data Limitations .....	17
3.4 Data Analysis .....	18
<b>CHAPTER 4: FINDINGS AND DISCUSSIONS .....</b>	<b>19</b>
4.1 Introduction .....	19
4.2 Regression Model .....	19
4.3 Demographic Characteristics of Sample Households .....	20
4.3.1 Gender of Respondents .....	20
4.3.2 Marital Status of Respondents .....	20
4.3.3 Age of Respondents .....	21
4.3.4 Education of Respondents .....	21
4.3.5 Household Size of Respondents .....	22
4.3.6 Farm Size of Respondents .....	22
4.4 Material Incentives (Inputs and Relief Food) .....	22
4.5 CF/CT Training .....	23
4.6 Perception on Profitability .....	23
4.7 Interpretation of Parameters .....	25
<b>CHAPTER 5: CONCLUSIONS AND RECOMMENDATIONS .....</b>	<b>27</b>
5.1 Introduction .....	27
5.2 Conclusion .....	27
5.3 Recommendations .....	30
<b>REFERENCES .....</b>	<b>31</b>
<b>APPENDICES .....</b>	<b>32</b>
Appendix 1: Statistical Analysis of Parameters .....	33
Appendix 2: Questionnaire For Adopters and Non-Adopters .....	34

## LIST OF TABLES

Table 1: Gender .....	20
Table 2: Marital Status .....	20
Table3: Age .....	21
Table 4: Education.....	21
Table 5: Household Size.....	22
Table 6: Farm Size.....	22
Table 7: Material Incentives .....	23
Table 8: CF Training .....	23
Table 9: Perception on Profitability.....	23
Table10: Interpretation of the Regression Model.....	24

## **LIST OF ABBREVIATION**

ACT	African Conservation Tillage Network
ADP	Animal Draft Power
CDF	Cumulative Distribution Function
CF & CT	Conservation Farming and Conservation Tillage
CFU	Conservation Farming Unit
CLUSA	Co-operative League for the United States of America
CSO	Central Statistic Office
DAPP	Development Agency of People to People
DF	Degree of Freedom
ECAF	European Conservation Agriculture Federation
FAO	Food Agriculture Organization
FSP	Food Security Pack
GART	Golden Valley Agricultural Research Trust
Ha	Hectare
H/H	Household
LM&CF	Land Management and Conservation Farming
MACO	Ministry of agriculture and co-operation
NGO	Non-Governmental Organization
PAM	Program Against Malnutrition
P-Value	Probability Value
SAPs	Structural Adjustment Programs
SIDA	Swedish International Development Agency
SPSS	Statistical Package for Social Sciences
ZIAT	Zambia Impact Assessment Team
ZNFU	Zambia National Farmers Union

## **ABSTRACT**

### **FACTORS AFFECTING THE ADOPTION OF CONSERVATION FARMING AMONG SMALL SCALE FARMERS IN MAPANZA AND NANGOMA.**

**Mulyokela Nawa**  
**University of Zambia, 2005**

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Conservation Farming Unit (CFU) has been carrying out conservation farming (CF) trials and advocacy to small scale farmers in Zambia since 1996. This was to assist those in severe drought prone areas to re-establish their food production base that had been negatively affected. CF is defined as several practices that permit the management of soil for agrarian use, altering its composition, structure and natural biodiversity as little as possible and defending it from erosion and degradation (ECAAF, 2001).

The overall objective of the study was to determine the factors that affect the adoption of CF among CFU small scale farmers in Mapanza and Nangoma agricultural blocks. A total number of 200 CFU farmers from twenty-four camps were interviewed using a questionnaire, focus group discussions and key informants. The data was coded and entered using SPSS. A regression was run and data was analyzed using the normit model by the use of marginal effects.

From the findings there was a significant relationship between demographic variables (age, household size, level of farmers' education) and adoption of CF. The study found that an increase in the farmer's level of education leads to a 6% increase in the probability of adopting CF holding all other factors constant. There was a significant relationship between adoption of CF and perception of CF profitability. That is, an increase in the perception of profitability resulted in an increase in adoption of CF by about 13% holding all other factors constant. Another significant relationship between material incentives such as relief food and inputs was found. An increase in the number of Food Security Packs received resulted in a 14% increase in probability of adopting CF holding all other variables constant. On the other hand, the study found that an increase in age of a farmer resulted in 1% decrease in the probability of adopting CF holding all other variables constant while an increase in household members resulted in a decrease by 6%.

Based on these findings, it is recommended that in future agricultural extension to small scale farmers through the extension staff should be promoted so as to increase adoption of CF. Since food security packs increases adoption of CF, mechanisms for targeting the packs to some farmers with potential should be developed so as to encourage them to adopt the technology. Perception of profitability is another factor that affected adoption of CF. In future, small scale farmers should be encouraged to grow cash crops such as cotton, and soy beans under CF which will help them to earn incomes.

# CHAPTER 1

## INTRODUCTION

### 1.1 Background

In recent years, Zambia's farming systems has changed. There has been seen an increase in the talk about Conservation Farming (CF) techniques and their benefits to farmers who may adopt them. Conservation farming is defined as several practices that permit the management of soil for agrarian use, altering its composition, structure and natural biodiversity as little as possible and defending it from erosion and degradation (ECAAF, 2001). It involved practices such as; dry season land preparation using minimum tillage methods (either ox-drawn rip lines or hand-hoe basins laid out in a precise grid of 15,850 basins per hectare), no burning but rather retention of crop residue from the prior harvest, planting and input application in fixed planting stations, mulching and nitrogen-fixing crop rotations (Haggblade and Tembo, 2003). Adoption is the utilization of the complete package of the above recommended practices at optimum levels (FAO 2004). This means that farmers may change the farming from traditional type of farming to conservation farming techniques. The farming practice that is mostly used by farmers in land preparation is the traditional or conventional farming, where 100% of the soil of the plot was disturbed (Kabwe, 2002). Conventional farming is the process of making a seedbed through tilling, inverting the soil and burning the crop residues so that weeds are controlled (ECAAF, 2001). Conventional tillage reduces the soil weed bank due to burning and inverting of the soil (100%), ash reduces the soil acidity, increase soil workability and burning kills harmful organisms in the soil.

However, this tillage system leaves topsoil, which contains 80% of soil fertility, unprotected, rendering it prone to agents of soil erosion. Some of the specific consequences of such unsuitable practice included depletion of soil organic matter and fertility, and a reduction in soil water holding capacity, infiltration, tilt and low pH (Kabwe, 2002). In this tillage system up to 30% of seasonal rainfall and 50% of applied nutrients is lost in storm flow (ZNFU, 2003). Oxidised topsoil is moved backwards and forward across a hard hoe pan during ridge splitting each year before or at the onset of the rains (ZNFU, 2003). This type of tillage makes it difficult to measure seed and fertiliser rates even if one has been lucky enough to access



inputs (ZNFU, 2003). All the above demerits mentioned reduce crop productivity and soil protection such that more sustainable agricultural practices, such as conservation farming, had gained importance in recent years.

The use of conventional tillage also brought about leaching and acidification in the soil due to soil erosion (ZNFU, 2003). Very low or low pH caused certain nutrients to be inaccessible to some crops and this affected crop yield (FAO, 2001). If lime is not applied to halt the acidity build up in the soil, the yield of crops would fall. The major hindrance to liming under conventional farming is that the recommended application rate (1500-2000Kg/ha) is very high and this lead to high capital cost due to high transportation costs. Compared to conventional farming methods, which required that lime be broadcasted, most conservation farming methods could help the farmers get the same pH reduction by placing reduced lime application rates in planting basins or ripped lines only. This would occupy only 10-15% of the surface area of the field (Argaard, 2005).

As a result of the adverse effects that conventional farming, CFU and other agricultural stakeholders have been advocating for conservation farming techniques to small-scale farmers where only about 15% of the soil surface is disturbed (ZNFU, 2003). Mulching, being one of CF/CT recommendations is a practice of covering the soil by crop stovers so that evaporation and soil erosion are reduced. Minimum tillage is where the field is only disturbed in areas of our interest that is, where the seed would be planted (Kabwe, 2002). The CF system enabled farmers to plant with the first rains when seeds would benefit from the initial nitrogen flush in the soil. By breaking pre-existing plow-pan barriers, the CF basins and lines improve water infiltration, water retention and plant root development (Haggblade and Tembo, 2003). The precise lay out of grids and planting lines enabled farmers to locate fertilizer and organic materials in close proximity to the plants, where they would provide greatest benefit (Haggblade and Tembo, 2003).

In Zambia, CF and related technologies have been promoted since the mid- eighties (Haggblade and Tembo, 2003). In the early 1990s, major changes in the climatic and economic conditions in the country were experienced. Besides the severe drought experienced

between 1991 and 1995 (especially in the southern half of the country-Zambia), the Zambian Government also introduced Structural Adjustment Programs (SAPs) and liberalization of the economy during the same period. In some parts of the country, the adverse effects of these changes were exacerbated by the loss of drought power due to animal diseases outbreak, including corridor disease and foot and mouth disease. In 1996/97 agricultural farming season, there were 290,163 trained oxen for small scale and medium farmers in Zambia. At the end of the farming season, the figure had reduced to only 234,158 of trained animals. A 70% loss of the trained oxen was reported in southern province (CSO, 1999). Therefore, the new challenges brought about by these changes have identified a need to adopt sustainable practices in farming systems. The leading trust in Zambia, Golden Valley Agricultural Research Trust (GART) in collaboration with the Conservation Farming Unit (CFU) had been carrying out conservation farming trials and advocacy to farmers respectively.

In recent years, researchers have looked at the factors that affect the adoption of CF recommendations advocated by CFU. There have been talks from stakeholders on these factors but without any level of significance or any probability proof. Therefore, this case study will sought to find if there is any significant relationship between the adoption of CF and the following parameters; demographics, material incentives, perception of the profitability of CF and CF training. The study was conducted among farmers trained by CFU. It was conducted in two agricultural blocks in Mapanza, Choma district and Nangoma, Mumbwa district. Interviews were conducted with randomly selected heads of households in the twenty-four agricultural camps of these blocks

## **1.2 Problem Statement**

Despite the benefits of the technology of CF/CT to small-scale farmers, none of the 859 households in Mapanza and 2078 in Nangoma of them have adopted these recommendations fully. Only about 2100 households have practised some CF recommendations in the two sampled blocks (CFU, 2005).

Many small-farmers were at different levels of adopting these recommendations that is some were adopting them, some were dropping out and some were entirely not adopting these recommendations. Only one researcher has looked at the factors that affect the adoption of CF/CT of CFU farmers in Zambia. This same researcher looked at mere factors descriptively without taking into consideration at which level of significance, confidence level or any probability proof to his findings. It is therefore that this research sought to determine factors that affected adoption of CF/CT using the normit model where levels of significance, confidence levels and probabilities.

## **1.3 Objectives of the Study**

### **1.3.1 General Objective**

The overall objective of the study is to determine the factors that affect the adoption of CF/CT.

### **1.3.2 Specific Objectives**

- To determine if there is any significant relationship between demographic variables (age, education level, gender, size of household) to the adoption and non-adoption of CF/CT.
- To determine if there is any significant relationship between incentives (inputs, relief food) to the adoption and non-adoption of CF/CT.
- To determine if there is any significant relationship between CF/CT training to the adoption and non-adoption of CF/CT.

- To determine if there is any significant relationship between the perception of farmers to CF/CT profitability and adoption of CF/CT.

#### **1.4 Rationale**

In the early 1990s, major changes in the climatic and economic conditions in the country were experienced. Besides the severe drought experienced between 1991 and 1995 (especially in the southern half of the country-Zambia), the Zambian Government also introduced Structural Adjustment Programs (SAPs) and liberalization of the economy during the same period. In some parts of the country, the adverse effects of these changes were exacerbated by the loss of drought power due to animal diseases outbreak, including corridor disease and foot and mouth disease. In 1996/97 agricultural farming season there were 290,163 trained oxen for small and medium farmers in Zambia. At the end of the farming season, the figure had reduced to only 234,158 of trained animals. A 70% loss of the trained oxen was reported in southern province (CSO, 1999). Therefore, the new challenges brought about by these changes have identified a need to adopt sustainable practices in farming systems.

The information from this case study will help agriculture stakeholders such as leading trust in Zambia, Golden Valley Agricultural Research Trust (GART) and Conservation Farming Unit (CFU) who have been carrying out conservation farming trials and advocacy to farmers respectively, to know which parameters will affect the adoption of conservation farming positively or negatively. This will enable them make sound CF/CT policies for it is the answer to the major changes in climatic and economic conditions our small scale farmers are facing. The information is also of great importance to the interested small-scale farmers and even commercial farmers who want to conserve their soils for their young generation. Planners and Economists also need this information in their day-to-day planning activities and policy making. The study would provide information that can stimulate and support the country's economic growth and development more especially as it relates to its contribution to household food security and income.

## **1.5 Limitation of the Study**

I encountered limitations in the process of carrying out this case study. These limitations are as follows;

- The study was based on purposive sampling method of data collection. This means that sample selection was only limited to small-scale farmers who were trained by CFU and not any other organization such as CLUSA. This created biasness on the data collected
- Most of the farmers that were interviewed do not keep farm records and therefore, the answers were based on the ability to recall data and information (data was collected from 2002-2004 agricultural seasons). This can lead to a systematic error in estimates
- The time available of one (1) month, vacation period for the collection of data from small-scale farmers was too short to interview the targeted three hundred farmers.

## **1.6 Organization of the Thesis**

The organization of this thesis is such that it contains five chapters. The order of discussions of these chapters is elaborated in the paragraphs which follow below;

It begins by discussing the introduction to the whole case study. Introduction is followed by discussing the statement of the problem, the study objectives, both general and specific, rationale that explains how significant the study is to those concerned. This is followed by the theoretical framework and last but not the least it ends by highlighting the limitations encountered in carrying out this project. Chapter one is followed by literature review. It reviews past research publications that have been done in relation to factors that affect the adoption of conservation farming among small-scale farmer. Chapter three looks at the methodology that was used in the case study. It starts with introduction, then description of the study site or area background, data collection procedure which include sample selection, survey process and types of data which were collected and the data limitations and then lastly but not the least, the data analysis. Chapter 4 elaborates the in-depth discussion of research results and discussions. The demographic characteristics of sampled households, material incentives, CF/CT training, perception of profitability of CF/CT, interpretation of the

regression model and table and parameter interpretation are discussed. Lastly chapter 5 deals with conclusions and recommendations of the study. The conclusion is discussed with reference to how results and discussions relate to the objectives. Recommendations are discussed with considerations that their aim is to reveal strategies to be undertaken in order to improve or increase the adoption of CF/CT recommendations among small-scale farmers.

## CHAPTER 2

### LITERATURE REVIEW

#### 2.1 Introduction

This chapter reviews the relevant past research publications that have been done in relation to the factors that affect the adoption of CF/CT recommendations. Literature on adoption is presented first and it is followed by literature on non-adoption. Literature on adoption include; demographics, incentives availability, CF/CT training, perception of profitability of the technology, cattle ownership, agro ecological region and agronomic benefits. Literature on non-adoption factors include; culture and preference, limited accessibility to legumes, lack of markets and disqualification. Additionally, adoption theory was reviewed on factors that affect adoption of a technology. When adopting a new technology, a farmer looks at the five criteria and these are: Profitability, Acceptability, Complexity, Congruity and Divisibility. If an individual perceived an innovation having greater relative advantage, compatibility, trialability, observability and less complex, the innovation would be adopted more rapidly than other innovations. These criteria would give the farmer a better satisfaction of his own needs e.g. food security in the household or increase in family income.

#### 2.2. Adoption of CF/CT Recommendations

Adoption of conservation farming is affected by; demographic variables, material incentives, extension training or support, profitability, cattle ownership, agro ecological regions and agronomic benefits.

##### 2.2.1 Personal Characteristics (Demographics)

According to a study carried out by Haggblade and Tembo, (2003), women apply CF to a greater proportion of their holdings than men. They also found tangible evidence that educated farmers such as retired school teachers, draftsmen and accountants make good CF

farmers. Also demographic variables such as large household size, increase in age of household head, bad health would lead to the non-adoption of CF practices.

ZIAT, 2005, also found out that, age of the head of household affects the production capacity of small-scale farmers. According to their survey carried out in Southern Province, about 34% of their respondents were above 46 years and majority (66%) were below 46 years and showed that they were in majority in adopting CF. They also found out that most beneficiaries were predominantly people below midlife and were regarded as potentially productive farmers with capacity to adopt CF practices. Most rural households depend on family labor for various farm activities and therefore, the size of the household has an impact on labor supply. Evidence from focus group discussions indicated that most households (large) had adequate family labor for timely implementation of CF recommendations, ZIAT, (2005).

Age of household head, household size, gender, marital status, major occupation and last but not the least formal education level will affect the adoption, non adoption and dropping out of farmers practicing CF/CT (personal interview with Peter Aagaard, CFU, 2005).

### **2.2.2 Incentives Availability**

According to study carried out by, Haggblade and Tembo, (2003), they found out that many farmers adopt CF practices that is from 74000 to 150000 after receiving relief food and inputs for that farming season. The drought of 2001/2 induced a big government and donor push into water conservation farming for the 2002/3 season. A group of donors, including SIDA, NORAD and FAO financed input packs for 60000 farmers. One Lima of maize and one Lima of a legume, which was managed by CLUSA, CARE, PAM, LM&CF and the CFU, this also saw many farmers adopt CF practices (Haggblade and Tembo, 2003). In addition, food for work saw each farmer digging two limas of CF basins on each of the 60000 small farmers in 2002/3 farming season, Haggblade and Tembo, (2003). They also found out that, numbers using basins had risen sharply in 2002/3 because of the big push provided by donor cash and packs and dry season digging of basins for an additional of 60000 small holders, Haggblade and Tembo, (2003).



### **2.2.3 Extension support such as training.**

According to Haggblade and Tembo, (2003), even within a given high-potential CF zone, adoption rates differ considerably. In Mumbwa District of Central Province, adoption of CF basins ranges from 27% at Dunavant Nangoma depot to only 8% at Shinuma. Access to extension support such as training, certainly influences farmers to adopt CF/CT. In Central District, areas of longstanding CFU, CLUSA, and Dunavant extension training and support, CF yield higher rates of adoption than elsewhere. Ripper use appeared high in areas where extension demonstrations have occurred, Haggblade and Tembo, (2003). According to Peter Argaard, (2005), conservation tillage and farming were enjoying considerable recognition by small-scale farmers in the areas where they have been demonstrate or trained. That could be verified by the increase in the number of farmers adopting the technology (4000) i.e. adopted different types of CF/CT technologies. ZNFU, (2003), also estimates that between 90000 to 115000 farmers had adopted basic CF/CT practices on a proportion for their land by 2002/3 farming season after receiving CF/CT training, ZNFU, (2003).

### **2.2.4 Perception of Profitability of CF/CT**

According to research carried out in Mujika, Southern Province by Essen and Nolin, (2005), 80%, of those who adopted CF/CT recommendations said that CF/CT was more profitable than conventional farming.

### **2.2.5 Cattle Ownership**

Within a given region, asset holdings of individual farmers would clearly influence their adoption decision. Access to labour and cattle matter most. For CF basins, the most likely adopter categories include current hand hoe farmers, for whom CF basins represent a clearly superior alternative, and cattle-poor households who currently farm with borrowed or rented oxen but as a result plant late and produce meagre output. For animal draft CF with rippers, conventional ox-ploughing households represent the clear client group, Haggblade and Tembo, 2003)

### **2.2.6 Agro-Ecological Region.**

According to Haggblade and Tembo, (2003), water-conserving CF technologies currently under widespread promotion i.e. ADP ripping and hand hoe basins were best suited to areas with low or scattered rainfall and clay or loamy soils. They further said that Zambia's agro-ecological regions I and II are the most suitable. Census of Dunavant distributors suggested that about 10% of cotton farmers in agro-ecological region II use CF basins, while none in the higher rainfall agro-ecological region III do, Haggblade and Tembo, (2003). Geographically, the CF basins appeal most where rainfall proves erratic and unreliable, particularly in agro-ecological region I and II, ZIAT, 2005. According to Haggblade and Tembo, (2003), incentives for adoption of water-conserving CF technologies proved strongest in Zambia's agro-ecological regions I and II, region of erratic rainfall and extensive plough-pan damage where 420,000 Zambians small-scale farmers currently farm.

### **2.2.7 Agronomic benefits**

According to ZNFU, 2003, high adoption rates could be attributed to the agronomic benefits such as high crop yields, soil protection and efficient use of inputs that had been brought about. Haggblade and Tembo, (2003), found out that, even though data on overall adoption remains fragmentally available, evidence suggested that between 20000 and 60000 farmers adopted some form of hand hoe CF in basins during the 2001/2 seasons while an additional 4000 adopted rippers because of the agronomic benefits such as high crop yields, soil protection and efficient use of inputs placement. In general, most farmers have indicated that they would continue to prepare CF planting basins because it enables them to plant early and to retain moisture and the crop performs better than in non-CF fields, according to a research carried out by ZIAT, (2005) in Southern Province. Above all, smallholder farmers adopted CF because it improved soil structure, gains from nitrogen-fixing crop rotations and reduced field preparation labour, which occurs gradually, and overtime, this is according to Haggblade and Tembo, (2003).

### **2.3. Non-Adoption of CF/CT Recommendations**

According to literature, non-adoption of CF could be caused by cultural preferences, lack of materials, limited access to inputs, lack of markets for produce and disqualification.

#### **2.3.1 Culture and Preference**

According to Haggblade and Tembo, (2003), even some areas of heavy extension support yield low adoption rates. They also found out that the low adoption of CF basins among cotton farmers in southern Zambia was due to longstanding traditions of cattle culture and preference for animal draft power. According to the personal interview with Mr. Argaard, people are reluctant to adopting CF because of their previous status in society for example ownership large herds of cattle in the past.

#### **2.3.2 Lack of Materials**

ZIAT, (2005), found out that, even though the majority understand the benefits of CT/CF, they have not yet used it because of the reasons given below; a) many farmers appreciate the need to apply fertilizer in planting basins but the majority indicate that they could not afford to buy fertilizer on their own b) that they need access to either Government or donor supplied fertilizers, c) some of these smallholders lack training on CF/CT technologies, the training in lime application is inadequate and many farmers have been disappointed, and this has led to farmers apply lime in non-acidic soils which has generated undesirable side effects on the crop

#### **2.3.3 Limited Access to Legumes**

According to ZIAT, (2005), even though the majority understands the benefits of crop rotation, they have not yet used it because they had limited access to legume seeds. Some farmers also indicate that they retain trash in the field but they are concerned that uncontrolled burning of the forest damages the trash. Furthermore ZIAT found out that, the presence of

trash in the field attracts free-range animals that eat the trash and destroy CF planting basins when they are prepared early. In addition, forest fires destroy the trash in the fields

#### **2.3.4 Lack of Markets**

According to Essen and Nolin, (2005), crop rotation was inadequate, partly due to lack of market for the produce such as sun hemp, partly because farmers found no use of cover crops or green manure. They also found out that, CF practices gave better yields but demanded more labour input, especially for land preparation and weeding.

#### **2.3.5 Disqualification**

Among those farmers exposed to CF training, about 30% adopted the practice after a period of time. Some farmers are non-adopters of the practices because promotional agencies such as CLUSA, CFU and other agencies disqualify them after failing to rigorously maintain CF practices. The strict requirement of the CFU had led to disqualification of as much as 50%, in a given year, particularly in the early years of CF extension, this was according to CFU, (1998).

### **2.4 Adoption Theory**

Rogers and Shoemaker (1971) carried out pioneering work of theories of adoption. According to Rodgers and Shoemaker, the following factors affect the adoption of a technology; profitability, acceptability, complexity, congruity, divisibility of a technology. The following sections heavily draws on the work of Rogers and Shoemaker (1971)

#### **2.4.1 Profitability of a Technology**

When adopting a new technology, profitability remains the key criteria. It indicates the market benefit arising to both the economy and the farmer. It is measured by the increment in the net value of marketed output realized from the change in the technology. Clearly, an

increase in marketed out put would realize high profits and this would attract the farmer to adopt a new technology.

#### **2.4.2 Acceptability of a Technology**

Acceptability score for a new technology is based on the “cost” of any change, measured by the loss of utilities derived from other products sacrificed by the resource allocation required to allow the change. The higher the cost of a new technology the least the utility the farmer would derive and therefore would offer more resistance to adopt the new technology.

#### **2.4.3 Complexity of a Technology**

Complexity of a technology measures the amount of disturbance created in the management routine of the farmer e.g., the reorientation he must make in his usual sequences of field operation over the season. It is scored by counting the number of days shifted in each planting time period between crops or between different planting time periods. The higher the complexity of a new technology, the higher the farmer would resist to adopt the new technology.

#### **2.4.4 Congruity of a Technology**

Congruity is how closely the new technology is compared to an existing practice. The higher the congruity in a technology, the least the resistance to its adoption.

#### **2.4.5 Divisibility of a Technology**

Divisibility refers to the scale at which a technology can be introduced. If a technology has fewer clashes with the farmer’s other programs or activities, it would attract adoption of that technology.

#### **2.4.6 Laggards**

Laggards are often old aged, who are very slow in considering new ideas and may never adopt the technology. The cause of not adopting is that, they are suspicious of technologies and the change agents. The old aged people are often traditional bound. Their participation in community activities is very low. The old are associated with poor resources and low education.

#### **2.4.7 Innovators**

Innovators are people who are educated and are the first ones to adopt new technologies, keen to experiment and normally have contacts for information that extend beyond the local community.

## **CHAPTER 3**

### **METHODOLOGY**

#### **3.1 Introduction**

The methodology used in the study is discussed by first describing the study site or area background, followed by the data collection procedure which included sample selection, survey process and types of data collected, data limitations and then last but not the least data analysis.

#### **3.2 Study Area**

The data was conducted from two Provinces. In Southern Province, Mapanza was sampled and in Central Province, Nangoma was sampled. Both Districts are in agro-ecological II, but Nangoma has an upper hand in terms of precipitation by 100mm, CFU, (2005). Crop production is the main economic activity in the two Districts. Maize and Cotton are the cash crops for Mapanza and Nangoma respectively. Mapanza is in Mbabala constituency. It has 859 households of which there are 2780 males and 2907 females making a total population of 5687 people (CSO, 2003). Of the 859 households, 750 households have received CFU training but only 600 households have adopted some CF recommendations while the remainder have not. Nangoma is in Nangoma constituency. It has 2078 households of which there are 6862 males and 6935 females. It has a total population of 13797 (CSO, 2003)

#### **3.3 Data Collection Procedure.**

Primary data was collected from CFU farmers in the two agricultural blocks that is Nangoma and Mapanza. In order to achieve study objectives, three instruments were used, namely a questionnaire, two focus group discussions (one from each block) and key informants. This enabled the study to gather additional information and data that could not come out clearly from the questionnaire.

### **3.3.1 Sample Selection**

The sample size was two hundred (200) farmers or households. The households were randomised and a random sample of 100 households was collected in each Province. Fifty adopters and another of non-adopter. A structured questionnaire was used to collect data. Probability sampling was used i.e. each farmer had a chance of being sampled. Stratified random sampling that is dividing the population into homogenous subgroups (adopters and non-adopters) was used. A simple random sample was then taken from each subgroup.

### **3.3.2 Survey Process and Type of Data Collected**

The fieldwork begun on 09<sup>th</sup> July 2005 up to 16<sup>th</sup> August 2005. This time was chosen because it was the time for student's vacation period so as to have enough time to collect the data. The data was collected with the assistance of the CFU field technicians. Questions from the structured questionnaire were asked. Field technician carried out the interpretations were necessary. Occasionally, English was used to those who understood it well. Once all selected households were interviewed, the next agricultural camp was visited for questionnaire administering. The general aim of the case survey was to gather quantitative as well as qualitative data on factors that affect the adoption of CF/CT recommendations. Given the fact that most households generally engage themselves in many farming and other economic activities, a wide variety of data was collected.

### **3.3.3 Data Limitations**

The following limitations were encountered with regard to data collection;

- Some farmers had difficulties in remembering the number of members in their household.
- Farmers faced difficulties in recalling data about 2002-2003 agricultural farming seasons because they did not keep any records on their farm activities.
- Some households refused to give the correct information on important issues such as when they run out of food in fear that they will not receive relief food.



### **3.4 Data Analysis**

The questionnaires were coded and cleaned from noise while in the survey area. This was aimed at checking and immediate action of verification. The data was captured and analyzed using statistical package for social sciences (SPSS) computer software. Frequency distribution tables were generated for demographic variables analysis. Cross tabs were generated to see the relationships between different variables. Then data was analysed using regression that is a normit model. Normit analysis explains the behaviour of a dichotomous dependent variable (adoption) using a normal cumulative distribution function (CDF). Marginal effects were calculated and only parameters, which were significant, were analysed.

## CHAPTER 4

### FINDINGS AND DISCUSSIONS

#### 4.1 Introduction

This chapter deals with the findings of the study. It describes the regression model, demographics, material incentives, CF training, perception of profitability, interpretation of the regression table and the parameter interpretation. The demographic characteristics of sample households discusses the sex, age, size of household, education level of household head.

#### 4.2 Regression Model

$$Y = B_0 - B_1X_1 - B_2X_2 - B_3X_3 + B_4X_4 + B_5X_5 - B_6X_6 + B_7X_7 + ei$$

**WHERE:**

$Y$  = ADOPTION

$B_0$  = INTERCEPT

$X_1$  = AGE

$X_2$  = SEX

$X_3$  = HOUSEHOLD SIZE

$X_4$  = LEVEL OF EDUCATION

$X_5$  = MATEREIAL INCENTIVES

$X_6$  = TRAINING

$X_7$  = PROFITABILITY

$ei$  = ERROR

Variables of the Regression Model were measured as follows: Adoption = 0 while Non-adoption = 1. Sex, Male = 0 while Female = 1. Material Incentives, Yes = 0 while No = 1. CF Training, Yes = 0 while No = 1. Perception of Profitability, Yes = 0 while No = 1. Age, H/H Size and Farmer's Level of Education were all measured as continuous variables.

### 4.3 Demographic Characteristics of Sample Households

Demographic variables (gender, marital status, age, level of farmers’ education and household size) are described below;

#### 4.3.1 Gender

The study shows that 61% of households were female headed and 39% were male headed. In Namngoma, there were 25% males while Mapanza had 14%. 25% females were from Nangoma and 36% were from Mapanza (see table 1).

**Table1: Gender of Respondents**

	Nangoma	Mapanza	Total
Male	50(25%)	28(14%)	78(39%)
Female	50(25%)	72(36%)	122(61%)

Source: Own Survey Data

#### 4.3.2 Marital Status

Most households’ heads, 67% were married and their spouses live in the house. 30% of the household heads were single while 19% were polygamist. Those divorced and widowed were 7% and 10% respectively. (see table 2).

**Table2: Marital Status of Respondents**

	Nangoma	Mapanza	Total
Single	23(11.5%)	7(3.5%)	30(15%)
Married	46(23%)	88(44%)	134(67%)
Divorced	7(3.5%)		7(3.5%)
Widow	7(3.5%)	3(1.5%)	10(5.0%)
Polygamist	17(8.5%)	2(1.0%)	19(9.5%)

Source: Own Survey Data

4.3.3 Age

The age range was between 19 years and 83 years. The mean age was 35 years. Only one respondent was 19 years and the same was with the maximum age that is 83years. The youngest was in Mapanza while the oldest was in Namgoma. (see table 3).

Table3: Age of Respondents

	Mean	Minimum	Maximum
Age	35	19(0.5%)	83(0.5%)

Source: Own Survey Data

4.3.4 Education

On average all farmers went to school that is grade eight on average. The range was from never went to school and grade twelve and all of these farmers were from Mapanza. (see table 4).

Table 4: Education of Respondents

	Mean	Minimum	Maximum
Education	8	0.00	12

Source: Own Survey Data

4.3.5 Household Size

Household size of the farmers ranged from six members to eighteen members and the average was eleven members in each family. Nangoma had the minimum range and Mapanza had the maximum (see table 5).

Table 5: Household Size of Respondents

	Mean	Minimum	Maximum
Household size	11	6	18

Source: Own Survey Data

4.3.6 Farm Size

At least each farmer had a hector of land and some had as much as thirty hectors and the mean hectare was 5.2 HA (see table 6).

Table 6: Farm Size of Respondents

	Mean	Minimum	Maximum
Farm size	5.2	1	30

Source: Own Survey Data

4.4 Material Incentives (Inputs and Relief Food)

Ninety-eight and half percent of the households’ heads adopted CF/CT because they one time or another received inputs and relief food from a certain organization for them to start practicing the technology. Of these Nangoma had the highest percentage of 50 % while Mapanza had only 48.5%. Only three of the total 200 respondent said they did not receive any incentives for them to practice CF/CT and all these were from Mapanza. These only represented 1.5% (see table 7).

**Table 7: Material Incentives of Respondents**

	Nangoma	Mapanza	Total
True	100 (50%)	97 (48.5%)	197 (98.5%)
False	0 (0%)	3 (1.5%)	3 (1.5%)

Source: Own Survey Data

**4.5 CF/CT Training**

Ninety-seven and half percent of the households’ heads interview said that the training they received was sufficient or adequate and helped them adopt the CF/CT recommendations. Among these, 48% were from Nangoma while 49% were from Mapanza. Only 2.5% from both blocks said the training they received was not adequate to adopt (see table 8).

**Table 8: CF Training of Respondents**

	Nangoma	Mapanza	Total
True	97(48.5%)	98(49.0%)	195(97.5%)
False	3(1.5%)	2(1%)	5(2.5%)

Source: Own Survey Data

**4.6 Perception on Profitability**

Sixty nine percent of the household heads interviewed perceived CF/CT technology as a profitable technology. 35% were from Nangoma while 33.5 were from Mapanza. 31% of the heads said it was not profitable to use or practice CF technology. (see table 9).

**Table 9: Perception on profitability of Respondents**

	Nangoma	Mapanza	Total
True	71(35.5%)	67(33.5%)	138(69.0%)
False	29(14.5%)	33(16.5%)	62(31.0%)

Source: Own Survey Data

**Table10: Interpretation of the Regression Model**

PARAMETER	PARAMETER ESTIMATE	t- VALUE CALCULATED	t- VALUE TABLE	MARGINAL EFFECT
INTERCEPT	0.73946 (0.73498)	1.00609	1.6450	0.30563
AGE	-0.02670 (0.01010)***	-2.64317	1.6450	-0.01104
SEX	-0.00317 (0.17958)	-0.01763	1.645	-0.00131
H/H SIZE	-0.14119 (0.05600)*	-2.52144	1.960	-0.05836
INCENTIVES	0.4768 (0.16959)**	2.05012	1.960	0.143701
TRAINING	-0.01137 (0.058792)	-0.01934	1.645	-0.0047
PROFIT	0.30955 (0.18066)*	1.71341	1.645	0.127942
EDUCATION	0.15535 (0.03728)***	4.16716	2.576	0.064209

GOODNESS OF FIT  $X^2(175df) = 268.777$       P-VALUE = 0.000      DF = 7-6=6

BRACKETS ARE STANDARDS ERRORS

MODEL IS SIGNIFICANT BECASUSE IT'S P-VALUE < 0.01

LEVEL OF SIGNIFICANCE AT: 10% = \*, 5% = \*\* 1 = \*\*\*

Source: Own Survey Data

A regression model was analyzed specifying that adoption was affected by demographic variables (age, sex, household size, level of farmers education), material incentives, CF/CT training and perception of profitability of CF/CT. The results are shown in the table 10 above. The goodness of fit of the chi square (X<sup>2</sup>) at 175df was 268.777. The p-value is 0.000. The degree of freedom of the regression model is 6. The standard errors are in the brackets under the parameter estimate column. The levels of significance are represented as follows; 10% =\*, 5%= \*\*, 1%=\*\*\*

The above results show that the model specified is significant because its p-value is less than 0.01. The t-value calculated and the t-value tables were compared. If t-value calculated is greater than the t-value table then the parameter is significant.

#### **4.9 Interpretation of Parameters.**

The intercept represents that even without any parameters, for example demographics, material incentives, perception on profitability and CF training, there will be about 31% probability of adoption of CF recommendations among small scale farmers. Age being one of the parameters looked at, it has a negative relationship with adoption of CF recommendation. The study found out that on average, 35 years, an increase in the age of a farmer by one year, leads to about 1% decrease in the probability of adopting CF/CT recommendation holding all other explanatory variables constant. On the other hand this means that a reduction in the average age say from 35 years to 34 years will result in the reverse of the above. This is at 1% level of significance.

Household size is also one of the parameters that were looked at and was significant at 10% level of significance. It has a negative marginal effect on adoption of CF recommendation on CFU farmers. The study found out that, on average, 11 family members, an increase in size of household by one member for example, leads to about 6% decrease in the probability of adopting CF recommendations holding all other explanatory variables constant. A reduction in the average size say from 11 members to 10 members will result to an increase in the probability of adopting CF by the same number



Material incentive is one of the parameters that was looked at and was significant at 5% level of significance. It has a positive marginal effect on adoption of CF recommendation on CFU farmers. The study found out that, an increase in the number of FSP for example by one pack, leads to about 14% increase in the probability of adopting CF recommendations, holding all other explanatory variables constant.

Perception on profitability is one of the parameters that was looked at and was significant at 10% level of significance. It has a positive marginal effect on adoption of CF recommendation on CFU farmers. The study found out that, an increase in the profitability by the sale of one extra bag of produce for example, by one, leads to about 13% increase in the probability of adopting CF holding all other explanatory variables constant

Education is one of the parameter that was looked at and was significant at 1% level of significance. The study from Nangoma and Mapanza reviewed that, on average (grade 8), an increase in the farmer's level of education for example by 1 grade leads to about 6% increase in the probability of adopting CF, holding all other explanatory variables constant.

The other two parameters (sex and training) were not significant at 1%, 5 % and 10% confidence level but had a negative relationship with the adoption of CF/CT recommendations.

## **CHAPTER 5**

### **CONCLUSIONS AND RECOMMENDATIONS**

#### **5.1 Introduction**

This chapter presents the conclusions and recommendations of the study. The conclusion is discussed with much emphasis on how the research results and findings relate to the objectives. Demographics will be concluded first, followed by material incentives and perception of profitability of CF/CT,

#### **5.2 Conclusion**

A positive relationship of about 14% between material incentives and the adoption of conservation farming exists at 5% confidence level. Haggblade and Tembo, 2003, found out that there was an increase in adoption of CF/CT recommendations when the SIDA, NORAD and FAO financed input packs for farmers from 74000 to 150000 the following farming season. The same research reviewed that food for work also increased the adoption of CF/CT recommendations by the same researchers. Study findings and literature from the past researchers are the same, so it can be concluded that material incentives increases adoption of CF/CT recommendations by about 14% at 5 % confidence level.

The findings from the analysis showed that there was a positive relationship of about 13% between the perceptions on of CF/CT at 10% confidence level and the adoption of conservation farming. According to theory, an increase in marketed output would realize high profits and this would attract farmers adopt a new technology like CF/CT. According to CFU, 2005, literature reviewed that an increase in perception of profitability will result in an increase in adoption of CF/CT recommendations. Nolin and Essen, 2005, in Mujika also found out that an increase in perception of profitability will increase the adoption of CF/CT. Study findings, theory and literature from other researchers are all the same. It can therefore

be concluded that farmers' perception on profitability increases the adoption of CF/CT recommendations.

At 1% confidence level findings showed that, there was a positive relationship of about 6% between the level of farmer's education and the adoption of conservation farming. According to theory innovators are educated and are the first ones to adopt new technologies, keen to experiment and normally have contacts for information that extend beyond the local community. Haggblade and Tembo, 2003, found out that an increase in one's education level resulted in an increase in adoption of CF/CT recommendations. The same study also showed that educated people for example retired teachers, draftsmen and accountants adopt and make good CF farmers. Study findings, theory and literature from other researchers show that the higher the level of education will result in the higher adoption of CF/CT recommendations. So it can be safe to conclude that an increase in level of farmers' education can result in a positive increase in the adoption of CF/CT.

On the other hand, findings from the study showed that there was a negative relationship of about 1% between an increase in age of the head of household and the adoption of CF recommendations at 1% confidence level. In theory, old age is found in non adopter who are very slow in considering new ideas and may never adopt the technology. The cause of not adopting is that, they are suspicious of technologies and the change agents. These old age are traditional bound. Their participation in community activities is very low. The old are associated with poor resources and low education. The findings are also the same as the literature of Haggblade and Tembo, 2003, which reviewed that as one grows up the participation in adoption of new technologies, reduces due to status and more of tradition bound. CFU, 2005, reviewed that, as one grows up they become less energetic thereby reducing the chances of adopting new changes such as conservation technologies. The study findings, theory and literature all explain the same. Therefore it can be concluded that as the age of a farmer increases the chances of him adopting a technology reduces.

There was a negative relationship between the size of farmer's household by about 5%, at 5% confidence level and the adoption of conservation farming. According to ZNFU, 2003, as the

family grows or increases there is role conflict as to who will do what chore. For example making of basins and weeding just to mention a few. According to Mr. P. Argaard, 2005, he also reviewed that as the family members increases there is a very big role conflict in the family. Since literate and study findings say the same thing, it can be concluded that as household size increases there is a decrease in the adoption of CF/CT recommendations.

### 5.3 Recommendations

- In future agricultural extension training for small scale farmers through the field extension staff should be promoted so as to increase adoption. Training and visit must be emphasised on non adopters.
- Since food security packs increases adoption of CF, mechanisms for targeting the packs to some vulnerable but viable farmers should be developed so as to encourage them to adopt the CF technology.
- Perception of profitability is another factor that affected adoption of CF. In future, small scale farmers should be encouraged to grow cash crops such as cotton, and soy beans under CF so that they can realize income benefits.
- In future, small working groups should be encouraged so as to reduce role conflicts during labour intensive periods among small scale farmers.

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**APPENDICES**

## APPENDIX 1: STATISTICAL ANALYSIS OF PARAMETERS

### \*\*\*\*\*PROBIT ANALYSIS \*\*\*\*\*

Parameter estimates converged after 16 iterations.  
Optimal solution found.

Parameter Estimates (PROBIT model: (PROBIT (p)) = Intercept + BX):

	Regression Coeff.	Standard Error	Coeff. /S.E.
Age	-.02670	.01010	-2.64317
profit	.30955	.18066	1.71341
Members	-.14119	.05600	-2.52144
Educati	.15535	.03728	4.16716
Sex	-.00317	.17958	-.01763
Training	-.01137	.58792	-.01934
Reliefod	.34768	.16959	2.05012

Intercept Standard Error Intercept/S.E.

.73946 .73498 1.00609

Pearson Goodness-of-Fit Chi Square = 268.777 DF = 175 P = .000

Since Goodness-of-Fit Chi square is significant, a heterogeneity factor is used in the calculation of confidence limits.

-----  
Covariance(below) and Correlation(above) Matrices of Parameter Estimates

	Age	moprifit	members	educati	sex	training
age	.00010	-.05066	-.04447	-.14548	.16403	.03132
Profit	-.00009	.03264	.05315	-.02866	.02162	.02878
Members	-.00003	.00054	.00314	-.11996	-.22088	.02844
Education	-.00005	-.00019	-.00025	.00139	.22196	.06536
Sex	.00030	.00070	-.00222	.00149	.03225	.07017
Training	.00019	.00306	.00094	.00143	.00741	.34565
Reliefod	.00008	.00285	.00051	.00129	.00170	.00505

Reliefod

Age	.04548
Members	.05375
Sex	.05577
Training	.05064
Reliefod	.02876



APPENDIX 2: QUESTIONNAIRE FOR AADOPTERS AND NON-AADOPTERS

CONSERVATION FARMING QUESTIONNAIRE.  
ADOPTERS AND NON-AADOPTERS.

SECTION A.

1. Farmers name?
2. Sex? Male ☐ female ☐
3. Number of family members in total?
4. Number of children attending school? boys ☐ girls ☐
5. Number of active labor? boys ☐ girls ☐
6. Level of farmers' education?  
Primary ☐ secondary ☐ tertiary ☐ none ☐
7. Marital status? single ☐ married ☐ divorced ☐ widow ☐ polygamist ☐
8. District?
9. Agricultural block?
10. In which camp are you
11. Village?
12. Main occupation of head of household? Farming ☐ Trading ☐ charcoal burning ☐  
government employee ☐ roadside shop ☐ others.....
13. What is the total farm size? Lima ☐ ha.. ☐

SECTION B.

1. What types of crops do you cultivate, area planted, yields and production?

Crop	Area (ha/lima)	Yields/ha/lima	Production/kg	Cropping type
Maize				
Sorghum				
Millet				
Cassava				
Cotton				
Others				

2. How long have you been farming? Years
3. Has somebody before farmed your farm? Yes ☐ no ☐
4. If not, was it virgin? Yes ☐ no ☐
5. What is your opinion about soil fertility since you started practising?  
High ☐ medium ☐ low ☐
6. What type of farming systems have you been using?  
Conventional tillage (100% ploughing with oxen)? ☐  
Conservation farming(use of basins, land preparation in the dry season)? ☐  
Organic farming (use of kraal manure, compost manure)? ☐  
Others (specify).....

7. General opinion about CF/CT.

	True	False
1. Basins are for people without cattle for draft power?	<input type="checkbox"/>	<input type="checkbox"/>
2. It does not pay to produce more because market is poor?	<input type="checkbox"/>	<input type="checkbox"/>
3. Manure or compost is just as good as fertiliser?	<input type="checkbox"/>	<input type="checkbox"/>
4. Basins are mainly for extra food security?	<input type="checkbox"/>	<input type="checkbox"/>
5. Fertiliser can be harmful to the soil?	<input type="checkbox"/>	<input type="checkbox"/>
6. Legumes add more nutrients to the soil?	<input type="checkbox"/>	<input type="checkbox"/>
7. CF/CT is a good way of making money?	<input type="checkbox"/>	<input type="checkbox"/>
8. Basins can be made on fields bigger than 4 Lima?	<input type="checkbox"/>	<input type="checkbox"/>
9. I would like to try other crops but can't find seeds?	<input type="checkbox"/>	<input type="checkbox"/>
10. Fertiliser cannot be replaced by compost or manure?	<input type="checkbox"/>	<input type="checkbox"/>
11. Plowing can make the soil too hard for the crops?	<input type="checkbox"/>	<input type="checkbox"/>
12. Weeding four times decreases the weeds next season?	<input type="checkbox"/>	<input type="checkbox"/>
13. Using full crop rotation uses too much land?	<input type="checkbox"/>	<input type="checkbox"/>
14. changing from conventional to CF is just too fast	<input type="checkbox"/>	<input type="checkbox"/>
15. it will be better to change slowly to CF	<input type="checkbox"/>	<input type="checkbox"/>
16. CF practice is no similar to conventional tillage	<input type="checkbox"/>	<input type="checkbox"/>
17. This makes it hard to change to CF	<input type="checkbox"/>	<input type="checkbox"/>
18. CF is very much disturbing in practising compared to conventional	<input type="checkbox"/>	<input type="checkbox"/>
19. CF practising has fewer costs	<input type="checkbox"/>	<input type="checkbox"/>
20. CF practices yields more profits	<input type="checkbox"/>	<input type="checkbox"/>

8. Who provided CF training?  
CFU ☐ PAM ☐ GTZ ☐ CLUSA ☐ others.....
9. What was your source of labour before practising CF?  
Hired ☐ family members ☐ others.....
10. What is your source of labour now?  
Hired ☐ family members ☐ others.....
11. What is your source of inputs before and after?  
Hired ☐ ☐  
Family members ☐ ☐  
Others.....
12. In which category of practising are you?  
a) Still practising? ☐ B. Non practising? ☐

## SECTION C. (STILL PRACTICING ONLY).

1. What types of crops do you grow under CF/CT?

Crop	area	Yield	Production kg	Practice	Year
Maize					
Cotton					
G/nuts					
Millet					
Cassava					
C.peas					
Others					

2. What were the yields in the past?

Year	maize	cotton	G/nuts	Others
2002-3				
2003-4				
2004-5				

4. When did you start practicing CF? Year

5. What CF methods do you use?

Ripping ☐ basins ☐ crop rotation ☐ mulchin ☐ others.....

6. What implements do you use?

Chaka hoe ☐ magoye ripper ☐ Others.....

9. What month do you start land preparation? Month

10. Do you plan to use CF this season? Yes ☐ no ☐

11. If yes, have you started land preparation? Yes ☐ no ☐

12. If no, to 10, why?.....

13. What type of systems did you follow before practicing CF?

Hand hoe ☐ own ox ☐ hired oxen ☐ combination of own oxen and hoe ☐  
combination of oxen and hoe ☐ others.....

14. Did you ever-own oxen? Yes ☐ no ☐

15. If yes, did they die? Yes ☐ no ☐

15. If no, were they sold? Yes ☐ no ☐

16. How has your cultivated land changed between 2002-5 agricultural farming season?

Growing season 2002-3 2003-4 2004-5

Cultivated land ☐ ☐ ☐

17. Why is it increasing/ decreasing? Good practice ☐ bad practice ☐

19. Why do you practice CF? Ranking 1,2,3,4,...

To increase food security? ☐

To increase yields ☐

To increase income? ☐

To increase status? ☐

To receive inputs ☐

Profitable ☐

☐ Drought survive? ☐

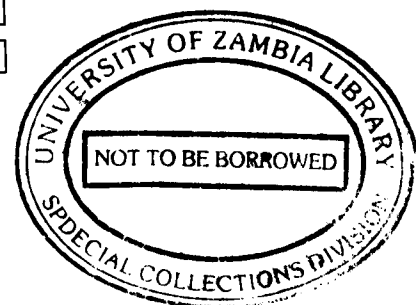
☐ fewer weeds? ☐

☐ Improved fertility? ☐

☐ Less work? ☐

☐ to receive relief food ☐

☐ others.....



SECTION D (NON-ADOPTERS ONLY)

1. What type of crops do you grow?

Year	maize	G/nuts	cotton	Others	Yields
2002-3					
2003-4					
2004-5					

2. What type of CF practices do you know? ☐

Ripping ☐ basins ☐ crop rotation ☐ mulching ☐ none ☐

3. What implements of CF do you know?

Magoye ripper ☐ chaka hoe ☐ others.....

6. Do you plan to start CF? Yes ☐ no ☐

1. If no, yes explain.....

2. Do you have enough draft power? Yes ☐ no ☐

3. What type of farm practices to you use?

Organic farming (use of manure, compost) ☐ conventional farming ☐

4. What are the reasons for not adopting? rank 1,2,3,4,5

- Low yields
- Low profits
- More weeds
- More work
- Less recreation time
- Lack of active labor
- Lack of inputs
- Sickness in the family
- Lack of necessary knowledge
- More costs
- Lack of relief food
- CF/CT reduces fertility
- Not convinced of the method
- Others.....

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