THE SUSTAINABILITY OF CONSERVATION FARMING IN THE SMALLHOLDER FARMING SECTOR. A CASE OF GURUVE COMMUNAL AREA IN ZIMBABWE

By

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Abstract

This study is based on fieldwork conducted in Ward 5 Guruve District of Mashonaland Central, Zimbabwe. Conservation farming (CF) has been widely embraced as an antidote to the perennial food insecurity situation, bedeviling drought prone regions in Zimbabwe, such as Guruve district and in Africa at large. Despite widespread promotion of CF among smallholder farmers in Zimbabwe, there has been some dis-adoption of CF by some farmers who originally participated in CF promotions. This study therefore seeks to evaluate the sustainability of conservation farming as an alternative solution to the threatened food security of smallholder farmers. The study therefore determines the socio-economic factors that influence adoption, continuation or discontinuation with conservation farming. It also establishes whether differences exist in terms of socio-economic attributes among farmers who continued and those who discontinued CF. In addition, the study also investigates the profitability of conservation farming practice compared to conventional farming practice. A combination of descriptive statistics, gross margin analysis, and logistic regression analysis was used to investigate the sustainability of conservation farming. Primary data collected through household interviews was used. A structured questionnaire was administered to a total of 90 randomly selected households comprised of three equal categories of farmers namely those that continued CF, discontinued CF and those who never practiced CF. In addition, secondary data was also used in the study.

The study revealed the existence of partial differences and similarities in socio-economic attributes among the three categories of farmers. The most important factors that significantly influence adoption of CF are: number of cattle owned, household labour and maize output. On the other hand, factors that significantly affect continuation/discontinuation with CF are: education of household head, number of cattle owned, access to credit and maize output. Gross margin analysis results showed that maize production using CF practice is significantly more profitable compared to conventional farming hence it is a sustainable farming practice that can be recommended for increasing crop output among smallholder farmers.

It was concluded that conservation farming practice among smallholder can be sustained if the issue of access to credit is addressed, household heads are equipped with education on the importance of CF, CF is promoted with user friendly farm implements to replace draft power shortage and maize output from the CF plot remains significantly higher than that obtained from conventional plot. Anything short of this will result in unsustainable CF. However, the challenge might be that of limited capacity by the government, the private sector and NGOs to continuously provide input support to smallholder farmers in large numbers and hence posing a threat to the sustainability of CF.

Dedication

To my parents, brothers, sister, wife and children for their support and being a source of inspiration.

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List of Abbreviations

Arex	Agricultural Research and Extension
CA	Conservation Agriculture
CADEC	Catholic Development Commission
CF	Conservation Farming
CIMMYT	International Maize and Wheat Improvement Centre
COMESA	Common Markets for East and Southern Africa
CRS	Catholic Relief Services
CVF	Conventional Farming
FAO	Food and Agricultural Organisation
GDP	Gross Domestic Product
GoZ	Government of Zimbabwe
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
NGO	Non Governmental Organization
NR	Natural Region
ORAP	Organization of Rural Associations for Progress
SAT	Sustainable Agricultural Technology
SPSS	Statistical Package for Social Scientists
UMP	Uzumba Maramba Pfungwe
UNMDG	United Nations' Millennium Development Goal
ZCFU	Zimbabwe Commercial Farmers' Union
ZFU	Zimbabwe Farmers' Union
ZIMVAC	Zimbabwe Vulnerability Assessment Committee

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CHAPTER ONE:

INTRODUCTION

1.0 Introduction and Background

The problem of food insecurity has become more intensely pronounced in recent years with the threat posed by recent trends, such as climate change, water scarcity, as well as ecosystems and biodiversity degradation exacerbating this problem (Gukurume *et al.,* 2010). Additional pressure has also emanated from the rapid population growth which has resulted in increase in demand for food (Gukurume *et al.,* 2010). In 1994 the world population was projected to double from roughly 6 billion to more than 12 billion in less than 50 years (Pimentel *et al*., 1994). In Sub-Saharan Africa, most rural communities are languishing in abject poverty, yet the agricultural systems being promoted there have unacceptably high environmental, economic, and social costs (Bolwig and Gibbon, 2007). To note is the fact that nearly 80% of the population in Sub-Saharan countries lives in rural areas with 70% of this rural population being directly dependent on agriculture for their livelihood (Carney, 1998). The farming methods used by these farmers are largely conventional which are sometimes not sustainable in terms of environmental preservation. It is against this background that conservation farming has been promoted to sustain and improve crop production among communal farmers in marginal rainfall regions of Zimbabwe, and sub Sahara Africa.

The terms ‘conservation agriculture’ and ‘conservation farming’ have often been used interchangeably in various literatures. For the purposes of this thesis, however, the two are treated as different. In this study, I have adopted the terminology as defined by the United Nation’s Food and Agriculture Organization (FAO) Conservation Agriculture Task Force for Zimbabwe (Twomlow *et al*., 2008a). Conservation Agriculture (CA) is a broad term, which encompasses activities such as minimum and zero tillage, tractor powered, animal powered and manual methods, integrated pest management, integrated soil and water management, and includes conservation farming (CF). Conservation Agriculture is generally defined as any tillage sequence that minimizes or reduces the loss of soil and water and achieves at least 30% soil cover using crop residues. Conservation farming is CA practiced by smallholder farmers using

small farm implements such as the hand hoe to create planting basins. It is actually a modification of the traditional pit systems once common in southern Africa (Mando *et al.*, 2006). This study is based on the production theory assuming that the main objectives of a smallholder farmer are food security and profit maximisation. A smallholder farmer is regarded as a producer and a consumer (Sadoulet *et al.*, 1995). This entails that a smallholder farmer takes into consideration "current consumption needs and production ends" (Reardon *et al.*, 1997). As a result a smallholder farmer will therefore react in various ways towards declining food production among them being the adoption of technologies brought to his attention such as conservation farming (FAO, 2001b).

A lot of benefits have been realized in agricultural production with conservation farming practice, which has greatly increased production worldwide. For example, in Uganda, like in many countries in Eastern and Southern Africa, conservation farming practices have increased crop production by more than 30% especially in the dry-land areas through the increase of stored soil water and minimized labour, energy and capital requirements in agricultural production (Lubwana, 1999). During a period of 15 years from 1991 to 2004, no-till adoption in Brazil grew by 22, 6 million hectares and in the same period maize grain production doubled from 57.8 million tons to 125 million tons while planted area experienced only a moderate increase (Derpsch, 2005). Certainly other factors as improved technology and better varieties have had an influence in this sharp increase in grain production, but probably the greatest influence came from applying the no-till technology. A similar situation happened in Argentina from 1988 to 2001 (Derpsch, 2005).

In sub- Saharan Africa, crop farming is characterized by frequent soil tillage, removal of waste crop materials from the fields by livestock grazing or burning, and, in many cases, mono-cropping (Chigonda, 2008). In addition, conventional tillage entails intensive ploughing and turning of the soil using the plough. This has obvious implications on soil organisms and soil moisture. For example, soil organisms get exposed to excessive solar radiation, while soil moisture loss is accelerated due to the exposure of a larger surface area to solar radiation. This means that plants experience moisture stress much earlier than expected. Furthermore, soil inversion enhances the oxidation of soil organic matter. Apart from that, soil turning leads to

reduced infiltration and aeration as a consequence of the resultant soil compaction, which, in turn, leads to the exposure of soil to erosion agents. In contrast, conservation farming mitigates, or even cures, the drawbacks associated with conventional tillage by guaranteeing minimum disturbance of the soil (Steiner, 2002b). Previously, in the 1950s to the early 1970s, African farmers could respond to declining productivity by shifting to new areas. This is no longer feasible, let alone possible, due to increasing population. As a result, agricultural areas are getting not only overused but also smaller. The net effect is declining productivity on account of declining soil quality, soil compaction, and infiltration. At a human level, there is increasing food insecurity and poverty in the region. As Chigonda (2008) contends, only a drastic change of farming systems, from the unsustainable towards more sustainable soil management, can improve the situation or even reverse the trend. As a result conservation farming as a method of farming that minimizes soil disturbance, applies more precise timing of planting, and utilizes crop residue to retain moisture and enrich the soil has been promoted among the smallholder communal farmers.

Over and above this, livestock, in general, and cattle, in particular, is a major symbol of wealth that is strongly cherished by communal farmers. Consequently, livestock has multiplied to exceed and surpass the land's carrying capacity. This is exacerbated by the fact that the population is increasing and, with the addition of new households, grazing lands are seriously overgrazed and the crop residue gets quickly cleared where it would have not been removed and stored as dry season supplementary fodder. The Zimbabwean population is estimated to have grown by 6,4% between 2008 and 2011 (CIA World Factbook, 2007). At the very best, communal animal husbandry has thrived at the expense of arable farming, otherwise both of the communal sub-sectors have become so seriously compromised to the extent that communal farming is evidently unsustainable. The low demand for other crops, with a distinct preference for maize, has also acted as a natural constraint to conservation farming, particularly crop rotation. Rotating maize, the staple food crop, would threaten food security in light of the ever increasing population (Makwara, 2010).

However, despite its much heralded benefits and popular campaign, conservation farming has been accepted with mixed feelings due to several socio-economic factors (Kassam, 2010).

Conservation farming has been difficult for many people to accept because it goes against many people's traditionally cherished beliefs. Some smallholder farmers have a negative perception towards conservation farming and conceive it as a strenuous program, which does not warrant the effort given to it. In their view, conservation farming requires a lot of human capital, a luxury which they cannot afford. This practice requires farmers to invest a lot of labour in digging basins, searching for organic fertilizers, mulching, weeding, and other related tasks. Given the associated costs and benefits with conservation farming practice, farmers are forced to resort to the conventional methods of farming, which to them, is tried and tested. In addition, conservation farming is considered a 'high-labour' input agricultural production technique. However there are some households that do not have sufficient labour resources to succeed on their own, especially during peak labour periods, such as basin making and harvesting. The labour constrained households include those headed by elderly people, those with few members, and those with chronically ill members who require constant care such as the HIV and AIDS-affected (Gukurume *et al.,* 2010).

1.1 The Nature of the Problem

In Sub-Saharan countries such as Zimbabwe, the decision to adopt conservation farming practices was not, in most cases, voluntary but promotion and technical support was provided by both the NGOs and government to smallholder communal famers in marginal ecological zones as a pilot project. These households were provided with agricultural inputs and appropriate extension support as incentives to adopt conservation farming technologies either through free inputs schemes or contract farming (Twomlow et al., 2008a). After a period of learning new conservation farming practices, there has been some unprompted adoption of conservation farming, mostly from farmers learning the technology from their neighbours mainly because of the associated benefits such as increased yield, moisture retention and efficient usage of input. However, despite conservation farming hype, there has been some dis-adoption of CF by some smallholder farmers in Guruve district who originally participated in conservation farming promotions, but afterwards opted out due to various reasons. While relief and government officials have responded to low productivity by providing alien expertise, inorganic fertilizers, hybrid seeds, and exotic technology (conservation Farming), they have done very little to address the issue of the sustainability of this exotic technology. It is because of this assertion that this

study therefore seeks to establish, the factors affecting adoption of CF, the sustainability of conservation farming among smallholder farmers especially after the withdrawal of input support mainly through the determination of factors that influence continuation or discontinuation with conservation farming.

For the purposes of this study, continuation with CF is described as a situation in which a household has put part of its cropping area under CF during the 2010/11 season, whereas discontinuation refers to a situation in which a household once practiced CF has stopped and now is into full time conventional farming.

1.2.1 Research Questions

The research will be guided by the following research questions.

1. What socio-economic attributes (demographic, livestock ownership, affordability of inputs, arable land, access to credit, extension contact and maize output) influence communal farmers to adopt conservation farming?
2. Are there any differences in socio-economic factors (demographic, asset and livestock ownership, source of inputs and food security status) among farmers continuing with conservation farming, and those who have discontinued conservation farming?
3. What is more profitable for the smallholder farmers, conservation farming or conventional farming?

1.2.2 Research Objectives

The broad objective is to determine the sustainability of conservation farming in the smallholder farming system in Zimbabwe. The specific objectives are to:

1. Identify socio-economic factors (demographic, livestock ownership, affordability of inputs, arable land, access to credit, extension contact and maize output) that influence smallholder farmers to adopt conservation farming.
2. Determine whether there are any significant differences in socio-economic attributes (demographic, asset and livestock ownership, source of inputs and food security status) among communal farmers continuing with conservation farming, and those who discontinued conservation farming.

3. Assess the profitability of practicing conservation farming compared to conventional farming.

1.2.3 Research Hypothesis

1. Socio-economic attributes (demographic, livestock ownership, affordability of inputs, arable land, access to credit, extension contact and maize output) do not influence smallholder farmers to adopt conservation farming.
2. There is no significant difference in socio-economic attributes (demographic, asset and livestock ownership, source of inputs and food security status) among communal farmers that continued conservation farming, and those who have discontinued conservation farming.
3. Conservation farming is not financially more attractive than conventional farming.

1.3 Expected Contribution and Justification of the Study

Finding answers to the above questions is important to smallholder farmers as well as agricultural planners, policy makers and development agencies involved in designing, developing, promoting and implementing CF as an option for improving crop production in the smallholder farming system. For example, cash constrained smallholder farmers need information on cheap sustainable farming practices to improve crop output and consequently reduce their food insecurity problem. They also need information on how to use these practices in order to optimize financial returns as well as to control excessive soil mining and depletion of soil nutrients. Often research and extension workers guide farmer decisions, but they may not know what is most appropriate for the farmer circumstances.

There has been a growing advocacy that CF is important in promoting household food security through improved crop production for smallholder farmers in sub-Saharan Africa and Asia, an approach that can help attain the United Nations' Millennium Development Goal (UNMDG) on food security (Hobbs, 2007). Despite this growing interest in conservation agriculture, the technology transfer effort in sub Saharan Africa is still limited to on-farm demonstration trials and few farmers are adopting/continuing the practice and in some cases dis-adoption has been

observed (Gowing *et al.*, 2008). The study will therefore contribute by finding out possible explanation to this low rate of continuation with conservation farming through the determination of its sustainability especially after withdrawal of support by government or non governmental organisations. In addition, knowing the socio-economic factors influencing smallholder farmers to continue/discontinue practicing CF will help policy makers to design and implement development interventions that are community driven and address their specific needs.

In addition, financial analysis is of critical importance in assessing and recommending proper incentives for communal farmers to improve their food security status and for various other stakeholders who are promoting conservation farming as an option in improving crop production among the smallholder farmers. It is important to determine whether or not farmers would have an incremental income significantly large enough to compensate them for the additional effort and risk they would incur when replacing conventional practice with CF practice. This study is therefore going to suggest possible answers to these problems by comparing the profitability of CF versus the conventional farming practice in terms of income and production costs using gross margin analysis.

1.4 Organisation of the Thesis

The thesis is organised into eight chapters. The first chapter covers the background, the nature of the research problem, research questions, research objectives, as well as the major research hypothesis made about the research problem.

Chapter two presents the literature review. This chapter begins by reviewing the significance of CF in Zimbabwe. It then discusses the framework for upsacling CF in Zimbabwe, significance of agriculture in the country, reflections of CF in Zimbabwe. In addition it reviews empirical studies of CF as well as its theoretical concepts.

Chapter three outlines the research methodology. Included in this chapter is the conceptual framework which is presented graphically. The analytical framework guiding the study is also presented. Following on is a section on data collection and management techniques used in the study. The chapter also highlights the major limitations of the various analytical tools applied in

this research.

Chapter four is the first analytical chapter. It is mainly a characterisation of sample households based on conservation farming status. It presents the geographical location of the sample, demographic characteristics, asset ownership, main livelihoods activities, land preparation, access and utilization of inputs, as well as food security status of sampled households. In addition, it presents the main reasons for continuation or discontinuation with CF.

Chapter five is an econometric analysis chapter. It presents the results of the logistic regression analysis on the determination of factors that influences adoption, continuation and or discontinuation with CF.

Chapter six is the final analytical chapter. It presents the comparative gross margin analysis of maize production using CF practice versus conventional farming practice. The chapter seeks to answer whether CF is financially more attractive that conventional farming practice.

Chapter seven distils the major conclusions from this research. It goes on to expound on the implications of this findings for rural development policy. This chapter concludes with recommendations for possible areas of further research.

CHAPTER TWO
LITERATURE REVIEW

2.0 Introduction

Promotion of conservation farming as a solution to food insecurity challenges confronting smallholder farmers in Zimbabwe and Sub-Sahara Africa at large has been regarded by many as a purely practical issue which theory can offer little benefit (Makwara, 2010). However, theoretical understanding remains an essential foundation to a consistent and effective framework that will bring long term improvement in crop production and food security of the marginalised rural farmers. The main objective of this chapter is to present the theoretical and empirical literature on CF in Zimbabwe and sub-Sahara Africa at large. This chapter starts by exploring significance of CF in Zimbabwe. This is followed by an analysis of significance of agriculture in Zimbabwe and reflections of CF in the country. A critique of empirical studies on CF then follows. Theoretical concepts on CF and major analytical frameworks such as gross margin analysis are also explored. A summary of insights from the chapter marks the end of the chapter.

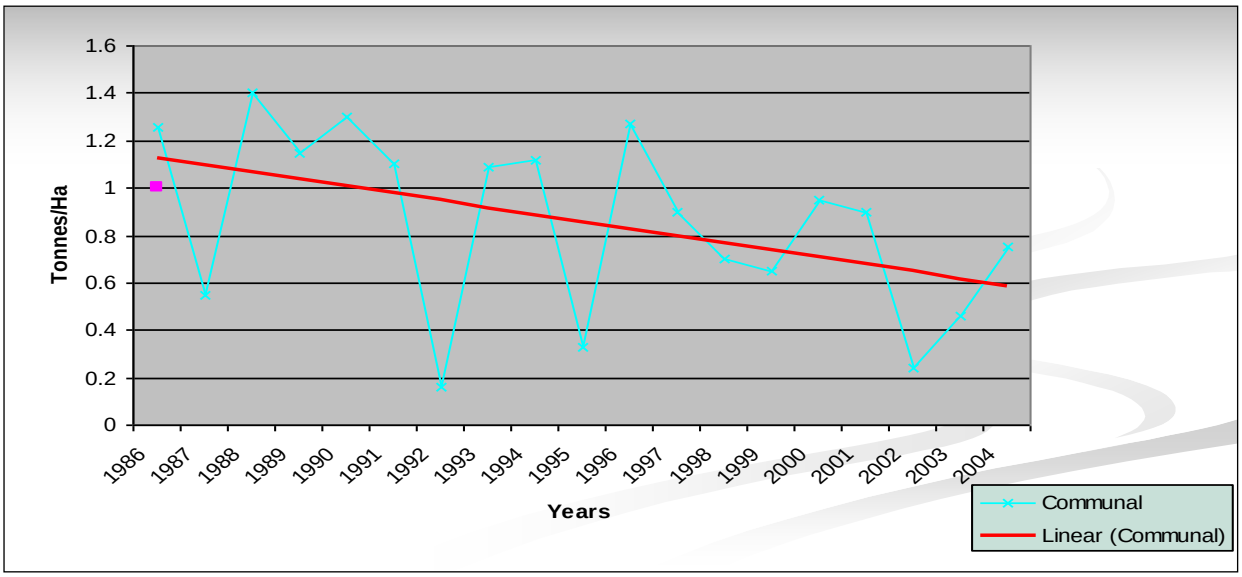
2.1 Significance of Conservation Farming in Zimbabwe

Maize, sorghum, pearl millet, finger millet and wheat make up the food grain crops in Zimbabwe. Figure 1 shows the trends in average communal maize production between 1986 and 2004. The fluctuations in maize production reflect the vulnerability of Zimbabwe to climatic changes. In 1991/1992 and 1994/1995 agricultural seasons, production was lower than the preceding seasons due to drought. The 1997/1998 production was destabilized by Cyclone Eline that affected the Eastern and Southern parts of Zimbabwe resulting in reduction in crop yields especially sugar cane, maize, seed cotton and wheat (Mudimu, 2002).

For close to a decade Zimbabwe has been experiencing problems of declining agricultural production and food security. Zimbabwe Vulnerability Assessment Committee (ZIMVAC) food security picture for the May 2009/10 and May 2010/11 consumption year shows a food security outcome that is not significantly improving for the two consumption years with an estimate of 18% (1.6 million people) and 15% (1.3 million people) of the rural population being food insecure during the peak hunger period respectively (ZIMVAC, 2010).

Smallholder farmers used to be the backbone of the country's cereal production, producing an average of about two thirds of Zimbabwe's cereals. The decline in agricultural production by smallholder farmers is due to multiple reasons which include economic decline and the rise in input costs. The decline in soil fertility which has contributed significantly to the increase in the cost of production has also reduced the profitability of farming for many smallholder farmers. In addition, the unavailability of many agricultural inputs such as fertilisers, unpredictable seasonal rainfall patterns and lack of collateral to access credit facilities from financial institutions has also increased the vulnerability of smallholder farmers who rely heavily on rain-fed subsistence agriculture. This is further exacerbated by smallholder farmers' low management and unsustainable land use. Figure 1 illustrates the downward trend in food production among the communal farmers prior to the conservation farming era in Zimbabwe (ZIMVAC, 2010).

Figure 1: Average Communal Maize Yields in Zimbabwe 1986-2004



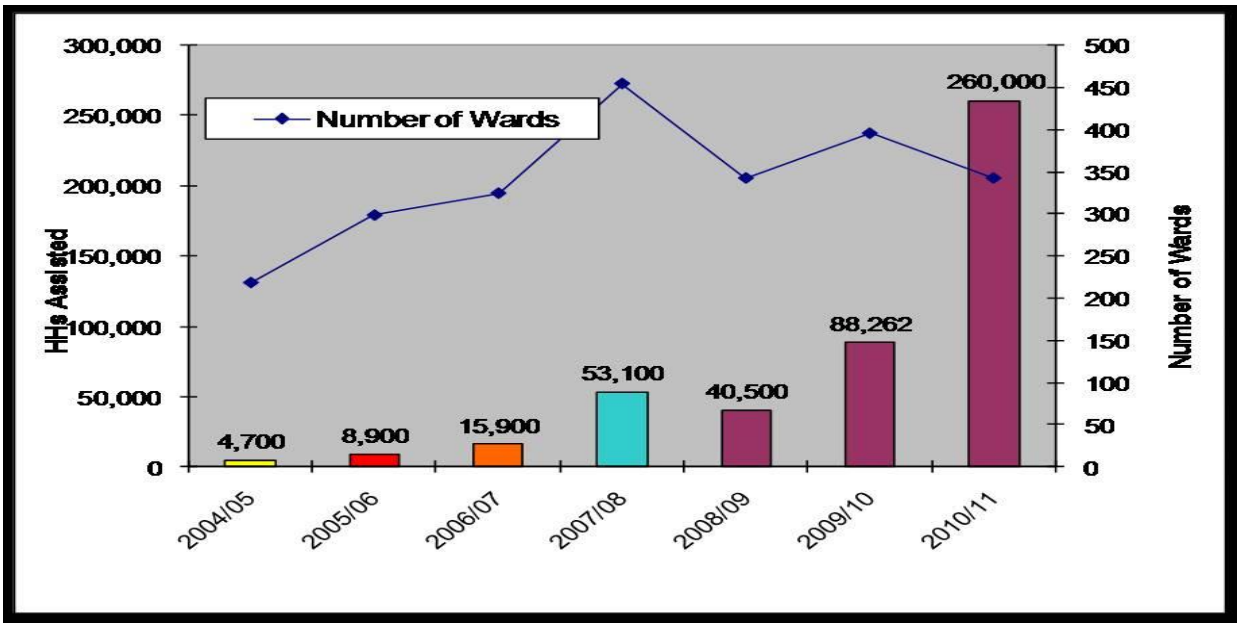
Source: ICRISAT 2008

The main cause of the frequent food insecurity of most communal households is their highly vulnerable subsistence based agriculture, which is extremely susceptible to external factors. Generally, yield levels are below food requirements and farming activities are characterized by very low management and unsustainable land use. Farmers faced with this situation usually try to expand cropping areas to compensate for poor yields, sometimes growing crops inappropriate to

the area; however, this stretches their already limited resources including labour, implementation management and fertilizers (ICRISAT, 2008). However, reasonable yield levels in favorable years and good performance shown by some farmers indicate a much higher production potential, which would be sufficient for food and cash crop production in most communal areas.

The government of Zimbabwe through the Ministry of Agriculture, Mechanization and Irrigation Development (AMID) and various NGOs through concerted effort have tried to address the problems of unaffordability and unavailability of inputs through the provision of inputs to smallholder farmers and reduction of the vulnerability of communal farmers to vagaries of nature through the promotion of CF. Conservation Farming seeks to address the problem of management and sustainable land use. To date in Zimbabwe according to the information submitted to FAO's Coordination and Information Unit by NGOs promoting CA, the estimated number of farmers practising CA as of the 2010/11 agricultural season stands at 260 000 households as shown in Figure 2 (FAO, 2011).

Figure 2: Seven Year Comparison of Conservation Farming in Zimbabwe



Source: FAO NGO Data Base (2011)

Figure 2 shows that there has been an increase on the number of communal farmers practising conservation farming since 2004 to 2010.

Conservation farming that has been promoted in Zimbabwe comprised of the following eight synchronized practices: winter weeding, digging planting basins, application of crop residues, application of manure, application of basal fertilizer, application of top dressing, timely weeding and crop rotation (Twomlow *et al*., 2008). The practices are done in synchronization starting with winter weeding. The importance of weeding before land preparation is to ensure that the plot is weed-free at basin preparation and also to prevent the dispersal of weed seeds. Crop residues are left in the field and applied on the soil surface in the dry season, soon after harvesting. The residues must provide at least 30% soil cover. The mulch buffers the soil against extreme temperatures, cushions the soil against traffic, and suppresses weeds through shading and improves soil fertility. Planting basins are then prepared in the dry season from July to October. The basins enable the farmer to plant the crop after the first effective rains when the basins have captured rainwater and drained naturally. Seeds are placed in each basin at the appropriate seeding rate and covered with clod-free-soil. The advantage of using basins is that they enable precision application of both organic and inorganic fertilizer as it is applied directly into the pit. Fertility amendments are applied soon after land preparation in the dry season.

Application of top dressing is done at 6 weeks after crop emergence. Timely weeding in combination with mulch should eventually lead to effective weed control. Rotating crops is one of the key principles of CF. Cereal/legume rotations are desirable because there is optimum plant nutrient use by synergy between different crop types (Twomlow *et al*., 2008).

2.2 Conservation Farming Upscaling Framework for Zimbabwe

The Ministry of Agriculture, Mechanisation and Irrigation Development convened a stakeholder consultative forum in 2010 and up to sixty participants attended the workshop from governments departments in the AMID (Agritex, Mechanization, Research and Specialist Services, Livestock Development and Economics and Markets), the private sector (Windmill), FAO, COMESA, Representatives of farmer unions (ZFU, CFU, ZNFU) and other government ministries, Environment and Natural Resource Management, Education. Also present were representatives from the donor community, NGOs and International Research organisations.

The major objective of the workshop were to review the current status of CF in Zimbabwe and come up with a national framework for CF implementation in the country in order to improve the impact of CF technologies. Conservation Farming in Zimbabwe is currently implemented by mainly NGOs with funding from various donors. This has resulted in the need for the harmonisation of all CF activities as well as more active role by government, farmer unions and farmers (GoZ, 2010).

In order for CF up scaling to succeed, the forum agreed on the need for more recognition of farmers' role by implementing agencies when promoting the technology. Major challenges identified during the workshop include the absence of a comprehensive national implementing framework to guide implementing agencies, the focus on manual CF systems which are labour demanding, the limited involvement of government at district and provincial level which has seen major farming sectors left out. There has been limited participation by the private sector in CF programmes particularly in the development of CF machinery (GoZ, 2010).

The major output of the workshop was an agreement to come up with a comprehensive CF implementing framework for Zimbabwe to guide CF implementation by the various stakeholders promoting CF in the country. The immediate objective of the CF strategy was to institutionalise, vigorously promote and implement CF principles to the extent that at least 500,000 farmers practice CF on 250,000 hectares and double the yields of conventional farming by 2015 on the CF fields (GoZ, 2010).

2.3 Significance of Agriculture in Zimbabwe

Agriculture dominates Zimbabwe's economy despite the fact that its contribution to Gross Domestic Product (GDP) is less than 20%. Agriculture provides food and income to about 75% of the country's 12.5 million population, approximately 70% of which reside in rural areas (GoZ, 1997). The sector contributes to other industries by supplying 60% of the raw materials required by the industrial sector (GoZ, 2002). The agricultural sector accounted for 42.5% of exports in 1985 and 46.28% of exports in 1996 (Muir, 1994 citing CSO, 1992; CSO, 1998). Export earnings from agriculture and food products were estimated at ZW$1,796.00 million in 1990, increasing to ZW$11,204.00 million by 1996 (CSO, 1998). Agriculture provided around 27% of

formal employment opportunities in 1995 (CSO, 1998).

Agriculture is important in Zimbabwe because of the following reasons: (1) It employs most of the rural households and it is the primary source of food for half the population; and (2) It is a potential source of foreign exchange for the country, which is partly used to offset the balance of payments deficit. The smallholder farmers in Zimbabwe heavily depend on land and rainfall for their agricultural activities. Currently all the land in Zimbabwe is regarded as state land and this lack of title probably retards investments on land and hence farming practices by smallholder farmers.

According to FAO (2008) findings, large parts of the SADC are semi-arid, with erratic rainfall and nutrient poor soils. In Zimbabwe, like other countries in the SADC region, production of the main staple maize continues to dominate in its semi-arid areas. Zimbabwe is divided into five agro-ecological regions known as natural regions based on the rainfall regime, soil quality and vegetation among other factors (FAO, 2006). The quality of the land resource declines from Natural Region (NR) 1 through to NR V (Rukuni *et al.,* 2006). Natural regions IV and V where most communal farmers reside and derive a living are too dry for successful crop production without irrigation but they grow crops in these areas despite the low rainfall. Millet is a common crop but most communal farmers also grow maize which is the preferred staple (Rukuni *et al*., 2006). The relative ratio of land allocation per crop and yield suggests that farmers in NRs II have a comparative advantage in the production of maize and cotton (FAO, 2006). FAO (2006) further explains that farmers in NR III have a comparative advantage in the production of cotton followed by maize. For farmers in NRs IV and V, their comparative advantage is in the production of small grains (FAO, 2006).

Before the Fast Track Land Reform Program (FTLRP) of 2000, Zimbabwe's agricultural sector was made up of two major sub-sectors; namely the large-scale commercial and the small-scale farming sector (Rukuni, 1994; Muir, 1994). The former comprised about 4,500 large farms on approximately 11 million ha of land, and generally occupy the highly productive agricultural land (Rukuni, 1994; Muir, 1994). In its quest to redress the land imbalances, which were in favour of the minority white commercial farmers, the Zimbabwe government embarked on a

FTLRP from 2000. The FTLRP was in response to the "spontaneous" occupation of white-owned commercial farms by liberation war veterans and collaborators in the run-up to the 2000 Parliamentary elections. The massive land redistribution programme has resulted in thousands of hectares of land being acquired by the state using the Land Acquisition Act. The Act empowers the government to compulsorily acquire land for redistribution to the landless indigenous people. The Department of Physical Planning partitioned the acquired farms into either A1 or A2 model holdings using ortho-photography and other existing maps (Paradzayi, 2007). The A1 model farms are based on the village concept, with communal residential and grazing areas, but separate farming areas. These are designed to alleviate pressure on the communal lands. A2 farms are much larger than the A1 farms and are self-contained and the owners are expected to engage in commercial agricultural operations. It is estimated that there are 15000 A2 model holdings that require title surveys for annexure to the 99-year leases (Paradzayi, 2007). The government of Zimbabwe is now under pressure to grant secure tenure to the new landowners so that they can use the land as collateral to develop infrastructure on the farms. The net effect of a secure tenure is to unlock the investment potential of the holdings for sustainable agricultural production. The government has adopted 99-year leasehold as the type of land tenure for the acquired A2 model farms. Under the Zimbabwean law, the 99-year leases have to be registered in the Deeds Registry and one of the requirements is that the land parcel in question should be surveyed in accordance with cadastral surveying standards and approved by the Department of the Surveyor-General (DSG). The other forms of land tenure are still recognized in the country.

2.4 Organisations behind Conservation Farming in Zimbabwe

In Zimbabwe, the oldest conservation farming initiative in the country is 'Operation Joseph' run by the River of Life Church. Operation Joseph builds on the Hinton Estates Out-Reach Program' initiated by Brian Oldrieve in the 1990s. The program focuses on the promotion of either basin tillage or shallow planting furrows in conjunction with a set package of inputs (seed and fertilizer) for a cereal-legume rotation. The second initiative is run by the International Maize and Wheat Improvement Centre (CIMMYT), with the aim of facilitating the widespread adoption of CF in the maize-based systems of Malawi, Tanzania and Zimbabwe. A third initiative was established in 2004/05 by the FAO Emergency Relief Office and the three Farmers' Unions of Zimbabwe (Zimbabwe Farmers Union; Zimbabwe Commercial Farmers

Union; Commercial Farmers Union). The project attempts to pass on the experiences of commercial farmers to communal farmers, with the objectives of improving food security and "commercializing" communal farming. The largest initiative in Zimbabwe is the promotion of conservation agriculture through humanitarian relief program focusing on vulnerable households, based on seed and fertilizer relief programs (Rohrbach *et al.*, 2005, Twomlow *et al.*, 2007), funded by Department for International Development (DFID) and the European Commission Humanitarian Aid Office (ECHO). In 2003, the Zimbabwean Conservation Agriculture Task Force (ZCATF) was formed involving donor organizations, NGOs, CIMMYT, ICRISAT (International Crops Research Institute for the Semi-Arid Tropics), FAO and the Department of Agricultural Research and Extension (AREX) with a mandate to promote CF in Zimbabwe. FAO's Emergency Office coordinates many of these activities and keep a database of what and where each NGO is operating in the country to ensure complementarities of effort and reduce duplication of activities in the same ward by different NGOs, which has happened in the past (Rohrbach *et al.*, 2004). Table 2.4.1 shows NGO allocation by district for the promotion of conservation farming.

Table 2.4.1: NGO Allocation by District in Zimbabwe

NGO	District	NGO	District
CADEC	Gweru, Gutu, Hurungwe	Red Cross	Chivi, Matobo, Guruve
CADS	UMP, Goromonzi	CIRAD	Mbire
Care International	Chiredzi, Gutu, Zaka, Mwenezi, Mberengwa, Chivi, Zaka, Msvingo, Bikita	Union Project	Mazowe, **Guruve**, Bindura
CTDT	Mudzi	Christian Care	Kariba, Gutu, Mwenezi
DAPP	Shamva	Mersycop	Chiredzi
GOAL	Gokwe South**,** Makoni, Hurungwe	Comitec	Chiredzi
Help Germany	Chegutu, Muzarabani, Zvimba, gweru, Kwekwe	World Vision	Murehwa, Mutoko, Insiza, Umzingwane
Lead Trust	Hurungwe	Action Faim	Chivi, Gutu, Mberengwa
ORAP	Lupani, Mangwe, Bulilima, Matobo	CRS	Mangwe
Ox Farm GB	Kwekwe	Safire	Gwanda, Gokwe North
SAT	**Guruve**, Kadoma, Rushinga, Mt Darwin, Zaka, Hurungwe, Makonde	Fambidzanai	Matobo

Source: FAO 2010

The NGOs have been extending inputs package mainly to vulnerable and average households in Zimbabwe either through free input schemes or contract farming. The input package comprise of fertilizer, seed and extension services towards the promotion of food crop production using conservation farming. Major crops under the program mainly comprise of maize, soya bean and small grain (sorghum, millet and cow peas) (FAO, 2010).

2.5 Reflections on Conservation Farming in Zimbabwe

Generally speaking, an insignificant number of communal farmers have adopted conservation agriculture in Zimbabwe. Farmers seem to be generally only aware of land preparation that makes use of the ox-drawn plough. Even those who own neither the plough nor draught power depend on hiring from fellow farmers. This suggests late planting and, therefore, reduced yields in view of the short, rainy season (Makwara, 2010). Under such circumstances, CF provides a perfect solution as it eliminates both the problem of the lack of draught power and the plough, on one side, and intensive soil turning by the mouldboard plough on the other. In addition, the problem of labour shortages also gets addressed. Farmers who experience labour shortages may not have to reduce their already small acreages as they fail to plough them on time. In any case, a lot of time and energy are wasted when ploughing. Steiner (2002b) contends that a farmer walks 30-40 km when ploughing one hectare under the conventional system, add to this the 10 km walked when seeding, in contrast to only 10 km when planting maize directly without ploughing. Soils, in most communal areas, are sandy, rocky, and loamy (Chenje *et al.*, 1998). This therefore, suggests that they are suitable for zero, or minimum, tillage. Such soils, coupled with the lower precipitation in communal lands, translate to a relatively lower biomass production, thereby maximizing the risk of overwhelming weed infestation. Minimum soil disturbances will enhance the ability of the soil to resist erosion by wind and rain. CF demands and dictates that farmers leave cloddy soil surfaces. The rough surface militates against both the raindrop impact and wind force besides resisting and retarding run-off formation. Where such clods were forming after ploughing, particularly on clay soils, farmers tend to pulverize them into a smooth texture in preparation for planting. This removes an intensively ploughed soils only defence against erosion clods (Chigonda, 2008).

Furthermore, communal farmers are in the habit of winter ploughing, which is subsequently

followed by another ploughing phase at the onset of the rainy season. Such a practice tends to expose the soil to erosion agents for a longer period of time. It is normal to experience gusty July-August winds, which sweep away tons of exposed and loosened soils. It has been argued that winter ploughing buries the remaining crop residues, thereby enhancing their decomposition. However, it should be realized that it tends to completely deprive the soil of a cover with obvious implications on erosion rates. Winter ploughing is said to help retain moisture and enhance aeration and infiltration. This should be viewed against the background that it increases the frequency and intensity of soil disturbances, which disturbs the already poor soil structure by making it powdery and, hence, more vulnerable to erosion (Makwara, 2010).

Ploughing every year and to the same depth creates a ploughing pan. Besides compromising aeration and infiltration, thus promoting runoff, the pan impedes crop-root development. Thus, with much of the seasonal rainfall being converted into overland flow, the effect of mid-season droughts, which are common in Zimbabwe's communal areas, are quickly felt (Twomlow *et al.,* 2008).

The role of soil cover management in the erosion prevention equation and weed suppression cannot be over emphasized. Sadly, there is a strong demand for crop residues, which competes with their role as ground protection against erosion or organic manure. Typically, there is a removal of crop residue from fields after harvesting and these are reserved as livestock fodder during the dry season. As if this is not enough, remains of maize cob shelling are a popular firewood substitute in communal areas where there is an acute shortage of firewood arising from rampant and extensive deforestation. Water drained through the ash from burnt shelled cobs is also used as a cooking soda substitute. Meanwhile animals clear the remaining crop residues as they roam freely during the dry season, thereby leaving a near-zero soil cover against the recommended 30% minimum cover (Gukurume *et al*., 2010).

Communal farmers typically grow maize as a pure stand with negligible intercropping with other crops, such as pumpkins, watermelons, cucumbers, and sweet reeds. This implies that inter-row erosion occurs throughout the greater portion of the rainy season, if not the entire season. Plant population densities are low, especially for maize, with most farmers planting one seed per

station instead of the recommended two. The low plant population further exposes the soil to the raindrop impact, which not only dislodges soil particles, but also allows run-off to build up more easily (Hagmann *et al.,* 1995). Communal farmers are in the habit of raking, heaping, and burning weeds. Worrisomely, this is usually done just before the onset of the rainy season as preliminary land preparation. This means that the rains will encounter bare soils with obvious implications on erosion rates. Ash from the burning of heaped weeds and residue is believed to enrich the soil. However, research proves that burning causes the loss of considerable amounts of plant nutrients and that some volatile nutrients, such as nitrogen, are lost as smoke (Tivy, 1998).

Communal farmers hardly rotate their crops because of the need to grow maize annually as a staple food crop. Maize, as the staple food crop, is typically grown as a pure stand, as alluded to earlier on. For those who rotate, they at best do so with other cereals, such as rapoko, sorghum, and millet crops, which require the same nutrients as maize and associated with the same pests and diseases. A very insignificant number of communal farmers include legumes in their rotation. Even so, only very small acreages are involved. Benefits of rotation are not meaningfully realized. The challenge of the relatively infertile soils of the communal lands coupled with the high costs of inorganic fertilizers and pesticides could, by and large, all be offset by proper crop rotation (Makwara, 2010).

2.6 Empirical Studies on Conservation Farming

2.6.1 Conservation Farming in Zambia

Development and promotion of CF have taken place in several key phases in Zambia. For the first two and a half decades following independence, Zambian agricultural policy focused squarely on the promotion of maize. Large-scale marketing support coupled with extensive fertilizer and input subsidies induced farmers to devote ever-larger areas to maize production (Wood *et al*., 1997). Maize marketing guarantees provided further inducement for farmer adoption of the high-input maize packages. As a result of heavy application of chemical fertilizers and sustained extensive ploughing, Zambian agriculture entered the 1990s with significantly declining land quality and productivity. Farmers quickly responded by diversifying out of maize production and by reducing fertilizer use by over two-thirds as

availability diminished and input prices jumped. A serious drought rocked Zambian agriculture in 1992, while fuel prices soared with the floating of the Zambian kwacha. In rapid succession, a serious outbreak of corridor disease in the mid-1990s precipitated an approximately 16 percent slump in cattle population between 1995 and 2000 (Haggblade *et al.*, 2003).

In response to these changes in their operating environment, farmers adopted conservation farming practices in Zambia which was being promoted. Leading players in the technology development and dissemination included the Conservation Farming Unit (CFU) of the Zambia National Farmers Union, the Golden Valley Agricultural Research together with their partners at the extension service of the Ministry of Agriculture and Cooperatives (MACO), and NGOs (Haggblade *et al.*, 2003).

The hand hoe comparison of minimum tillage systems was introduced to Zambia in 1995 by a Zimbabwean farm manager brought in as a consultant to the Zambia National Farmers' Union (ZNFU) to help set up low-tillage farm trials at the newly established Golden Valley Agricultural Research Trust (GART). In the course of this work, he related his success in applying a system of permanent planting basins for hand hoe farmers on the estate he managed in Zimbabwe (Oldrieve 1993). Inspired by the notion of six to eight tons maize yields under hand-hoe cultivation, the ZNFU established a Conservation Farming Unit (CFU) in late 1995 to adapt the hand hoe basin system to Zambian conditions and to actively promote it among smallholders. With modest early funding from a variety of supporters, including the World Bank, the ZNFU Conservation Farming Unit moved rapidly to develop guidelines and conduct on farm trials with maize and cotton farmers in Central and Southern Provinces (Haggblade *et al.*, 2003).

In 2009, it was estimated that between 160,000 and 180,000 families were applying the basic forms of conservation farming on portions of their land (Aagard *et al.,* 2009). Adoption has been increasing each year, and it is expected that by end of 2012 there will be 250,000 adopters (Haggblade *et al.,* 2003). Farmers who have adopted conservation farming are more food secure, have surpluses to sell, can avoid labour peaks and produce good crops in all but the very driest seasons.

Independent research in Zambia has shown that yield increases range from 25% to over 100% for all crops in the first year. In seasons of poor rain distribution such as the 2009/2010 season, conservation farming makes a difference between total crop failure and a reasonable yield (Aagard *et al.*, 2009).

2.6.2 Conservation Agriculture in Brazil

Brazil is the flagship example of the success of CA in the developing world. Brazil now has the second greatest amount of land managed under conservation agriculture, just behind the United States. Today there are nearly 25 million hectares of no-till in Brazil (Derpsch, 2008). A Brazilian NGO called Zero Tillage Agriculture Transmission (ZTAT) was able to accomplish this mostly due to a great number of partnerships with government and private sectors, as well as the enlistment of a group of local farmers' clubs (Williams, 2008). It was the sole job of the local farmers' clubs to disseminate information about CA, and tout the advantages and it is because of these farmers' clubs that CA has been so successful in Brazil (2001).

An interesting aspect of the development of CA in Brazil was that it mirrored the development of adequate herbicides that were available to Brazilian farmers. The most notable herbicide produced was glyphoshate, which is more commonly known as Round Up. This was an especially powerful weed desiccant that was surprisingly inexpensive. Some farmers who had begun to try CA prior to the release of Round Up were unable to spread the technology further because there was still a lot of work associated with CA. Perhaps it was the idea of adding a medicine to the weeds that made it easier for farmers to deviate so far from the norm that they considered safe (Williams, 2008).

Van der Klinken, a man who was attempting to disseminate CA via two-day training sessions, formed ZTAT. In order to facilitate the process of dissemination, he organized a group that was to oversee the farmers' clubs and their role as disseminators of information. Throughout the efforts of ZTAT, they found that the greatest resistance they faced was that of the researchers and academics who did not see immediate benefits of the practice. It was not until medium and large-scale farmers began to demand technologies associated with CA that researchers and extension agents started to get on board. Thus, they were the impetus for a more rapid uptake of

conservation agriculture as a practice. However, in the end it was the farmers' clubs that were the driving force to disseminate the knowledge into rural Brazil (Williams, 2008).

2.6.3 Empirical Studies on Factors Affecting Adoption of Conservation Farming

It is generally agreed that CF improves crop production and thus enhancing food security and also contributing significantly to household income. Its popularity is mainly attributed to the myriad of benefits that accrue from the adoption of CF practices. Most of the analysis on conservation farming's contribution to income and livelihoods has however concentrated on factors affecting adoption of CF. Not much work has been done on assessing the sustainability of CF.

Earlier work by Twomlow *et al.,* (2008) showed that there has been a significant expansion in CF practices in Zimbabwe following promotional efforts by relief agencies aiming to improve food security among vulnerable farmers. Irrespective of earlier concern on the demand for labour, elderly farmers and households affected by HIV/AIDS are among the adopters of CF. In his analysis Twomlow only targeted farmers known to be practicing CF and known to be targeted by the NGOs as being vulnerable to food production shortages. Perhaps communal farmers participate in CF mainly because of the attached benefits such as the much needed seed and fertilizers from supporting NGOs. Fear for the future could be another factor that is compelling these farmers to practice CF although their level of commitment is questionable. They would have been working with the NGOs in various programs for quite some time. The fear therefore would be that if they opt out of the program, they might be left out of other future programs by these NGOs. Thus, their participation in this CF would be merely more cosmetic than genuine, since they participate out of fear of disappointing the NGOs that have been aiding them for a long time during times of need. The advantage that these farmers could have is that the NGOs marshaling CF do not have proper monitoring and evaluation mechanisms, which relates to what Chambers (1983) termed as "Rural Development Tourism". It can thus be noted that at the end of the day, CF can be difficult to sustain once support is withdrawn by NGOs.

The above notion is also supported by Twomlow's Tobit model results that revealed that extension access, NGO support, increased plot size and agro-ecological location significantly

influences the intensity of adopting different components of CF technology. Twomlow *et al.,* (2008) also noted that significant yield gains realized from adopting CF practices also offset the production costs associated with the technology. This improves viability and provides an incentive for CF adoption by smallholder farmers in Zimbabwe. In the same study, he noted that relief program will continue to be an important intervention in support of CF technology uptake working together with national extension services given the economic situation in Zimbabwe. But in his analysis Twomlow did not incorporate the sustainability of CF after the withdrawal of NGO support.

Another study was conducted by Mupungwa *et al.,* (2008) to assess the influence of conservation tillage methods on soil regimes in semi-arid southern Zimbabwe. Mupungwa *et al.,* (2008) discovered that planting basin tillage methods gives a better control of water losses from the farmers' fields. Despite the below average rainfall received during the study period planting basins tillage method has a greater potential for capturing rainwater and promoting infiltration than ripper, double and single conventional ploughing techniques. Their findings are consistent with those of Twomlow *et al.,* (2008). Perhaps this implies that support from NGOs plays a pivotal role in the adoption of CF practices by the smallholder farmers. Therefore there is need to assess the sustainability of CF among the smallholder farmers after the withdrawal of support by NGOs.

One more study by Nyagumbo (2002) on factors affecting the adoption of CF by smallholder farmers revealed that socio-economic and socio-cultural rather than technological attributes are more important in shaping adoption decisions among smallholder farmers in Zimbabwe. Furthermore, Low *et al.,* (1991) conducted a study to find factors influencing investment decision among smallholder farmers in Zimbabwe. It was revealed in this study that perceived property rights were more important than factor property rights in influencing investment decisions. If this assertion is true, then smallholder farmers in Zimbabwe might have a challenge on investing more on their pieces of land since all land in Zimbabwe is owned by the state and hence the uncertainties attached. In addition the study is silent on how CF can be sustained once adopted by the smallholder farmers.

Empirical studies on conservation practices in other areas have indicated mixed results with some showing a positive correlation between farm size and CF while others have shown a negative correlation (Chomba, 2004). Empirical studies elsewhere were used to predict the likely behavior of farmers with respect to CF. The works of Reardon *et al.,* (1997 b), Jalloh (2001) and Knox *et al.,* (1998) state that the practice of CF is likely to be followed by those who are risk averse. Moreover, Rajasekharan *et al.,* (2002) in Kerala, India, showed that the decision-making behavior of farmers in adoption of CF practice was significantly and positively influenced by the availability of family labour and the perception of the profitability of CF. However, the influence of labour on the use of CF depends with the stage. At the initial stage CF is expected to be labour demanding but as time goes on CF is expected to be less involving in terms of labour.

The light shed elsewhere on CF practices by Sayre *et al.,* (2001) indicate lack of information on conservation farming practices, and demand for crop residue as fodder are cited as greatly influencing the adoption of CF practices such as no-till, crop rotation and crop residue management among farmers of Altiplano of Central Mexico. Experience in other countries revealed that the following broad categories of factors play a pivotal role in the adoption of CF.

2.7 Theoretical Concept on Conservation Farming

Adoption of agricultural practices is one of the subject areas that have been heavily researched globally (Chomba, 2004). However, most of these studies related to adoption of conservation practices have simply used farm and farmer characteristics to determine factors affecting adoption of conservation practices without providing the rationale for their inclusion based on theory (Ervin, 1992; Feder *et al*., 1985). Swinton and Quiroz (2003), Marra *et al.,* (2001), McConnell (1983), used production theory and assumes a farmer has an objective to maximize profit. Some farmers have adopted conservation practices because they found that immediate yield benefits and profits were attractive. However, Swinton *et al.,* (2003) and Norris *et al*., (1987) used household model based on utility maximization.

In order to adequately determine factors that influence farmers to adopt CF technologies, the focus of the adoption analysis needs to go beyond the characteristics of farmers and plots of land (CIMMYT, 1993). A farmer should be regarded as both a producer and consumer (Sadoulet *et*

al., 1995). This implies that a farmer takes into consideration current consumption and production and also policy and physical effects (CIMMYT, 1993; FAO 2001). A farmer may react in a number of ways towards a decline in production and/or variability in production that undermines consumption needs. Existing practices may be modified or new ones may altogether be adopted (FAO, 2001b). Before investing in a CF practices brought to a farmer's attention, the farmer looks at the monetary incentives, whether the capacity is there to implement the practice and what constraints he is facing (Ervin *et al.,* 1982; Reardon *et al.,* 1995).

One of the concerns of the farmer is how long he has to wait before getting the benefits of CF investments (Reardon and Vossi 1997a). For example, soil and water conservation practices have different wait periods. Their perceived returns may be slower than the immediate impact of inputs like fertilizers (Barlowe 1978; Readon *et al.,* 1997a). Most farmers in developing countries have high preferences rates for consumption whereby today's consumption of resources is more valuable than the future consumption (Field, 2001). As a result smallholder farmers in Zimbabwe are likely to have great preferences for conservation practices that yield benefits in the shortest time possible. In addition farmers tend to be conscious about uncertainties that may arise from both the physical environment and a new technology (Knox *et al.,* 1998). Farmers in such a situation may feel more comfortable to continue with current practices despite noticing a decline in soil productivity (Siachinji-Musiwa, 1999). They regard such behavior as risk reduction strategies.

In view of the above discussion, the study's approaches about the decision-making behaviour of Zimbabwean farmers in the adoption of practices under consideration are made based on the following assumptions:

- The farmer's primary objective is to be food secure;
- The farmer wants to generate farm revenues to meet household cash obligations;
- The farmers are risk averse hence farmers living in geographical areas with erratic rains want to reduce risk as much as possible and thus CF practices that have a quick effect on productivity and reduce yield variability are more appealing to them;
- The farmers face constrained resources in land, labour, management skills and capital hence activities and practices that ameliorate the pressure on these resources are more appealing to farmers.

This study considers farmer behaviour in the adoption of CF or any piece of the technology package within the theoretical framework discussed above and the incentive and capacity paradigm employed by Clay *et al.*, (2002), and Reardon and Vosti (1997 a). A farmer is regarded as a consumer and an investor hence an investment that yields utility over time to a farm household is employed. The conceptual model for investment in CF or any piece of the technology package highlights that the farmer pursues consumption and production ends conditional on expected investment returns and other conditioning variables such as the availability of labour and inputs.

CHAPTER THREE

MATERIALS AND METHODS

3.0 Introduction

This chapter looks at the general description of the research methods that were used in the study. It starts by exploring the conceptual framework used in the study. It then goes on to cover the data collection approaches, techniques, sources of data and the location details of the study area. After the review of the data collection and data management techniques, the empirical tools of analysis are presented. The advantages and disadvantages of each method are also articulated in this chapter.

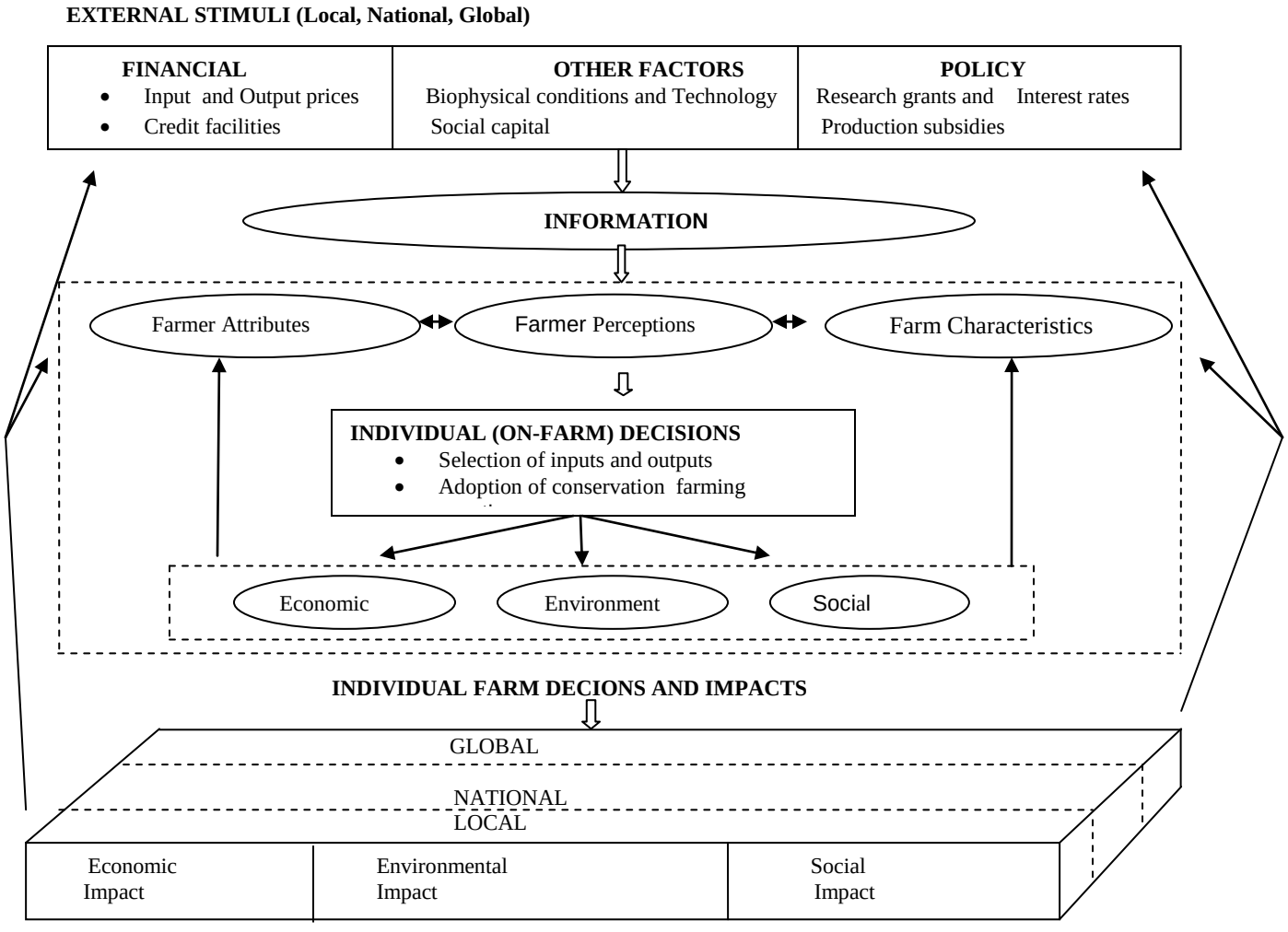
3.1 The Adoption of Conservation Farming: A Conceptual Framework

The framework in Figure 3 explains various factors that influence smallholder farmers' adoption decisions. The flow diagram show how households make choices about adoption of CF practices under the constraints imposed by their socio-economic attributes and on farm resources, as well as higher level factors at the local to global scales. For example, lacking adequate tenure and access to credit, the farmer cannot invest in CF if this requires a large capital outlay. Information about new technologies and financial conditions is a precursor to changes in farm practices and acquiring it does not usually involve large financial outlays. Government credit and extension policies play an important role here. In contrast to the more direct working of agriculture sector policies and financial incentives, some social and institutional factors have a more indirect influence. Nonetheless, all these factors affect the net returns, risks and other pecuniary elements that drive the decision-making process. Central to this model of the decision making process are farmers' perceptions. Changing policy and financial incentives or declining natural resource quality signal to the farmer that the current pattern of use of household resource may no longer be desirable. As a result farmers may switch to new techniques such as CF that can yield better returns.

Conservation farming practices is just one of many options available to farmers responding to perceived changes in their production environment. For example, all or a few of the household's members may migrate or accept off-farm employment, or remain behind and modify farming practices. Critically, the impact on soil productivity can be either positive or negative, depending

upon numerous factors. If households choose migration, they may reduce the intensity with which they farm existing plots, or abandon their old lands altogether and bring new land in frontier areas under cultivation. The latter can have serious implications if farmers transfer unsustainable soil management practices to new areas. There are also many technical alternatives available to producers if they choose to change existing management rather than migrate, and these include CF. The choices of individual farmers are cumulative and can have eventual impacts well beyond the individual farm. The working of the feedback mechanisms (Figure 3) closes the loop and there is potential for either a self-reinforcing series of improvements in soil productivity or spiralling degradation.

Figure 3: The Adoption of Conservation Farming: A Conceptual Framework



Source: Adapted from FAO, 2001.

3.2 Data Collection and Management

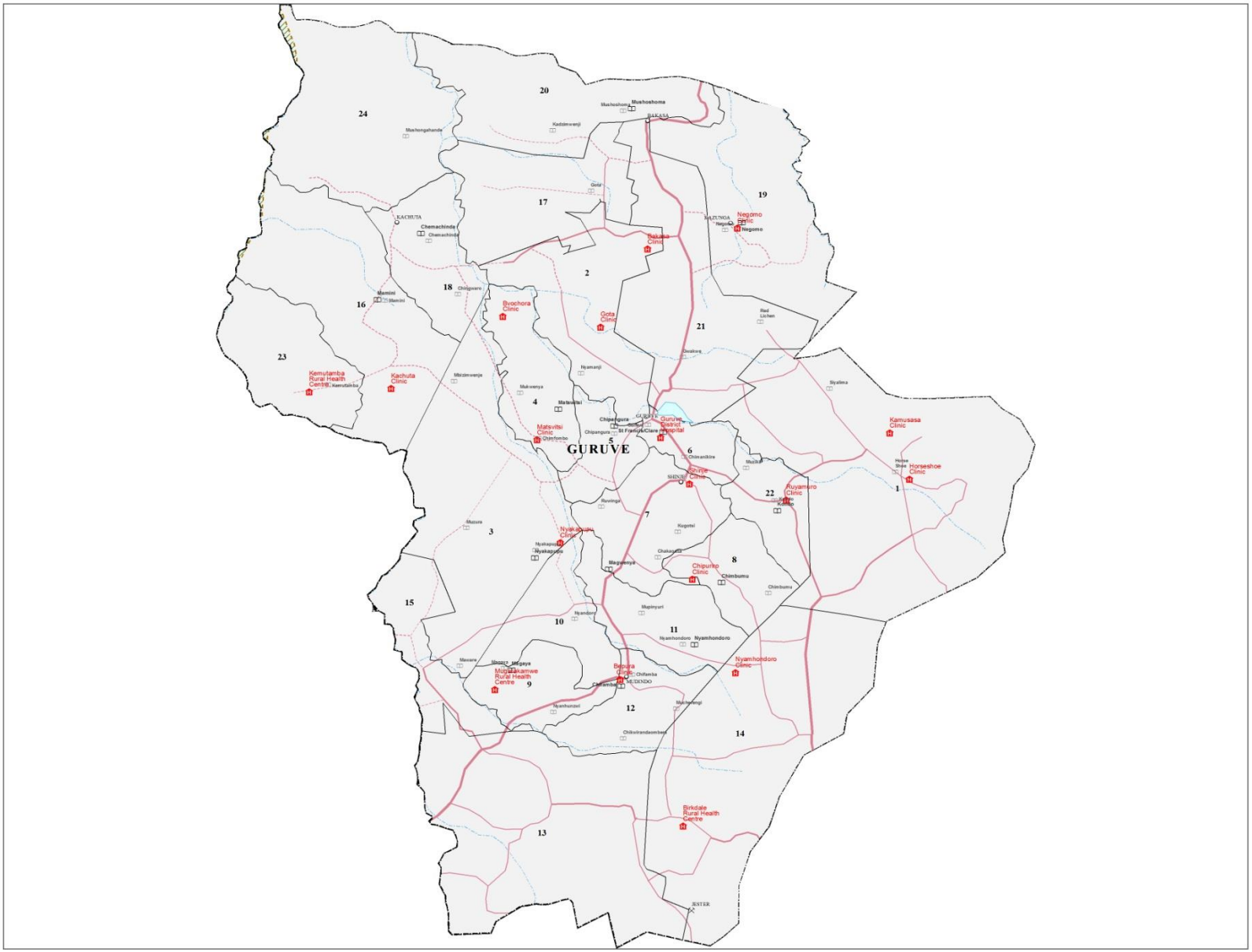
3.2.1 Study Site

This study was conducted in Guruve district ward 5. Several factors justify the selection of Guruve district as the research site. Firstly, conservation farming has been promoted in the districts by both the government and NGOs such as Union Project, SAFIRE and Sustainable Agricultural Technologies (SAT). Selected smallholder farmers benefited from inputs and extension support programs that were implemented by participating NGOs since 2004. Union Project has been promoting CF in ward 5 of Guruve district since 2004 through contract farming. Major crops under its program include maize, cowpeas, sugarbean and soyabean. The NGO provides inputs in the form seed and fertilizers to selected beneficiaries to be paid back in the form of grain after harvesting. According to the Ministry of Agriculture in conjunction with the Food and Agriculture Organisation's crop assessments, the district as a whole has been declared food insecure for the past five years. Lastly, the infrequent rains and occasional mid season droughts that occur in this district typify the agro ecological conditions under which most smallholder farmers in Zimbabwe operate. The study covers the period 2004 to 2010/11 seasons. This is mainly because CF has been promoted in the district since 2004 and the latest data that was available from farmers was for the 2010/11 season at the time of data collection.

The district is in the semi arid areas of the Mashonaland Central province. The district receives between 650 to 750 mm of rainfall per annum occurring from November to March followed by a cool to warm period from May to October. The district is mainly a rural district with agriculture being the main activity. Smallholder agriculture in this semi-arid district is mainly rain fed and therefore is subject to numerous constraints. These include low rainfall with high spatial and temporal variability and significant loss of soil water through evaporation. Variations in semi-arid rainfall pattern also include delayed onset and premature end of the rainy season (Nonner, 1997). Intra-seasonal dry spell during the cropping season have became a common feature and their impact on crop production is often severe, especially if they coincide with critical stages of crop development (Rockstrom et al, 2007). The major crops usually grown in the area are maize, cotton, groundnuts, cowpeas, millet and sunflower. Figure 4 shows the district.

Figure 4: Guruve District Map (Source: UNOCHA Base Maps 2010)

GURUVE



Locations

- Key Location
- Place of Local Importance
- Mission
- Mine
- Primary School
- Secondary School
- Health Facility

Boundaries

- National Boundary
- Province Boundary
- District Boundary
- Ward Boundary

Transport Network

- Major Road
- Secondary Road
- Feeder Road
- Connector Road
- Track
- Railway Line

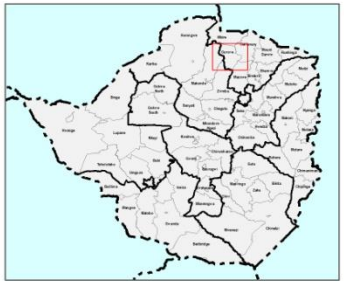
Hydrology

- Main River
- Waterbody
- Protected Conservation Area

Map Doc Name: OCHA_District_Atlas_Admin_A3_100104
Creation Date: 4 January 2010
Projection/Datum: Arc 1950
Web Resources: http://ochaonline.un.org/zimbabwe
Nominal Scale at A3 paper size:

Map data source(s):
Vector data from Department of the Surveyor General (DSG). Schools and other infrastructure may be under-represented depending on available digital data.

Disclaimers:
The designations employed and the presentation of material on this map do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations concerning the legal status of any country, territory, city or area or of its authorities, or concerning the



3.2.2 Population and Sample Size Selection

The population comprised of communal farmers in the Guruve district. The district has a population of about 138,428 people and ward 5 has an estimated population of 5,768 people (ZIMVAC, 2010). The sample comprised of 90 households equally divided into three categories namely farmers who continued CF, discontinued CF and those who never practiced CF drawn from ward 5 of Guruve district where Union Project is promoting CF through contract farming. The main reason for choosing farmers supported through contract farming was that of giving real assessment of the profitability of CF since farmers are not getting free inputs. Sampling process began with a purposive sampling of ward 5 known to be practicing CF as a result of promotion by the government and Union Project under the coordination of FAO. This was followed by the selection of villages and listing of farmers known to have practiced conservation at some point. Three sub samples were drawn from the selected villages, namely farmers who continued CF, discontinued CF and those who never practiced CF. Random sampling technique was then used to select households from each cluster. Given the limited number of farmers who discontinued with conservation farming, most of the farmers who discontinued with the practice were interviewed. The quantitative data was collected through the administration of a household questionnaire to a total of 90 households, thus relying on farmers' estimates and recall for data on land areas and yields. Prior to field surveys, pre-tests of the three sets of questionnaires was undertaken to improve the questionnaire design and enhance quality of responses obtained from the farmers.

3.3 Primary Data

3.3.1 Formal Household Survey

The primary data used in this study was collected through household interviews. The questionnaires were administered to a total of 90 households comprising of three equal categories of farmers namely farmers who continued CF, discontinued CF and those who never practiced CF for the purpose of collecting both quantitative and qualitative data. Farmers who continued and discontinued CF were chosen on the basis of CF that was promoted by the Union Project whereas farmers who never practiced CF were chosen randomly from farmers who never practiced CF. Two enumerators were engaged and trained by the researcher for the purpose of undertaking the interviews. Technical assistance was received from the local extension workers and the Union Project Field Officer. The main aim of undertaking the survey was to solicit smallholder communal farmer perspectives on conservation farming practices and its sustainability. In addition the survey sought to identify the profitability of CF practice in the

smallholder farming sector compared to the conventional farming. Furthermore, the survey gathered information on household demographic characteristics.

3.3.2 Discussion of Limitations in Primary Data Collection

Some of the data required for this study was either not readily available from communal farmers or not very accurate since most smallholder farmers do not have records on all operations they do on a given enterprise in a given plot. Hence it was very difficult for them to remember some of the data such as amounts of inputs used and amount of labour hired. The interviews may have led to false information as respondents may have wanted to please the interviewer to get more inputs since the concept of CF was known to be associated with input assistance either through free input schemes or contract farming. An attempt was however made to ensure responses were not biased by clarifying the objectives of the study clearly and interviewers were advised to avoid leading questions. In addition, errors may have been encountered in recording the data from the structured questionnaire but this problem was minimised by cross checking each entry twice. Data cleaning was also helpful to mitigate this problem.

3.4 Secondary Data

In addition to the primary data collection activities described above, secondary data from previously published studies and tabular datasets was also collected on the general socio-economic characteristics of the district and relevant macroeconomic issues. Secondary sources of data provided a quick and relatively easy method of obtaining a good overall understanding of the field. The study also consulted grey literature from organisations which had work on conservation farming such as the Food and Agriculture Organisation of the United Nations. The major challenge encountered in soliciting for secondary data was that, though most journal articles were available online, they could only be accessed at a cost.

3.5 Analytical Framework

Table 3.1 gives a summary of research objectives, hypothesis, data requirements, sources and analytical tools used to test the proposed hypothesis.

Table 3.1: Summary of Research Objectives, Hypothesis, Data Requirements and Analytical tools.

Research Objective	Research Hypothesis	Data required	Analytical Tools
Identify socio-economic factors that influence smallholder farmers to adopt CF.	Socio-economic attributes (demographic, livestock ownership, arable land, affordability of inputs, access to credit, extension access and maize output) do not influence smallholder farmers to adopt conservation farming.	Primary data (Socio-economic characteristics that influence farmers to adopt CF)	Logistic Regression Analysis
Determine whether there is any significant difference in socio-economic attributes among farmers continuing with CF, those who discontinued CF.	There is no significant difference in socio-economic attributes (demographic, asset and livestock ownership, source of inputs and food security status) among communal farmers that continued CF, those who discontinued CF.	Primary data (attributes of farmers continued CF, discontinued CF)	Descriptive statistics Logistic Regression Analysis
Assess the profitability of practicing conservation farming compared to conventional farming.	Conservation farming is not financially more attractive than conventional farming.	Costs, benefits and yield levels from crops produced using conservation farming and conventional farming practices	Gross Margin Analysis

3.5.1 Descriptive Statistics

Descriptive statistics can be defined as methods involving the collection, presentation and characterization of a set of data in order to properly describe the various features of the data set. Descriptive measures are useful for analysing and interpreting quantitative data. The most common descriptive measures include measures of central tendency (mean, median and mode) and measures of dispersion such as the variance and the standard deviation. All quantitative data was captured using SPSS and summarized using descriptive statistics. The household was used as a unit of analysis for the investigation of socio-economic characteristics and other related issues.

The descriptive statistics were used to start the discussion on the research **hypotheses.** Other descriptive statistics used include frequency tables, measures of central tendency and dispersion

as well as independent t-test.

Frequency Tables

Frequency tables were used to analyse the demographic characteristics of farmers who continued conservation farming, discontinued CF and those farmers who never practiced CF. In addition, reasons for continuing or discontinuing CF, source of inputs and benefits to food security status of households by their conservation farming status were analysed using frequency tables.

Cross Tabulation

A cross tabulation presents data for two variables in a table as a way of clearly bringing out the relationship between the two (Vogts 1993). A cross tabulation displays the joint distribution of two or more categorical variables (Norusis 1996). For example, sex of household heads was cross tabulated with conservation farming status of households, education level of household heads and conservation farming status of households. This helped to ascertain the existence of a significant association between conservation farming status and the above socio-economic variables.

Pearson Chi-square test and T-test

The chi-square test was used to test whether there is an association between two variables. For this study the Chi-Square test was performed to establish whether there is relationship between conservation farming status and the sex of household head, marital status, contact with extension agent. The null hypothesis is that there is no association between the independent variable and the dependent variables.

The T-test was performed for the comparison of the mean land ownership, age of household head and food security status among farmer categories.

3.5.2 Gross Margin Analysis

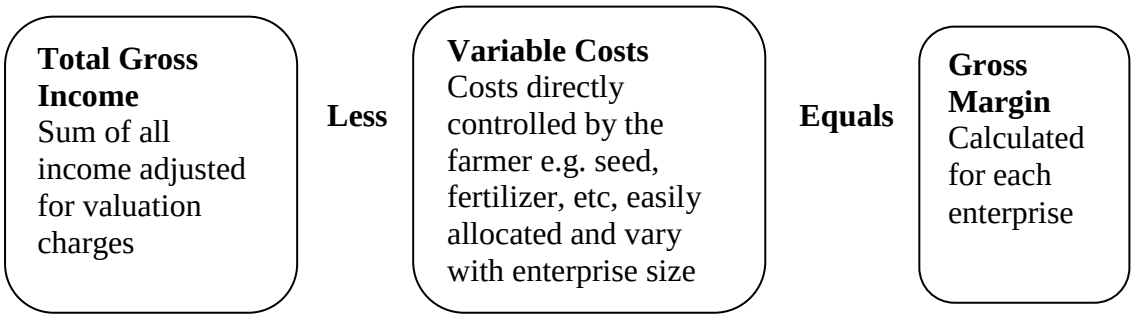
Gross Margin Analysis is a financial analytical tool that indicates the profitability of enterprises through the contribution to fixed costs (Matala *et al*., 1998). It is the difference between the total gross income and the total variable costs of an enterprise. Gross margin analysis measures the contribution of each enterprise to the overall farm profit. One of the advantages of gross margin analysis is that it allows comparisons to be made between different enterprises and farm units. In addition, financial analysis is important for planning purposes of each enterprise and the farm as a whole. It can also be used to make forecast on the operation of farm enterprises as part of the

planning process.

Gross margin analysis was used to test whether conservation farming with inputs obtained through contract farming factored as production cost is financially more attractive than conventional farming. The gross margin of an enterprise is probably the most commonly used tool in farm analysis and planning. It refers to the difference between the gross income earned and the variable costs incurred (Makeham and Malcolm, 1986). The gross income is the product of the estimated physical products or outputs, and their selling prices. Included in the gross income is the amount of products stored, consumed or sold (change in inventory, money owing from the board or cooperative after the first payment was received when the product was delivered). The variable costs are the costs that are directly associated with the enterprise or firm and can be varied in the short run (Gittinger, 1995).

Gross margin analysis was used to analyse the gross profitability of producing crops using conservation farming versus crops produced under conventional farming method at farm level. However, it is important to note that the gross margin is not necessarily a profit indicator although it assumes a linear model. Increasing the scale of operation could increase the gross margin proportionally and that will not mean that the activity undertaken is profitable. Therefore gross margin will be calculated per unit (land, labour, and capital). Generally it is important to ensure that the total gross margin to be higher than the total overhead costs for the farming enterprise to be economically viable.

This study assumes the following gross margin model:



The model assumes that gross margin per enterprise is the difference between gross income and variable costs of that enterprise. Variable costs used for calculations include those associated with crop operations, harvesting and marketing. Gross margins can be used as a basis for making comparisons between enterprises or can be combined to produce whole farm budgets.

Limitations of the Gross Margin Analysis

The following are the limitations of the Gross Margin Analysis methodology:

a) Gross margins are not a measure of the profit of a particular enterprise, as they do not include overhead costs such as depreciation, and interest to fixed factors of production. The farmer regardless of whether or not any crop is produced incurs these overhead costs. In addition, comparisons of gross margins should be interpreted in relation to fixed costs and overall investment levels. Some enterprises require greater fixed costs and annual investments than others. So an enterprise change could result in a lowering of fixed costs for one enterprise that is greater than an increase in gross margin of another enterprise (Gittinger, 1995).

b) Positive gross margin values for all enterprises do not necessarily mean that the whole operation (or even the individual enterprise) is profitable. For whole farm profitability there is need to sum up all the enterprise gross margins and subtracting the operation's fixed costs (by calculating economic profit) (Gittinger, 1995).

c) Also gross margin analysis usually does not take into consideration potential social and environmental impacts that might result from implementing various economic enterprises. Potential environmental impacts (both positive and negative) from each economic enterprise could be identified and economic values can be attached as a way of incorporating social and environmental benefits and costs in the gross margin analysis. However, due to the difficulties encountered in measuring these potential environmental costs and benefits, they are usually eliminated from financial gross margin analysis (Nhemachena, 2004). Most economic decisions involve multiple criteria (e.g. financial, environmental, and social) for making economic choices on optimal or best economic enterprises. Therefore, decision making on starting or continuing with any economic enterprise need to take into account potential environmental impacts in addition to measurable economic costs and benefits of that undertaking.

d) Furthermore gross margin analysis is not an optimisation analytical tool and does not show the optimal way or most profitable way of producing an enterprise. It only compares financial returns from different enterprises, that is net returns to variable costs.

3.5.3 The Logistic Regression Model

The logistic regression model was used to estimate factors affecting the likelihood of a household practice CF. The model was also used to assess the factors affecting the likelihood of a household to continue CF or discontinue CF. The model was used to test the hypotheses that socio-economic attributes do not influence smallholder farmers to (i) adopt conservation farming and (ii) continue or discontinue conservation farming. In the first case, conservation farming status is a dummy variable. In other words it has two possible options whether one adopted CF or never practiced CF. The logistic regression was used for analysis. In this case the dependent variable was coded 0 (never practiced conservation farming) or 1 (practiced conservation farming). In the second case, conservation farming status is also a dummy variable. In other words it has two possible options whether one continued CF or discontinued CF. So logistic regression was used for analysis. In this case the dependent variable was coded 0 (discontinued conservation farming) or 1 (continued conservation farming). The Logit model is a useful tool where the dependent variable is qualitative (Gujarati, 1995). An important statistic for the logistic regression is the exp (B) value. Exp (B) is given by e (2.718) raised to the value of the regression coefficient. This is the value by which the odds of the event change when the ith independent variable increases by one unit. If the value is greater than 1, the odds are increased; if the value is less than 1, the odds are decreased. A value of 1 leaves the odds unchanged.

Logistic model was first carried out to analyze the factors that are significant in determining who practiced conservation farming or not. The model used is represented by the equation:

$$\mathbf{CFPRACTS} = \alpha_0 + \alpha_1 Hhage + \alpha_2 Arableland + \alpha_3 Marstatus + \alpha_4 Educanlevel + \alpha_5 Hhlabour + \alpha_6 Catleown + \alpha_7 Extnacess + \alpha_8 Inptafordbity + \alpha_9 Creditaces + \alpha_{10} Maizeoutput + u$$

Where:

CFPRACTS is whether one practiced conservation farming (dummy dependent variable; CFPRACTS =1, if practiced conservation farming, 0 otherwise)

a_1 to a_{10} are the coefficients for the respective independent variables

μ is the error term

The symbols for the independent variables and their relationship to the dependent variables are shown in Table 3.2.

In addition, a logistic model was also used to check which factors significantly determined the continuation or discontinuation with conservation farming.

CFCONTDIS = $\alpha_0 + \alpha_1 Hhage + \alpha_2 Arableland + \alpha_3 Marstatus + \alpha_4 Educanlevel + \alpha_5 Hhlabour + \alpha_6 Catleown + \alpha_7 Extnacess + \alpha_8 Inptafordbity + \alpha_9 Creditaces + \alpha_{10} Maizeoutput + u$

Where:

CFCONTDIS is whether one continue or discontinue conservation farming (dummy dependent variable; CFCONTDIS =1, if continue conservation farming, 0 otherwise)

a_1 to a_{10} are the coefficients for the respective independent variables

μ is the error term

The symbols for the independent variables and their relationship to the dependent variables are shown in Table 3.2

The advantages of the logistic regression model are;

1. It does not make assumption of linearity between dependent and independent variables
2. It does not assume homskedasticity and does not require normally distributed variables.
3. Logistic variables can be used to estimate odd ratios for each of the independent variables in the model.

A number of goodness of fit models can be applied to test significance of the logistic regression model. In the model three measures of goodness of fit were adopted. These were Hosmer Lemshow test, Cox and Snell's R-Square, Nagelkerke's R-square.

Table 3.2: Variables used in the Two Logistic Regression Models

Symbol	Variable Description	Relationship with Dependent Variable 1, CFPRACTS (Expected sign)	Relationship with Dependent Variable 2, CFCONTDIS (Expected Sign)
Hhage	Household head age	Households headed by young household heads are more likely to practice CF than those headed by older household heads (Negative).	Households headed by young household heads are more likely to continue with CF than those headed by older household heads (Negative)
Arableland	Arable land	Households with more arable land are more likely to practice conservation farming compared to their counterparts (Positive)	Households with more arable land are more likely to continue conservation farming compared to their counterparts (Positive)
Marstatus	Marital Status	Households headed by widows are less likely to practice CF since the practice is claimed to be labour intensive (Negative)	Households headed by widows are less likely to continue CF since the practice is claimed to be labour intensive (Negative)
Educanlevel	Education level	Households headed by heads that have spent more years in school are less likely to practice CF (Negative)	Households headed by heads that have spent more years in school are less likely to continue CF (Negative)
Hhlabour	Household labour	Households with more people involved in agricultural activities are more likely to practice CF (Positive)	Households with more people involved in agricultural activities are more likely to continue CF (Positive)
Catteown	Cattle owned	Households with more cattle are more likely not to practice CF (Negative)	Households with more cattle are more likely not to continue CF (Negative)
Extenaces	Extension access	Households headed by heads that have more access to extension education are more likely to practice CF (Positive).	Households headed by heads that have more access to extension education are more likely to continue CF (Positive).
Inputafordbity	Affordability of inputs	Households that afford inputs are more likely to practice CF (Positive)	Households that afford inputs are more likely to continue CF (Positive)
Access to credit	Access to credit	Households with access to credit are more likely to practice CF(Positive)	Households with access to credit are more likely to continue CF(Positive)
Maizeotput	Maize output	Farmers who are getting significantly higher output from their CF plots are more likely to practice CF (Positive)	Farmers who are getting significantly higher output from their CF plots are more likely to continue CF (Positive)

CHAPTER 4

CHARACTERISTICS OF CONSERVATION AND NON-CONSERVATION FARMING HOUSEHOLDS

4.0 Introduction

This is the first of the three result chapters in this study. It looks at the characteristics of households that never practiced CF, continued CF and those that discontinued CF in ward 5 of Guruve district. The chapter starts by looking at the geographical location of the sample and proceeds to look at the demographics characteristics of the sampled households, asset ownership, main livelihoods activities, and usual source of inputs and history of food security status of interviewed households disintegrated by conservation farming status. This chapter is critical as it allows the researcher to get a feel of the data and thus building momentum of the proceeding analytical chapters.

4.1 Geographical Location of the Sample

Union project has been promoting conservation farming in this ward 5 of Guruve district since 2004 through contract farming. A total of 250 farmers were supported during the 2010/11 season with inputs (maize seed and fertilizers). Selection of beneficiary was done by the Union project in consultation with the local village headmen and Arex officers targeting households without draught power (vulnerable) as well as potential farmers reflected by asset declaration such GMB sales records. As a result beneficiary list comprised of all social economic classes of smallholder farmers.

4.2 Demographic Characteristics of Sampled Households

4.2.1 Sex of Household Head

For the overall sample, 69% of the households are headed by males whilst 31% are headed by females. When the data is disaggregated by CF status, the same picture still persists with most households being predominantly headed by males. This picture resonates so well with what is found in rural areas of Zimbabwe whereby headship of the household is bestowed to males by traditional laws or religious beliefs. Further analysis of household headship sex by farmer's conservation farming status revealed that for households that never practice conservation farming, 70% are male headed whereas 30% are female headed. The trend was the same for households that continued CF where 53% are male headed whilst 47% are female headed households. The same trend also prevailed on households that discontinued conservation farming where 83% of male headed compared to 17% female headed. Table 4.2.1 shows sex of

household head by conservation farming status.

Table 4.2.1: Sex of Household Head

		Overall	Conservation Farming Status		
		% of total households	% of households never practiced CF	% of household continued CF	% of households discontinued CF
Sex of household head	Male	69	70	53	83
	Female	31	30	47	17

4.2.2 Age of Household Head

Overally, the average age for households who never practiced conservation farming is 41 years, for those who continued conservation farming is 43 years and for households that discontinued the practice is 45 years. This concurs with the notion that conservation farming is relatively labour intensive and hence the practice is employed by active and middle aged farmers in the communal areas of Zimbabwe. Table 4.2.2 shows average age of household head by conservation farming status.

Table 4.2.2: Age of Household Head

	Conservation Farming Status		
	Household Never practiced CF	Household continued CF	Households discontinued CF
Average Age (years)	41	43	45

4.2.3 Marital Status of Household Head

Generally across the three farmer categories the majority of household heads are married. Table 4.2.3 shows marital status of household head by CF status. Overall, 78.9% of the household heads are married and 21.1% are not married. When the data is disaggregated by conservation farming status, the proportion of married households for farmers who never practiced CF is 76.7% whilst that for farmers who continued and discontinued CF is 78.9% and 21.1% respectively. The proportion of not married household heads is slightly higher for the farmers who continued CF (26.7%) relative to the farmers who never practiced CF (21.1%) and those who discontinued the practice (13.3%).

Table 4.2.3: Marital Status of Household Head

		Overall	Conservation Farming Status		
		% of total households	% of households never practiced CF	% of household continued CF	% of households discontinued CF
Marital status of household head	Married	78.9	76.7	73.3	86.7
	Not married	21.1	23.3	26.7	13.3

Note: Not married include those who are single/never married, widowed and separated

4.2.4 Education Level of Household Head

Overall, 15.6% of household heads have primary education, 82.2% have secondary education whilst 2.2% have tertiary education. When the data is disaggregated by CF status, 16.7% of those who never practiced CF have primary education, 80% have secondary education whereas only 3.3% have tertiary education. The same trend follows on farmers who continued and discontinued CF with 83.3% of each category having secondary education. Table 4.2.4 shows education level of household head by district and by CF status.

Table 4.2.4: Education Level of Household Head

Education level of household head	Overall	Conservation Farming Status		
	% of total households	% of households never practiced CF	% of households continued CF	% of households discontinued CF
Primary	15.6	16.7	16.7	13.4
Secondary	82.2	80.0	83.3	83.3
Tertiary	2.2	3.3	0	3.3

4.2.5 Average Household Size

Table 4.2.5 shows the average number of people per household by household conservation farming status.

Table 4.2.5: Average Household Size

Education level of household head	Overall	Conservation Farming Status		
	% of total households	% of households never practiced CF	% of households continued CF	% of households discontinued CF
Average number of people per household	5	6	5	6
Average number of household members involved in agricultural activities	4	5	4	4

Overall, the average number of people per household is five. When households are disaggregated by conservation farming status, there are slightly more people per household for farmers who never practiced CF and those who discontinued the practice (6 people) than those who continued CF (5 people). When comparing the average number of household members involved in field agricultural activities, overall, households that never practiced CF have more members (5 people) involved in agricultural activities than households that continued and discontinued CF (4 people). This picture does not resonates well with the assertion that CF is labour intensive and hence it's undertaken by households that have more people involved in agricultural activities.

4.2.6 Household Vulnerability Characteristics

The survey recorded number of orphans, household members who are chronically ill and individuals with physical/mental disabilities. Overall, the proportion of households with at least one orphan is 32.2%, 12.2% having at least one chronically ill person and 1.1% have at least one disabled person. Further analysis shows that 26.6% of both, households who never practice conservation and those who discontinued have at least one orphan. Farmers who continued conservation farming have the highest proportion of households with at least one orphan (43.3%). Comparison of households with at least one chronically ill person revealed that two categories of farmers namely; farmers that never practiced CF and those continued CF have the same percentage of households with at least one chronically ill person (13.3%) whereas farmers that discontinued the practice have 10%. The proportion of households with disabilities when disaggregated by farmer's CF status is too small to make any significant comparison. Table 4.2.6 show the proportion of households with at least one orphan, chronically ill person and disabled person.

Table 4.2.6: Household Vulnerability Characteristics

Vulnerability Characteristic	Overall	Conservation Farming Status		
	% of total households	% of households never practiced CF	% of households continued CF	% of households discontinued CF
Orphans	32.2	26.6	43.3	26.6
Chronic illness	12.2	13.3	13.3	10
Disabilities	1.1	0	0	3.3

4.3 Asset Ownership

4.3.1 Productive Asset Ownership

Table 4.3.1 presents the proportion of households that own various assets. In general, the most commonly owned productive assets are ox drawn plough, knapsack sprayers and wheel barrows. Overall, more 60% of all households owns an ox drawn plough, a knapsack sprayer a scotch cart and a wheelbarrow. When data is disintegrated by farmer type, 93.3% of households that never practiced CF own an ox drawn plough, 76.7% of those who continued CF own a plough whereas 86.7% of those who discontinued CF own a plough. The trend is almost the same for a scotch cart, and a wheelbarrow. An ox drawn harrow and cultivator are the least owned farm implements by all farmer types. Overall, 22.2% and 38.9% of households owns an ox drawn harrow and cultivator respectively. When data is disintegrated by farmer type, 13.3% of households that never practiced CF own an ox drawn harrow whereas 16.7% and 30% of households that continued and discontinued CF owns the same asset respectively.. The trend in asset ownership by farmer category resonates well with prior expectation that households with more productive assets are likely to discontinue CF for conventional farming.

Table 4.3.1: Productive Asset Ownership

Productive Asset	Overall	Conservation Farming Status		
	% of total households	% of households never practiced CF	% of households continued CF	% of households discontinued CF
Ox drawn plough	88.9	93.3	76.7	8.7
Scotch cart	66.7	60	63.3	76.7
Ox drawn harrow	22.2	13.3	16.7	30
Wheelbarrow	95.6	96.7	86.7	93.3
Ox drawn cultivator	38.9	36.7	35	40
Knapsack sprayer	77.8	80	96.7	36.7

4.3.2 Livestock Ownership

Table 4.3.2 shows the proportion of households owning various types of livestock by farmer's CF status. Cattle are an important source of draft power and are regarded as a symbol of wealth for most smallholder farmers in Zimbabwe. They are also a source of milk and other animal products for rural households. A greater proportion of households in the total sample own cattle (75.6%). When data is disaggregated by CF status it reveals that 66.7% of households that never practiced CF own cattle, 73.3% of farmers who continued CF own cattle and a relatively higher proportion of farmers who discontinued CF own cattle (86.7%).

Table 4.3.2: Livestock Ownership

Livestock	**Overall**	**Conservation Farming Status**		
	% of total households	% of households never practiced CF	% of households continued CF	% of households discontinued CF
Cattle	75.6	66.7	73.3	86.7
Goats	94.4	100	96.7	86.7
Pigs	5.6	6.7	3.3	6.7
Poultry	100	100	100	100

Goats are an important source of meat for smallholder farmers. They are easier to dispose off in times of cash needs as compared to cattle. Often they are bartered for food in times of shortages. All households that never practiced CF own goats and a slightly higher proportion of households that continued CF own goats (96.7%) compared to those that discontinued CF (86.7). Chickens proved to be the most commonly reared small stock for all categories of households with more than 94% of both categories owning at least 4 chickens. Donkeys and sheep were the least common type of livestock reared by both categories of households in the ward.

4.3.3 Land Ownership

Land is an important asset for rural households whose livelihoods are dependent on agriculture. The size of household farm is often regarded as an important factor in adoption decisions. Table 4.3.3 shows land ownership by CF status.

Table 4.3.3: Land Ownership

Land	Overall	Conservation Farming Status		
	Total Households	Households never practiced CF	Households continued CF	Household discontinued CF
Average Arable land (Ha)	1.22	1.13	1.32	1.19

Overally, 1.22ha is the average arable land for the total households in the sample. When disaggregated by CF status, the average arable land for households that never practiced CF is 1.13ha, for those that continued CF it is 1.32ha and households that discontinued CF have an average of 1.19ha. The overall picture resonates well with our prior expectation that households with relatively more arable land will continue CF as they have adequate land to try new practices in addition to their traditional plots.

4.4 Main Livelihoods Activities

For all the categories of farmers, very marginal numbers indicated that they derived their livelihood from small business, petty trade, fishing, informal mining and informal employment. The major livelihood activity for the interviewed households was dry land farming which was ranked as the number one by 98.9% of the total sample. This was followed by gardening whilst livestock and informal employment were ranked third. 96.7% of households that never practice conservation farming ranked dry land farming as their first livelihood activity, 100% of households that continued CF also ranked dry land framing as their first livelihood activity and the same applies to households that discontinued CF. Gardening was ranked the second best livelihood activity by 90%, 93.3% and 97% of households that never practiced CF, continued CF and discontinued CF respectively. Both informal employment and livestock were ranked third livelihood activity. 70% of households that never practiced CF ranked livestock as their third livelihood activity whilst 36.7% and 10% of households that continued and discontinued CF respectively ranked livestock as their third livelihood activity. Informal employment was ranked third by 16.7% and 80% of households that continued and discontinued CF respectively. Table 4.4 shows the three main livelihoods activities as ranked by households by farmer's conservation farming status.

Table 4.4: Main Livelihoods Activities

Activity	Rank	% of farmers who never practiced CF	% of farmers who continued CF	% of farmers who discontinued CF
Dry land farming	1	96.7	100.0	100.0
Gardening	2	90.0	93.3	96.7
Informal employment	3	70.0	36.7	10.0
Livestock	3	0	16.7	80.0

4.5 Land Preparation, Access and Utilization of Inputs

4.5.1 Tillage

Of the interviewed households, entire households that continued CF (100%) used planting basins whereas households who never practiced CF and those who discontinued CF used animal drawn plough for tillage (100%). All famers who continued CF used planting basins largely because of the widespread promotion of the technique by NGOs and Arex.

4.5.2 Usual Source of Maize Seed

Households were asked about the main sources of inputs they accessed during the 2010/11 season regarding maize seed. Overall, 41.1% indicated purchasing, followed by NGOs (40%), 8.7% indicated government program, remittances (6.79%) and retained (3.3%). When the data is disintegrated by CF status, majority of households that never practiced CF (46.7) and those that discontinued CF (76.7) indicated purchasing as their main source of maize input whereas all households that continued CF (100%) indicated NGO as their main source of maize seed. The fact that 76.7 % of households that discontinued CF indicated purchase as their main source of maize seed might be the probable reason for discontinuing CF since they are no longer getting maize seed from the NGOs. Table 4.5.2 shows major sources of maize seed for the last five years.

Table 4.5.2: Major Source of Maize Seed during the 2010/2011 Season

Source of Maize Seed during 2010/11 Season	Overall	Conservation Farming Status		
	% of total households	% of households never practiced CF	% of total households	% of households never practiced CF
Purchases	41.1	46.7	0	76.7
Government Programs	8.9	26.7	0	3.3
Retained	3.3	6.7	0	3.3
NGOs	40.0	10.0	100.0	10.0
Gifts/Remittances	6.7	10.0	0	10.0

4.5.3 Usual Source Fertilizers

NGOs are the major source of fertilizers for households that continued CF as 100% of these households received most of their fertilizers from NGOs during the 2010/11 cropping season. For households that never practiced CF and those that discontinued CF, purchases remain the main source of fertilizes as indicated by its proportion of 36.7% and 50.0% respectively followed by government programs with 23.3% for households that never practiced CF and 33.3% for households that discontinued CF. Table 4.5.4 shows the major sources of fertilizers during the 2010/11 cropping season.

Table 4.5.3: Major Source of Fertilizers during 2010/11 Season

Source of fertilizers during 2010/11 Cropping Season	Overall	Conservation Farming Status		
	% of total households	% of households never practiced CF	% of total households	% of households never practiced CF
None	15.6	40.0	0	6.7
Purchases	28.9	36.7	0	50.0
Government Programs	18.9	23.3	0	33.3
NGOs	34.4	0	100.0	3.3
Gifts/Remittances	1.1	0	0	3.3
Other contracting companies e.g. Cottco	1.1	0	0	3.3

4.6 Food Security

4.6.1: History of Cereal Production

To get a sense of the food security situation over the last five years, households were asked about the usual months that own production lasts and also years during which the households did not produce enough to last a consumption year. The survey also investigated the major reasons for

not producing enough cereals and sources of cereals these households had access to during years of shortage. Table 4.6.1 shows the proportion of farmers who produced enough cereal to last a full consumption year between 2006 and 2010 by CF status.

Table 4.6.1: History of Cereal Production

Year	Conservation Farming Status					
	Households never practiced CF		Households continued CF		Households discontinued CF	
	Did not produce enough (%)	Produced enough (%)	Did not produce enough (%)	Produced enough (%)	Did not produce enough (%)	Produced enough (%)
2006/07	90.0	10.0	76.7	23.3	86.7	13.3
2007/08	90.0	10.0	33.3	66.7	63.3	36.7
2008/09	30.0	70.0	16.7	83.3	33.3	66.7
2009/10	13.3	86.7	3.3	96.7	46.7	53.3
2010/11	90.0	10.0	23.3	76.7	76.7	23.3

The results show that the proportion of households that continued conservation farming that produced enough increased gradually from 23% in 2006/07 to 97% in 2009/10 cropping season and then dropped to 77% in 2010/11 cropping season. The pattern is almost the same for households that never practiced CF and those that discontinued CF. However, the magnitude of increase is different as revealed by the proportion of households that produced enough cereal increasing from 13% in 2006/07 to 53% in 2009/10 cropping season and then dropped to 23% in 2010/11 season for households that discontinued CF. For households that never practiced CF, the proportion of households that produced enough cereal started from a low figure of 10% in 2007/08 and increased to a high of 87% in 2009/10 season and then dropped to 10% in 2010/11 season.

For the households that failed to produce enough cereals the reasons for such a state are presented in table 4.6.2. Only 6.7% of households that discontinued CF cited non availability/no affordability of seed as the reason for producing inadequate cereals. The same proportion of 13.3% for the households that never practiced CF and those that discontinued CF cited non availability/non affordability of fertilizers as their limiting factor for not producing adequate cereal. The major limiting factor was poor rainfall as indicated by 66.7% of households never practiced CF, 63.3% of households continued CF and 76.7 of households discontinued CF. A relatively higher proportion of households that continued CF, 26.7% cited shortage of labour as the reason for not producing enough cereal compared to only 3.3% for other two categories of households. Lack of extension services and lack of drought power were also given as reasons for

inadequate cereal production.

Table 4.6.2: Reasons for Producing Inadequate Cereal

Reasons	% Households Never practiced CF	% Households Continued CF	% Households Discontinued CF
Non-availability/ non-affordability of seed,	0	0	6.7
Non-availability/ non-affordability of fertilizer	13.3	0	13.3
Poor rainfall	66.7	63.3	76.7
Shortage of labour	3.3	26.7	3.3
Lack of draught power	3.3	0	0
Lack of extension service	13.3	0	0

4.6.2 Major Sources of Cereals during Shortages

Sources of cereals vary from purchases, casual labour, food aid, to gifts and remittances and livestock sales. Purchases was cited as the major source of cereals during times of shortages as indicated by 43.3% of households that never practiced CF, 30% of households that continued CF and 66.7% of households that discontinued CF. Based on proportions of households, government food aid was the second option as shown by 33.3% of households that never practiced CF, 30% 0f households that continued CF and 13.3% of households that discontinued CF. Other sources of cereals during times of shortage includes NGO food aid, remittances and livestock sales as revealed by 30% of households that continued CF, 6,7% of households that discontinued CF and 16.7% of households that never practiced CF respectively. Table 4.6.3 shows sources of cereals during periods of shortage as indicated by proportions of households and their CF status.

Table4.6.3: Major Sources of Cereals during Shortages

Source of cereal	% Households Never practiced CF	% Households Continued CF	% Households Discontinued CF
Purchases	43.3	30.0	66.7
Casual labour	6.7	0	6.7
Food aid (Government)	33.3	30.0	13.3
Food aid (NGO)	0	30.0	0
Remittances and gifts	0	0	6.7
Livestock sales	16.7	0	6.7

4.7 Conservation Farming

4.7.1 Who introduced Conservation Farming to the Household

An analysis of the households that continued CF shows that most of them (50.0%) had CF introduced to them by NGO only whereas most of the households that discontinued CF (70%) got their CF knowledge from both Agritex and NGOs. Table 4.7.1 shows the agents of CF.

Table 4.7.1: Agents of Conservation Farming

	% Households Continued CF	% Households Discontinued CF
NGO only	50.0	10.0
Agritex only	26.7	3.3
NGO and Agritex	20.0	70.0
NGO and other farmers	3.3	13.3
Agritex and other farmers	0	3.3

4.7.2 Reasons for Continuation/Discontinuation with Conservation farming

Households were asked for reasons why they continued or discontinued CF. Table 4.7.2 shows that most households who continued CF are doing so mainly because they are still receiving support from NGO as revealed by a high proportion of households (76.7%). However there are some (16.7%) are doing so in view that it is a good farming method with which they can obtain higher yields thus pointing towards sustainable promotion of CF. Lack of draught power and good yields associated with CF are also some of push and pull factors respectively for continuing CF.

Table 4.7.2.1: Reasons for Continuation/Discontinuation with CF

Reasons for continuing CF	Proportion of Households (%)	Reasons for discontinuing CF	Proportion of Households (%)
Still receiving support from NGO	76.7	No longer receiving inputs from NGO	40.0
Good farming method	16.7	Labour intensive	36.6
Lack of draught power	3.3	No benefit	20.0
Good yields	3.3	Inadequate inputs received from NGO	3.3

For those that discontinued practicing CF, they did so because they are no longer receiving inputs from NGOs (40%). The second most important reason is that CF is labour intensive (36.6%). This suggests that CF should include mechanised CF technology/implements and herbicides to lessen labour demands associated with the practice especially at the initial phases of practise. In addition to the reason given above for continuing/discontinuing CF, households were further asked about their own opinion regarding continuing/discontinuing CF. Table 4.7.2.2 show farmers' own opinion for continuing CF.

Table 4.7.2.2: Farmers' Opinion for Continuing CF

Reasons for continuing CF	Frequency	Proportion of Households (%)
Conserves moisture, soil and water	2	6.7
Saves inputs	1	3.3
Allows better and early crop establishment	1	3.3
Reduction of production cost and increase revenue	1	3.3
High and stable yield	18	76.7
Learning process	1	3.3
Easy way of getting inputs	6	20

Basing on farmer's opinion, the main reason for continuing CF is that of getting high and stable yield as revealed by 76.7% of farmers that continued CF. Water, moisture and soil conservation, inputs saving and better crop establishment are some of the reasons for continuing CF as shown by small proportions of farmers. There are also farmers who continued CF just for the sake of getting inputs and only a small proportion do so for the noble reason of learning. It is encouraging to note that most households that continued CF appreciates that CF allows farmers to realise high and stable yields (76.7%) which point towards sustainability of CF even after withdrawal of input support. Table 4.7.2 show farmers' own opinion for discontinuing CF.

Table 4.7.2.3: Farmers' Opinion for Discontinuing CF

Reasons for continuing CF	Frequency	Proportion of Households (%)
No major yield difference	2	6.7
Labour intensive	9	30
Availability of draught power	3	10
Illness of family member(s)	5	16.7
Lack of surplus after paying back the contractor	9	30
CF is considered as a farming method for the poor	2	6.7

30% of farmers that discontinued CF indicated that the practice is labour intensive and hence their discontinuation. According to these farmers the practice requires the farmer to invest a lot of labour in digging basins, searching for organic fertilizers, mulching, weeding, and other related tasks. The farmers suggested that for CF to succeed there is need for rigorous education and availing of herbicides and other related equipment to reduce the need for intensive labour. Thus, without these, it will be difficult to sustain CF and consequently its cherished goals will not be realized.

Another group cited illness of family members as their reason for discontinuing CF (16.7%). The ravaging HIV and AIDS pandemic is compounding on the situation, as far as the labour crisis is concerned. It is disturbing to note that the elderly, especially the women, are expected to

spearhead the implementation of the program, in terms of labour, and, at the same time, take care of not only the sick, but also minor children who have been orphaned by the deadly HIV and AIDS pandemic. Thus, for such women, CF in spite of its much heralded merits is an unnecessary burden.

Another group of farmers (6.7%) discontinued CF because of the traditional perceptions of the zero tillage system. Traditionally, this farming method was preserved for those in the impecunious category who neither had draught power nor the money to hire people to till the land on their behalf. They see no value in digging basins, while they have more than enough cattle and donkeys for draught power. One respondent said "what will be the use of donkeys, then, if I dig basins myself instead of using these donkeys for draught power". Some of the farmers (30%) who discontinued with CF revealed that there are no tangible surpluses after paying back for inputs obtained on credit to warrant such undertaking and for others (6.7%) there are no major yield differences between the two farming practices and hence they opted for the conventional practice.

4.8 Summary of Findings

From the foregoing analysis it can be summarised that there are differences and similarities in terms of demographic characterises, asset ownership, main livelihoods activities, access and utilization of inputs, and food security status between households that never practiced CF, continued CF and those that discontinued CF. There are also various reasons for continuing and discontinuing with CF. The major reason for continuing CF is that of still receiving input support from NGOs as well as high and stable yield associated with the practice. On the other hand the main reasons for discontinuing CF are that of no longer receiving input support from NGOs and the issue of labour intensity among others.

CHAPTER 5

FACTORS DETERMINING HOUSEHOLD LIKELIHOOD OF PRACTICING CONSERVATION FARMING

5.0 Introduction

This chapter analyses the hypotheses that there is no significant difference in socio-economic attributes between communal farmers who: (i) adopted CF and those who never practiced CF; (ii) continued CF and those who discontinued CF.

5.1 Analytical Approach

To determine the significant factors that influence a household to practice CF or not, binomial logistic regression model was used. The binomial logistic was also used to analyze factors that affect continuation or discontinuation with conservation farming.

5.2 Factors Affecting Conservation Farming Practice

Results for the logistic regression on conservation farming practice are shown in Table 5.2.

Table 5.2: Conservation Farming Practice Logistic Regression

Variables	B	Standard Error	Significance	Exp (B)
Household head age	-5.989	9.632	0.984	0.003
Arable land	6.299	1.967	0.974	2.470
Marital Status	-2.132	3.492	0.999	0.119
Education level	6.879	3.415	0.997	2.140
Household labour	0.779	0.392	0.047**	2.459
Number of Cattle owned	-0.397	0.190	0.036**	0.672
Extension access	7.136	3.398	0.981	2.169
Affordability of inputs	4.136	4.365	0.975	1.570
Access to credit	2.006	2.478	0.418	0.135
Maize output	0.012	0.004	0.001*	1.112
Constant	-6.784	2.545	0.008	0.001

Overall percent correct: 88.30%
* Significant at 1%level of significance
** Significant at 5% level of significance

88.30% correct prediction value was obtained. This implies that the variables used in the model were very good in predicting the observed outcome of the regression analysis. From table 5.2, number of cattle owned, household labour and maize output significantly affect adoption of

conservation farming. On the other hand, household age, arable land, marital status, education level, extension access, affordability of inputs and access to credit facilities do not significantly affect adoption of conservation farming.

5.2.1 Number of cattle owned

The variable number of cattle owned is significant at 5%. The coefficient of the variable which is negative indicates that households with less or no cattle have higher probability of practicing conservation farming than households with more cattle. The value of exp (B) is 0.672. This means that a unit increase in the number of cattle owned decreases the odds of that household practicing conservation farming by 32.8%. In other words, households with more cattle are less likely to practice conservation farming than those with less or no cattle.

As mentioned earlier, cattle are an important source of draft power and a source of milk for most smallholder farmers. Due to the 1992 draught and recurrent unreliable rainfall thereafter, smallholder farmers' cattle herds were severely affected to the extent that some smallholder farmers were left without any cattle. This implies that households without draft power are more vulnerable to food insecurity and have fewer options for crop establishment than their counterparts with cattle. So to cope up with this vulnerability, households that have no cattle practice conservation farming to enable early crop establishment with the first effective rainfall leading to better crop output.

5.2.2 Households Labour

The variable household labour is significant at 5%. The coefficient of the variable is positive. This means that households with more labour are likely to practice conservation farming than households with less labour. The value of exp (B) is 2.459 implies that a unit increase in the size of the household labour increases the odds of the household practicing CF by 145.9%. More household members who are actively involved in agricultural activities means more land can be cultivated under CF using simple implements such as hand hoes. In addition more members in the household means more mouths to feed and such households are more vulnerable to the worsening food security. So they are bound to look for alternative ways of coping up with deteriorating food security. This then makes those households that have more labour to have a higher probability of practicing CF than those with less labour endowment.

5.2.3 Maize Output

Another variable that is significant in the model is, maize output. The variable is highly significant at 1% and the coefficient is positive. This implies that the more maize output a household get from the CF plot, the more likely that the household will practice CF. The value of exp (B) is 1.112, which means that a unit increase in maize output from the CF plot would increase the odds of the households practicing CF by 11.2% *ceteris Paribas.* Maize is the staple food of the people in Zimbabwe. Maize is one of the main reasons why most households are practicing CF. By practicing CF; households are assured of meeting some of their annual maize requirements. So if a household is already producing enough maize through conventional farming, it is less likely that it would practice CF. However if a household is producing inadequate maize through conventional farming practice, it is more likely that it will practice CF.

5.3 Factors Affecting Continuation/Discontinuation with Conservation Farming

Table 5.3 shows results of a logistic regression run to determine the factors that affect continuation/discontinuation with conservation farming.

Table 5.3: Continuation/Discontinuation with CF Logistic Regression

Variables	B	Standard Error	Significance	Exp (B)
Household head age	0.125	0.99	0.207	1.133
Arable land	-1.105	1.510	0.464	0.331
Marital Status	-0.647	2.248	0.774	0.524
Education level	-2.505	1.367	0.067***	0.082
Household labour	0.031	0.506	0.952	1.031
Number of Cattle owned	-0.471	0.188	0.012**	0.624
Extension access	3.687	1.972	0.784	0.891
Affordability of inputs	2.230	2.591	0.389	9.301
Access to credit	4.209	1.685	0.012**	2.299
Maize output	0.007	0.002	0.001*	1.172
Constant	-2.978	3.071	0.332	0.051

Overall percent correct: 86.7%
* Significant at 1%level of significance
** Significant at 5% level of significance
*** Significant at 10% level of significance

86.7% correct prediction value was obtained. This implies that the variables used in the model were very good in predicting the observed outcome of the regression analysis. The following variables significantly affect the continuation or discontinuation with CF: education level of the

household head, number of cattle owned by a household, access to credit and maize output obtained from the conservation farming plot. On the other hand the variables, age of household head, arable land, marital status, household labour endowment, extension access and affordability of inputs do not significantly affect continuation or discontinuation with CF.

5.3.1 Education Level of Household Head

The variable education level of household head is significant at 10%. The coefficient of this variable is negative. This implies that the higher the level of education of the household head, the more likely that the household would discontinue CF. On the other hand, the lower the education level of the household head the more likely that the household would continue CF. The value of exp (B) is 0.082, which indicates that a unit increase in education level of the household head would decrease the odds of household continuing CF by 91.8%. This implies that the more educated the head of households is, the more open he/she is to other options in terms of his/her livelihood, and would likely to discontinue CF for these other options. One of the options is finding and/or having another source of income probably in the urban area. So when he/she finds CF to be cumbersome, he/she would give it up easily since he/she is flexible enough to get another source of income. On the other hand, it means that less educated household heads are more likely to continue with CF. This could be because the less educated household heads have fewer options in terms of their livelihood sources, so CF presents a good opportunity to raise their livelihood status through increased production.

5.3.2 Number of Cattle Owned

The variable number of cattle owned is significant at 5%. The coefficient of the variable which is negative indicates that households with less or no cattle have higher probability of continuing conservation farming than households with more cattle. The value of exp (B) is 0.624. This means that a unit increase in the number of cattle owned decreases the odds of that household continuing conservation farming by 37.6%. In other words, households with more cattle are less likely to continue conservation farming than those with less or no cattle.

Households with cattle are more likely to discontinue CF since they have access to draft power and as a result would opt for the conventional farming practice which to them is less labour intensive. On the other hand, for households with no cattle it implies that they do not have access to draft power and a result they would continue with conservation which enable them early crop establishment using simple implements such as hand hoes.

5.3.3 Access to Credit

Another variable that is significant in the model is access to credit. The variable is significant at 5% and the coefficient is positive. This implies that the more the access to credit a household has, the more likely that the household would continue practicing CF. On the other hand, the less the access to credit, the more likely that the household would discontinue CF. The value of exp (B) is 2.299 indicates that a unit increase in access to credit facilities would increase the odds of that household continuing with CF by 129.9%. In other words, households with more access to credit are likely to continue CF. This is because household with access to credit can purchase their inputs on time and hence can comply with the requirements of CF. In the area of this study, that is Ward 5 of Guruve District, access to credit can be in the form of inputs (seed and fertilizers) obtained through contract farming being administered by the Union Project. This enables timely availability of inputs and hence timely execution of farm operations.

5.3.4 Maize Output

The variable, maize output is highly significant at 1% and the coefficient is positive. This implies that the more maize output a household get from the CF plot, the more likely that the household would continue CF. On the other hand, the less maize output a household get from the CF plot the more likely that the household would discontinue CF. The value of exp (B) is 1.172, which means that a unit increase in maize output from the CF plot would increase the odds of the households continuing CF by 17.2%. As what has been over–emphasized in this report, maize is the staple food of the people in Zimbabwe. Maize is one of the main reasons why most households are practicing CF. By practicing CF, households are assured of meeting some of their annual maize requirements.

5.4 Summary of Findings

This chapter has shown that: number of cattle owned by a household, household labour endowment and maize output significantly affect the overall conservation farming practice in the Ward 5 of Guruve district. On the other hand, continuation/discontinuation with CF is significantly influenced by the following factors: education level of the household head, number of cattle owned, access to credit facilities and maize output from the CF plot.

CHAPTER 6

PROFITABILITY ANALYSIS OF CONSERVATION FARMING

6.0 Introduction

The last chapter determines socio economic factors that influence continuation/discontinuation with CF. This chapter builds on these findings and compares the profitability of CF against conventional farming based on survey data of maize crop enterprise collected from the two categories of farmers in ward 5 of Guruve district namely, those that continued CF and those that discontinued CF. Comparative gross margin analysis was used to test the hypothesis that: CF is not financially more attractive than conventional farming.

6.1 Yield Comparison in Maize Production

Maize is the most cultivated crop in the communal areas of Zimbabwe. It is also the staple crop for the country. In ward 5 of Guruve district, maize is the most cultivated crop with all farmers growing maize every season so as to feed their families. Farmers seek to maximize maize yields so as to alleviate food shortages at household level. Therefore, the major benefit they would seek from CF would be improved maize yields. Assuming that farmers are rational economic agents they would also seek to minimize costs of production. Table 6.1.1 shows mean yield comparisons for maize being grown under the two tillage systems.

Table 6.1.1 Maize Yield Comparison

Farming practice	Conservation Farming	Conventional Farming
Mean yield per ha in kg	3746.97	1682.73

To test whether CF results in higher maize yield than conventional farming, the paired samples test was used to make inferences about the difference between the yields obtained using the two farming practices. An independent samples t test was run using SPSS and the results are presented in table 6.1.2.

Table 6.1.2 Independent Samples t test of Maize yield

Conservation Farming Status	Maize yield in kg per hectare		t- test
	Mean	Standard deviation	
Continued CF	3746.97	877.23	8.775*
Discontinued CF	1682.73	943.81	

* Significant at 5% level of significance
** Significant at 10% level of significance

Based on the results presented in table 6.1.2, we can conclude that CF result in higher yield per hectare compared to conventional farming practice.

6.2 Input Usage Comparison in Maize Production

In addition to increased maize outputs farmers would also be interested in a farming practice that would minimize costs of production so as to save on the scarce resources they own. The table below serves to illustrate variability in input usage between the two farming practices.

Table 6.2 Input Usage Comparison in Maize Production

Variable input kg/ha	Conservation Farming		Conventional Farming		t test
	Mean	Standard deviation	Mean	Standard deviation	
Maize Seed	24.11	3.42	28.26	3.26	2.73
Manure	240.4	33.54	369.46	56.45	9.875*
Basal fertilizer	294.72	33.01	157.23	87.47	-7.26*
Top dressing	256.00	29.10	125.87	77.10	-5.08*

* Significant at 5% level of significance
** Significant at 10% level of significance

The table above shows that major agricultural inputs used by smallholder farmers in ward 5 of Guruve district were local or improved seed, organic and inorganic fertilizers. Smallholder farmers generally do not use pesticides and herbicides, however pesticides are used when the need arise. Table 6.2 shows that there is more usage of inorganic fertilizers by farmers who continued with CF compared to those who discontinued with the practice and are now using conventional farming practice. However the situation is different on organic fertilizer as more is used under conventional practice than CF. Statistical inference confirmed the same that there is a significant difference in terms of manure, basal fertilizer and top dressing usage between farmers who continued CF and those who discontinued with the former using more inorganic fertilizers

than the latter. However the results indicated that there is no significant difference in terms of maize seed usage between the two groups under comparison.

6.3 Labour Use Comparison in Maize Production

Smallholder farmers rely mostly on family labour for most of their farm operations. Data on labour use was collected for the major operations such as land preparation, weeding, crop residue application and harvesting. The table illustrate some of the major activities in maize production and time required to execute the task in labour days per hectare for the sampled households.

Table 6.3: Labour Use Comparison in Maize Production

Item	**Conservation Farming**		**Conventional Farming**		**T test**
	Mean	**Standard deviation**	**Mean**	**Standard deviation**	
Land preparation	18	4.95	5	1.47	-72.06*
Manure application	5	1.23	5	1.17	0.23
Planting	6	1.52	3	0.46	-17.51*
Basal fertilizer application	6	0.82	3	0.54	-13.64*
Top dressing	6	2.10	3	0.45	-2.4*
First weeding	15	3.26	8	1.55	-26.33*
Second weeding	12	1.02	8	0.86	-15.70*
Harvesting	9	1.88	8	0.95	2.78
Total	**78**		**40**		

* Significant at 5% level of significance
** Significant at 10% level of significance

The table above suggest that CF requires more labour days on average to grow a hectare of maize compared to the conventional farming practice. Statistical inference using an independent samples t-test confirms that CF requires significantly more labour days on land preparation, planting, basal fertilizer application, top dressing, first weeding and second weeding than conventional farming. However, there is no significant difference in terms of labour days required on manure application and harvesting.

6.4 Gross Margin Analysis of Maize Production

This section of the chapter presents results from gross margin analysis for maize grown by smallholder farmers. Gross margins were calculated using data collected on average input usage (seed, fertilizer and labour) and output for maize grown under the two farming practices. To facilitate interpretation and comparison, inputs that did not differ significantly across the two groups of farmers were kept constant; for example the cost of land. Input and output prices used are the prevailing market prices. Input prices were obtained from major crop outlets as most of the inputs are now available on the local shops following the adoption of the multicurrency monetary system in 2009. Maize producer price used is the GMB's buying price since the parastatal normally offers better producer prices than private buyers. As a result a producer price of $275.00/tonne was used.

Table 6.4.1 shows the gross margin analysis for maize under the two farming practices under consideration for smallholder farmers. Detailed maize budget is attached in the appendix

.

Table 6.4: Gross Margins Analysis Maize Production

	Conservation Farming	Conventional Farming	t test
Yield levels (t/ha)	3.75	1.68	8.77*
Selling price ($/t)	275.00	275.00	0.22
Gross income ($/ha)	1030.15	462.55	1.14*
Total Variable Costs (TVC)	591.10	336.56	9.33*
Gross Margin (GM)	439.05	125.99	1.827*

* Significant at 5% level of significance
** Significant at 10 %level of significance

The gross margin analysis results above shows that both farming practices were viable for smallholder farmers as indicated by the positive gross margins for maize. However, CF practice is more profitable as compared to conventional farming practice. This is probably due to the fact that though CF is input intensive, it resulted in significant yield gains hence higher gross margin than conventional farming. Farmers practicing CF had a gross margin of 3.5 times higher than that for conventional farming practice. The results are firm despite the fact that digging basins is labour intensive. The results also confirm the higher labour returns from maize production under CF compared to conventional farming.

To ascertain whether gross margin for CF is significantly higher than that of conventional farming, an independent t-test was run to make the inference. Based on this statistical

inference, we can conclude that CF result in significantly higher gross margin compared to conventional farming practice. The fact that CF result in a relatively higher gross margin than conventional farming practice could be the possible reason why some farmers continued CF and this may lead to the sustainability of the practice.

6.5 Summary of Findings

Gross margin analysis revealed that both farming practices were viable for smallholder farmers as indicated by the positive gross margins of maize enterprise. However it is important to note that CF practice is more profitable than conventional farming as revealed by its significantly higher gross margin than that of conventional farming practice. This is true despite the fact that CF is labour intensive as indicated by more labour days being required to grow a hectare of maize under CF compared to conventional farming practice. Based on these results, we can reject the null hypothesis that CF is not financially more attractive than conventional farming, in favour of the alternative hypothesis.

CHAPTER 7

SUMMARY, CONCLUSION AND POLICY RECOMMENDATIONS

7.0 Introduction

This chapter summarizes the major findings and presents conclusions and recommendations based on empirical results of this study. The chapter also gives an overview of policy insights and implications of the findings in the study and answers the research questions posed in chapter one. The chapter begins by revisiting the hypothesis that guided this study. This is followed by a summary of insights and recommendations for policy and development planning. Lastly the chapter presents areas of further study.

7.1 Summary of Findings and Conclusion

The first hypothesis of this study was that: Socio-economic attributes (demographic, livestock ownership, affordability of inputs, arable land, access to credit, extension access and maize output) do not influence smallholder farmers to adopt CF. The results revealed that:

- The decision to practice CF or not is mainly determined by the number of cattle owned, household labour endowment and maize output:

Based on these results, it can be concluded that CF among smallholder can be sustained if the issue of access to credit is addressed, household heads are equipped with education on the importance of CF, CF is promoted with user friendly farm implements to replace draft power shortage and maize output from the CF plot remains significantly higher than that obtained from conventional plot. Anything short of this will result in unsustainable CF.

The second hypothesis of the study was that: There is no significant difference in socio-economic attributes (demographic, asset and livestock ownership, source of inputs and food security status) among smallholder farmers that continued CF and those that discontinued CF. The study found that:

- The decision to continue/discontinue CF is mainly influenced by the education level of the household head, the number of cattle owned, access to credit and maize output.

The third hypothesis of this study was: conservation farming is not financially more attractive than conventional farming. Gross margin analysis of maize enterprises revealed that:

- Both farming practices were viable for smallholder farmers. However, maize production using CF was significantly more profitable compared to conventional farming. Farmers continuing CF had a gross margin of 3.5 times higher than that for conventional farming.

Therefore, I conclude that CF is sustainable as long as the net returns from CF are significantly higher than returns from conventional farming.

7.2 Policy Insights and Implications of Findings

The policy insights and implications from the first analysis was that there are differences in socioeconomic attributes between farmers that continued CF, discontinued CF and those that never practiced CF in terms of demographic characteristics, asset and livestock ownership, source of inputs and food security situations. Given that smallholder farmers are heterogeneous as partially confirmed by this study, it is imperative for rural development agents to promote developmental projects such as CF that are embedded in the society's make up for such programs to be sustainable. Given the differences in sources of inputs and labour endowments among the three types of farmers, CF promotion need to be complemented with farmer support in acquiring inputs. Such implements as direct planters, mulch shredders and rippers, fertilizer and seeds, among others, should be made available at affordable prices. This would aid and ease the farmers' transition journey from conventional to sustainable CF. However to avoid the danger of the dependency syndrome, it would be necessary for the provision of credit facilities for the purchase of necessary implements and inputs. There is need for the participation of all stakeholders such as government, NGOs and the private sector.

To address the issue of food security differences, there is need to create demand for other crops so as to remove the strong market preference for maize. This could entail promoting other food crops into becoming the country's staple, alongside maize. Under such circumstances, CF would be promoted and a wider spectrum of various crops would be grown, so crop rotation would be practiced.

The second objective was to assess socio-economic factors that influence smallholder farmers to continue or discontinue CF. The results revealed that, the decision to continue/discontinue CF is mainly determined by the number of cattle owned, education level of the household head, household labour access to credit facilities and maize output. This shows that there is potential for continuation of CF in ward 5 of Guruve District if these socio-economic attributes are addressed. Conservation farming can go a long way in curing many ills of communal farming. It is logical, thus to charter into this area by increasing awareness among communal farmers accompanied with the provision of credit facilities. This can be achieved by crafting an aggressively robust, innovative, and practical extension approach. In it, household heads should be made to see the benefits that will accrue to them from sustainable CF. The first port of call would be to run refresher courses for extension workers or retraining them where necessary. This would get them to be fully equipped and grounded to impart knowledge on sustainable CF to their clients (communal farmers). There is also need to avail herbicides and other related equipment to partially substitute the role of cattle. There is call for the establishment of a supporting legal framework for CF at national level that will coordinate all CF activities of government, donors and the private sector to spearhead the promotion of increased maize output through CF.

The continuation with CF can be complemented by the active participation of the local retail outlets in the supply of agricultural inputs through contract farming at sustainable interest rates. This will assist in providing the much needed credit facilities to smallholder farmers. Retailers in marginal areas should be encouraged to stock seed, fertilizers, herbicides and other necessary farm implements. Such access to inputs would also reduce transport costs and farmers might be able to purchase them even if NGO aid/contract farming is withdrawn. This would also benefit farmers who are not supported by relief interventions or contract farming. In addition, this will ensure timely availability of inputs. Strengthening local retailers' ability to provide agricultural inputs do require a clear exit strategy from the local NGO that had previously been providing these inputs. To reduce discontinuation with CF, there is need to ensure timely availability of inputs either through contract farming, donor support, and government programs on rural finance.

Given that maize output is also a major determinant on continuation/discontinuation with CF; farmers should be allowed flexibility on their maize plot sizes. Some communities believe there is a mandatory plot size for maize under CF, particularly if farmers are receiving inputs from

NGOs. Areas allocated to maize crop under CF should be determined by each farmer's resource endowments and budget constraints. Allowing farmers to make their own decision about CF technology is critical and empowering. Giving farmers ownership of the package would ensure sustainability. Educational level of the household heads also contributes towards the CF status of a household. There is need to encourage farmer to farmer training. Such associations afford them access to information and to share experience more easily.

The final objective of the study was to assess the profitability of conservation farming compared to conventional farming. In order for a project to be sustainable in the long term it should be profitable to farmers. The gross margin analysis revealed that CF is financially more profitable than conventional farming irrespective of its high input intensity. There is need therefore to provide market (both input and output) for the maize crop to promote continuation with CF and hence its sustainability. The implications of these findings are that providing incentives to farmers to increase maize production could help improve food production and household income. The sustainability of CF depends on the immediate gains of CF to the smallholder farmer especially in the face of immediate problems such as poverty, food insecurity and poor agricultural productivity. The resource constrained smallholder farmer can therefore not be expected to continue practices that in the long term may improve production, but in the short term provide no benefits or even net loses.

8.3 Suggested Areas of Further Study

Although this study partially identified the existence of socio-economic difference among farmers that continued, discontinued and never practiced CF, assessed the profitability of CF as well as identifying factors that influences adoption, continuation or discontinuation of CF, there is need for the identification of the capacity of government, NGOs and the private sector to ensure existence of conducive socio-economic attributes that promote the sustainability of CF. Thus it is critical for a development research on the capacity of all interested stakeholders to ensure availability of inputs on time through the existence of efficient input and output markets, extension services and existence of all support services to ensure sustainability of CF among Zimbabwean smallholder farmers at large.

The study did not address the issue of the environment and climatic change on the sustainability of CF. The approaching crisis, brought about by inappropriate agricultural practices, the exponential rise in population and the impacts of climate change have the potential to produce a perfect storm of starvation, desertification, flooding and destruction of irrigation water sources. Thus there is need for further study on how this will affect the sustainability of CF.

The analysis on comparative profitability of maize production between CF practice and convectional farming practice considered only private profitability which is a short term goal. However the overriding concept is the sustainability of CF. Farmers invests in capital in expectation of future returns. Therefore there is need for further research on long term benefits of conservation farming among smallholder farmers. There is also need to do an environmental impact assessment of the principles of CF compared to the principles of conventional farming. For example there is need to value biomass production as well as improvement in soil physical properties such as soil structure and improved water absorption capacity as a result of continuing CF.

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APPENDIX 1: Gross Margin Analysis of Maize Production

Gross Margin Analysis of Maize Production							
Maize Budget		**Conservation Farming**			**Conventional Farming**		
Yield levels (t/ha)				3.75			1.68
Selling price ($/t)				275.00			275
Gross income ($/ha)				1030.15			462.55
Total Variable Costs (TVC)				591.10			336.56
Gross Margin (GM)				**439.05**			**125.99**
Variable input	**Unit**	**Quantity**	**Unit Cost ($)**	**Cost ($/ha)**	**Quantity**	**Unit Cost ($)**	**Cost ($/ha)**
A. Prior to Harvesting							
1. labour	day	69	2.00	138.00	32	2	64.00
2. Tractor operation	litre	0	0.00	0.00	0	0	0.00
3. Maize seed	kg	24.11	2.20	53.04	28.26	2.2	62.17
4. Fertilizer and lime:							
a. Compound D	kg	294.72	0.64	188.62	157.23	0.64	100.63
b. Ammonium Nitrate	kg	256.00	0.64	163.84	125.87	0.64	80.56
5. Herbicides:							
a. MCPA (litre/ha)	litre	0.00	12.00	0.00	0.00	12.00	0.00
6. Insecticide (litre/ha)							
a) Monochrotophos (litre/ha)	litre	0.00	13.50	0.00	0.00	13.5	0.00
TVC Prior to Harvesting				**543.50**			**307.36**
B. Harvesting and Marketing							
1. labour days	day	9.00	2.00	18.00	8.00	2.00	16.00
4. Packing materials:							
a. Bags (50kg bag)	bag	74.00	0.40	29.60	33.00	0.40	13.20
b. T2 Twine: g/t	kg	0.00	0.00	0.00	0.00	0.00	0.00
5. Transport out:	litre	0.00	0.00	0.00	0.00	0.00	0.00
TVC Harvest to market				**47.60**			**29.20**
TVC				**591.10**			**336.56**
TVC/tonne				157.80			200.09

APPENDIX 2: Household Survey Questionnaires

The Sustainability of Conservation Farming in the Smallholder Farming Sector. A Case Study of Guruve Communal Areas in Zimbabwe

1. Farmers who Continued Conservation Farming

Section A: Site and Location

A1 Province	**A2** District	**A3** Enumerator's name	**A4** Date
A5 Respondent Name	**A6** Village Name	**A7** Ward Name	**A8** Ward Number
A9. Total Arable Land (Hectares) (Owned + Accessed)			

Section B: Demographics (*write the appropriate response in the space provided***)**

B1. What is the name of the HH Head?	
B2. Sex of HH Head (1 = Male 2 = Female)	
B3. D.O.B of HH Head (year of birth only)	
B4. Marital Status of HH Head 1=Single/never married 2= Married 3= Divorced/ Separated 4= Widowed	
B5a. Education level of household head 0=No school 1=Primary 2=Secondary 3=Tertiary 4= Vocational	
B5b. Number of people in the HH	

	Please write '0' if there are none	**Members aged 0-17 years**	**# of Members aged 18 -59**	**# of Members aged 60+**
B6	Male			
B7	Female			
B8	Orphans *(one or both parents dead)*			
B9	Chronically ill *(ill for 3 (out of 12) or more months and unable to work)*			
B10	# physically/mentally challenged			

B11. How many household members are involved in agricultural activities?	

Section C: Main Livelihood Activities (Rank the 3 most important only, 1 being the most important)

Livelihood Activity	**Rank**	**Livelihood Activity**	**Rank**	**Livelihood Activity**	**Rank**

1 = Dry Land Farming		**5** = Informal employment		**9** = Petty Trade	
2 = Irrigated Farming		**6** = Fishing		**10** = Small business	
3 = Gardening		**7** = Formal Mining		**11** = Livestock	
4 = Formal employment		**8** = Informal mining		**12**= Other (specify)	

Section D: Household Assets (How many of each of the following assets or implements in working condition does the household own or keep)			
Asset	Total	Asset	Total
1.Ox drawn ploughs		**6**.Wheelbarrow	
2. Ox drawn Harrow		**7**. Scotch Cart	
3. Ox drawn cultivator		**8**. Tractor	
4.Rippers		**9** Direct seeders	
5.Sprayers		**10**. Hand hoe	
Livestock Ownership (How many of each of the following animals does the household own or keep)			
Asset	Total	Asset	Total
1.Cattle		**4**.Goats	
2. Donkey		**5**. Pigs	
3. Sheep		**6**. Poultry	

Section E: Sources of Inputs	
E1. During the 2010/2011 season, what were the household's <u>main</u> sources of inputs for the following crops (one source per input type)	
Input	**Source**: 1 = Purchases, 2 = Government Programmes, 3 = Retained, 4 NGOs, 5 = Gifts/Remittances 6= Other, specify
Maize	
Sorghum	
Groundnuts	
Cotton	
Tobacco	
Paprika	
Cowpeas	
Millets	
Basal Fertiliser	
Top Dressing Fertiliser	

E2. Did the household ever received inputs from NGOs during the last three seasons? 0 = No , 1 = Yes

E3. If yes, in which year/s did the household received inputs from the NGO?
0= Inputs not received over the past three seasons 1 = 2008/09 2 = 2009/10 3 = 2010/11 4= 2008/09 and 2009/10 5= 2008/09 and 2010/11 6 = 2009/10 and 2010/11 7 = All three season

E4.If source of inputs was through purchase, was the market for inputs readily available? 0 = No 1 =Yes

E5 If the inputs were not readily available, where did you buy your inputs from?
.....
E6 Were the inputs price affordable? 0 =No 1 =Yes

E7 If no, what should be done to improve affordability of inputs?
.....
E8 Did you access your inputs for the 2010/11 on time?
0 = No 1=Yes
E9 If no, why?
.....
E10 Do you agree that availability of credit facilities can improve your access to farming inputs?
0= Not agree 1 = Agree 2 = Strongly agree

F11 Do you have access to credit facilities?
0 =No 1 =Yes

Section F : Conservation Farming (Maize Plot)

F 1 What was the area planted to maize under CF in the season 2010/11 in acres/Ha? (*state whether hectares or acres)*

F2 What was the cost of land preparation on the CF plot? (*monetary value if any*)

F 3 For the following inputs, what quantities were applied in kg during the 2010/11 season on the CF plot?

Input	**Quantity used in kg**
Maize seed	
Manure	
Basal fertilizer	
Top dressing	

F4 What was the total quantity of labour used for the following farm activities during the 2010/11 season on the CF plot?

Activity	**Labour days per hectare**
Land preparation (making planting basins)	
Crop residue application	
Manure application	
Planting	
Basal fertilizer application	
Top dressing application	
First weeding	
Second weeding	
Harvesting	

F5 What was the total maize harvest realised from CF plot in 2010/11? (*State the number of bags and whether its 50kg bag or 90kg bag*).....

F6 What has happened to your maize yields since you started CF practice? 1 = Remained the same 2 =Increased a bit 3 = Increased a lot 4 = Decreased

F7 What has happened to your seasonal labour requirements since you started CF practice?
1 = Remained the same 2 =Increased a bit 3 = Increased a lot 4 = Decreased a bit 5 = Decreased a lot

F8 What has happened to area under maize since you started CF practice?
1 = Remained the same 2 =Increased a bit 3 = Increased a lot 4 = Decreased

F9 Which other crops were grown using CF in the 2010/11 season?

Crop	**Area planted in 2010/11(*State whether Ha/acres)***	**Quantities Harvested (***State the number of bag and whether its 50kg bag or 90kg bag)*
1.		
2.		
3.		
4.		

Section G : Conventional Farming (Maize Plot))

G 1 What was the area planted to maize under conventional farming during the 2010/11 season in acres/ha? (*state whether hectares or acres)*

G2 What was the cost of land preparation on the conventional plot (*monetary value if any*

G3 For the following inputs, what amounts were applied during the 2010/11 season on the conventional plot?

Input	**Quantity used in kg**
Maize seed	
Manure	
Basal fertilizer	
Top dressing	

G4 What was the total quantity of labour used for the following farm activities during 2010/11 season on the conventional plot?

Activity	**Labour days per hectare**
Land preparation	
Manure application	
Planting	
Basal fertilizer application	
Top dressing application	
First weeding	
Second weeding	
Harvesting	

G5 What was the total maize harvest realised from the conventional farming plot in 2010/11? (*State the number of bags and whether its 50kg bag or 90kg bag*).....

G6 Which other crops were grown in the 2010/11 season?

Crop	**Area planted in 2010/11(*State whether Ha/acres)***	**Quantities Harvested (***State the number of bags and whether it's 50kg bag or 90kg bag)*
1.		
2.		

3.		
4.		

Section H: Household Food Security

H 1. Usually the household produces cereals to last how many months? Months

H 2. Over the last five years, which years did the household produce enough cereals to last a consumption year
(0 = Did not produce enough, 1 = Produced enough)

2006/07	2007/08	2008/09	2009/10	2010/11

H3 If the household does not usually produce enough cereals to last a consumption year, what is the **main** reason?

1 = Non-availability/ non-affordability of seed, 2 = Non-availability/ non-affordability of fertiliser,

3 = Poor rainfall, 4 = Shortage of labour 5 = Lack of draught power 6 = Other, specify.....

H 4. During the years which the household did not produce enough, what was the major source of cereal?
0= Not applicable 1= Purchases 2=Casual Labour 3=Food aid (Govt) 4= Food aid (NGO) 5= Remittances and Gifts
6= Gold panning 7= Livestock sales 8= Black Smithing

Section I : Continuation with Conservation Farming

I 1 When did the household started practising conservation farming (digging planting basins/ ripper tines)(year)
.....
I 2 What principles has the household been practising (Circle all that apply)
1=minimum soil disturbance (basins/ripper) 2= mulching/crop cover 3= crop rotation 4=Winter weeding
5 = Precision application of basal and top dressing

I 3 Who introduced CF to the household? ***(Circle all that apply)***

1 = NGO, 2 = Agritex , 3 = Other farmers, 4 = Other, specify

I 4 Was it introduced through technology only or technology with inputs.
1 = Technology only 2 = Technology with inputs

I 6 Did anyone from the household receive any extension/training during the 2010/11 season
0 = No 1 =Yes

I 7 How was the extension being provided (Circle all that applies)

1 = Individual farmer visit 2=field days 3 = Demonstration plots 4=pamphlet 5= at input distribution point
6 = Other
(Specify).....

I 8 Did the household continued CF in 2010/11 season
0 = No 1 = yes

I 9 If the HH continued conservation farming, indicate why? ***(Circle all that apply)***

1 = Still receiving support from NGO 2 = Good farming method 3 = Lack of draught power 4 = Good yields

5= Newly introduced 6= Other, Specify

I 10 In your now opinion, why did you continued conservation farming?
.....
....

I 11 What challenges are you facing concerning CF?
.....

I 12 What can be done to increase the uptake of CF?
.....

I 13a Has the area under your household CF plot/s increased?
0 =No 1 =Yes

I 13b
Why?.....

I 14 What are your perceptions on the sustainability of conservation farming?
.....

I1.15 Is conservation farming adopted by non beneficiaries?
0 = No 1 = Yes

I 16 If yes
why?.....

I 17 What has happened to the household income since you started practicing conservation farming?
.....

I 18 What has happened to the household food security status since you started conservation farming?
.....

I 19 What is now the source of feed for your livestock/cattle in winter?
.....

I 20 How labour intensive is the process of collecting maize stalks and grass for ground cover?

1 = Low 2 =Average 3 = High 4 = Extremely high

The Sustainability of Conservation Farming in the Smallholder Farming Sector. A Case Study of Guruve Communal Areas in Zimbabwe			
2. Farmers who Discontinued Conservation Farming			
Section A: Site and Location			
A1 Province	**A2** District	**A3** Enumerator's name	**A4** Date
A5 Respondent Name	**A6** Village Name	**A7** Ward Name	**A8** Ward Number
A9. Total Arable Land (Hectares) (Owned + Accessed)			

Section B: Demographics (*write the appropriate response in the space provided***)**	
B1. What is the name of the HH Head?	
B2. Sex of HH Head (1 = Male 2 = Female)	
B3. D.O.B of HH Head (year of birth only)	
B4. Marital Status of HH Head 1=Single/never married 2= Married 3= Divorced/ Separated 4= Widowed	
B5a. Education level of household head 0=No school 1=Primary 2=Secondary 3=Tertiary 4= Vocational	
B5b. Number of people in the HH	

	Please write '0' if there are none	**Members aged 0-17 years**	**# of Members aged 18 -59**	**# of Members aged 60+**
B6	Male			
B7	Female			
B8	Orphans *(one or both parents dead)*			
B9	Chronically ill *(ill for 3 (out of 12) or more months and unable to work)*			
B10	# physically/mentally challenged			

B11. How many household members are involved in agricultural activities?	

Section C: Main Livelihood Activities (Rank the 3 most important only, 1 being the most important)					
Livelihood Activity	**Rank**	**Livelihood Activity**	**Rank**	**Livelihood Activity**	**Rank**
1 = Dry Land Farming		**5** = Informal employment		**9** = Petty Trade	

2 = Irrigated Farming		**6** = Fishing		**10** = Small business	
3 = Gardening		**7** = Formal Mining		**11** = Livestock	
4 = Formal employment		**8** = Informal mining		**12**= Other (specify)	

Section D: Household Assets (How many of each of the following assets or implements in working condition does the household own or keep)

Asset	Total	Asset	Total
1.Ox drawn ploughs		**6**.Wheelbarrow	
2. Ox drawn Harrow		**7**. Scotch Cart	
3. Ox drawn Cultivator		**8**. Tractor	
4.Rippers		**9** Direct seeders	
5.Sprayers		**10**. Hand hoe	

Livestock Ownership (How many of each of the following animals does the household own or keep)

Asset	Total	Asset	Total
1.Cattle		**4**.Goats	
2. Donkey		**5**. Pigs	
3. Sheep		**6**. Poultry	

Section E: Sources of Inputs

E1. During the 2010/2011 season, what were the household's <u>main</u> sources of inputs for the following crops (one source per input type)

Input	**Source**: 1 = Purchases, 2 = Government Programmes, 3 = Retained, 4 NGOs, 5 = Gifts/Remittances 6= Other, specify
Maize	
Sorghum	
Groundnuts	
Cotton	
Tobacco	
Paprika	
Cowpeas	
Millets	
Basal Fertiliser	
Top Dressing Fertiliser	

E2. Did the household ever received inputs from NGOs during the last three seasons? 0 = No , 1 = Yes

E3. If yes, in which year/s did the household received inputs from the NGO?
0= Inputs not received over the past three seasons 1 = 2008/09 2 = 2009/10 3 = 2010/11 4= 2008/09 and 2009/10 5= 2008/09 and 2010/11 6 = 2009/10 and 2010/11 7 = All three season

E4.If source of inputs was through purchase, was the market for inputs readily available? 0 = No 1 =Yes 2= N/A

E5 If the inputs were not readily available, where did you bought your inputs from?

.....

E6 Were the inputs price affordable? 0 =No 1 =Yes

E7 If no, what should be done to improve affordability of inputs?

.....

E8 Did you access your inputs for the 2010/11 on time?

0 = No 1=Yes

E9 If no, why? .....

E10 Do you agree that availability of credit facilities can improve your access to farming inputs?

0= Not agree 1 = Agree 2 = Strongly agree

E11 Do you have access to credit facilities?

0 =No 1 =Yes

Section F : Conventional Farming (Maize Plot))

F 1 What was the area planted to maize under conventional farming during the 2010/11 season in acres/ha? (*state whether hectares or acres)*

F2 What was the cost of land preparation on the conventional plot (*monetary value if any)*

F 3 For the following inputs, what amounts were applied during the 2010/11 season on the conventional plot?

Input	**Quantity used in kg**
Maize seed	
Manure	
Basal fertilizer	
Top dressing	

F4 What was the total quantity of labour used for the following farm activities during 2010/11 season on the conventional plot?

Activity	**Labour days per hectare**
Land preparation	
Manure application	
Planting	
Basal fertilizer application	
Top dressing application	
First weeding	
Second weeding	
Harvesting	

F 5 What was the total maize harvest realised from the conventional farming plot in 2010/11? (*State the number of bags and whether its 50kg bag or 90kg bag*)

.....

F 6 Which other crops were grown in the 2010/11 season?

Crop	**Area planted in 2010/11(*State whether Ha/acres)***	**Quantities Harvested (***State the number of bags and whether it's 50kg bag or 90kg bag)*
1.		
2.		
3.		
4.		

Section G: Household Food Security

G 1. Usually the household produces cereals to last how many months?	Months

G 2. Over the last five years, which years did the household produce enough cereals to last a consumption year
(0 = Did not produce enough, 1 = Produced enough)

2006/07	2007/08	2008/09	2009/10	2010/11

G3 If the household does not usually produce enough cereals to last a consumption year, what is the **main** reason?

1 = Non-availability/ non-affordability of seed, 2 = Non-availability/ non-affordability of fertiliser,

3 = Poor rainfall, 4 = Shortage of labour 5 = Lack of draught power 6 = Other, specify.....

G 4. During the years which the household did not produce enough, what was the major source of cereal?
0= Not applicable 1= Purchases 2=Casual Labour 3=Food aid (Govt) 4= Food aid (NGO) 5= Remittances and Gifts
6= Gold panning 7= Livestock sales 8= Black Smithing

Section H : Discontinuation with Conservation Farming

H 1 When did the household start practising conservation farming (digging planting basins/ ripper tines)(year)

H 2 What principles has the household been practising (Circle all that apply)
1=minimum soil disturbance (basins/ripper) 2= mulching/crop cover 3= crop rotation 4=Winter weeding

H 3 Who introduced CF to the household? ***(Circle all that apply)***

1 = NGO, 2 = Agritex , 3 = Other farmers, 4 = Other, specify

H 4 Was it introduced through technology only or technology with inputs.
1 = Technology only 2 = Technology with inputs

H 5 What was the major selection criterion for the input beneficiaries?
.....

H 6 When did the household discontinued conservation farming? (year)

H 7 Why did the household discontinued conservation farming?

1= No longer receiving inputs support from NGO 2 =No benefits 3= Labour intensive 4 = Other, Specify.....

H 8 In your now opinion, why did you discontinued conservation farming?
.....

H 9 Why did you practice conservation farming in the first place?
.....

H 10 What challenges were you facing concerning CF?
.....

H 11 What are the disadvantages of CF?
.....

H 12 What are the advantages of CF?

.....

H 13 What can be done to stop discontinuing with CF?

.....

H 14 What has happened to your seasonal labour requirements since you started CF practice?

.....

H 15 What are your perceptions on the sustainability of conservation farming?

.....

H 16 What has happened to the household income since you discontinued conservation farming?

.....

H 17 What has happened to the household's food security status since you discontinued CF?

.....

H 18 What is now the source of feed for your livestock/cattle in winter?

.....

H 19 How labour intensive is the process of collecting maize stalks and grass for ground cover?

1 = Low 2 =Average 3 = High 4 = Extremely high

The Sustainability of Conservation Farming in the Smallholder Farming Sector. A Case Study of Guruve Communal Areas in Zimbabwe			
3. Farmers who Never Practice Conservation Farming			
Section A: Site and Location			
A1 Province	**A2** District	**A3** Enumerator's name	**A4** Date
A5 Respondent Name	**A6** Village Name	**A7** Ward Name	**A8** Ward Number
A9. Total Arable Land (Hectares) (Owned + Accessed)			
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B1. What is the name of the HH Head?			
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B5a. Education level of household head 0=No school 1=Primary 2=Secondary 3=Tertiary 4= Vocational			
B5b. Number of people in the HH			

	Please write '0' if there are none	**Members aged 0-17 years**	**# of Members aged 18 -59**	**# of Members aged 60+**	
B6	Male				
B7	Female				
B8	Orphans *(one or both parents dead)*				
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4.Rippers		**9** Direct seeders	
5.Sprayers		**10**. Hand hoe	

Livestock Ownership (How many of each of the following animals does the household own or keep)

Asset	Total	Asset	Total
1.Cattle		**4**.Goats	
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Section E: Sources of Inputs

E1. During the 2010/2011 season, what were the household's <u>main</u> sources of inputs for the following crops (one source per input type)

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Maize	
Sorghum	
Groundnuts	
Cotton	
Tobacco	
Paprika	
Cowpeas	
Millets	
Basal Fertiliser	
Top Dressing Fertiliser	

E2. Did the household ever received inputs from NGOs during the last three seasons? 0 = No , 1 = Yes

E3. If yes, in which year/s did the household received inputs from the NGO?
0= Inputs not received over the past three seasons 1 = 2008/09 2 = 2009/10 3 = 2010/11 4= 2008/09 and 2009/10 5= 2008/09 and 2010/11 6 = 2009/10 and 2010/11 7 = All three season

E4.If source of inputs was through purchase, was the market for inputs readily available? 0 = No 1 =Yes 2= N/A

E5 If the inputs were not readily available, where did you bought your inputs from?

.....

E6 Were the inputs price affordable? 0 =No 1 =Yes

E7 If no, what should be done to improve affordability of inputs?

.....

E8 Did you access your inputs for the 2010/11 on time?

0 = No 1=Yes

E9 If no, why?

.....

E10 Do you agree that availability of credit facilities can improve your access to farming inputs?

0= Not agree 1 = Agree 2 = Strongly agree

E11 Do you have access to credit facilities?

0 =No 1 =Yes

Section F : Conventional Farming (Maize Plot))

F 1 What was the area planted to maize under conventional farming during the 2010/11 season in acres/ha? (*state whether hectares or acres)*

F2 What was the cost of land preparation on the conventional plot (*monetary value if any)*

F 3 For the following inputs, what amounts were applied during the 2010/11 season on the conventional plot?

Input	**Quantity used in kg**
Maize seed	
Manure	
Basal fertilizer	
Top dressing	

F 5 What was the total maize harvest realised from the conventional farming plot in 2010/11? (*State the number of bags and whether its 50kg bag or 90kg bag*).....

F 6 Which other crops were grown in the 2010/11 season?

Crop	**Area planted in 2010/11(*State whether Ha/acres)***	**Quantities Harvested (***State the number of bags and whether it's 50kg bag or 90kg bag)*
1.		
2.		
3.		
4.		

Section G: Household Food Security

G 1. Usually the household produces cereals to last how many months? | Months

G 2. Over the last five years, which years did the household produce enough cereals to last a consumption year

(0 = Did not produce enough, 1 = Produced enough)

2006/07	2007/08	2008/09	2009/10	2010/11

G3 If the household does not usually produce enough cereals to last a consumption year, what is the **main** reason?
1 = Non-availability/ non-affordability of seed, 2 = Non-availability/ non-affordability of fertiliser,
3 = Poor rainfall, 4 = Shortage of labour 5 = Lack of draught power 6 = Other,
specify.....

G 4. During the years which the household did not produce enough, what was the major source of cereal?
0= Not applicable 1= Purchases 2=Casual Labour 3=Food aid (Govt) 4= Food aid (NGO) 5= Remittances and Gifts 6= Gold panning 7= Livestock sales 8= Black Smithing

Section E : Conservation Farming

H1 Did the household ever practice conservation farming (digging planting basins/ ripper line)?
0 = No 1 =Yes

H 2 Why did the household never practise conservation farming?
1= Never received inputs support from NGO 2 =No benefits 3= Labour intensive 4 = Never received extension on CF

H3 In your now opinion, why did you never ever practice conservation farming?
.....

H4 What was the major selection criterion for the input beneficiaries by supporting organizations?
.....

H5 What are the socio-economic characteristics of those households practicing CF?
.....

H6 What do you think are the challenges/disadvantages of CF?
.....

H 7 What are the advantages of CF?
.....

H 8 What should be done to facilitate uptake of CF?
.....

H9 What are your perceptions on the sustainability of conservation farming?
.....

H10 Is CF being adopted by non beneficiaries? 0 = No 1 = Yes
H11 If yes, why?
.....

H 13 How do you compare your household food security status with those practicing conservation farming?
.....

H14 What is now the source of feed for your livestock/cattle in winter?
.....

H15 How labour intensive is the process of collecting maize stalks and grass for ground cover?
1 = Low 2 =Average 3 = High 4 = Extremely high

The End