Determinants of Adoption of Conservation Agriculture by Communal Farmers in Masvingo District, Zimbabwe.

BY

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DEDICATION

I dedicate this dissertation to my late parents Heaviest Mazodze and Anna-Colleta Chinyengetere Mazodze and to my lovely wife Berita Katsande Mazodze.
ACKNOWLEDGEMENTS

Various individuals and organizations contributed immensely for this whole piece of work to be a success story.

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ABSTRACT

Conservation agriculture has been advocated as a viable practice to improve productivity, food security and poverty alleviation among communal farm households in Zimbabwe. Previous empirical studies have shown that, despite its documented benefits, the adoption rates of conservation agriculture by communal farmers have been rather mixed. This has raised a question of whether it matters “who and how” promoters target in promoting conservation agriculture. This paper uses a logit model to investigate the determinants of adoption of conservation agricultural practices by communal farm households in Masvingo district. The marginal effects results showed that conservation agriculture in Masvingo District has most been adopted by young female farmers. Further determinants of adoption found to be significant are awareness and access to information and extension services, household size, membership to local organisations and farming experience. The significance of estimation results is that it matters who and how promoters target in creating the “awareness effect” and in dissemination of information about this technology. The study thus enables us to add further empirical evidence and insights towards understanding the factors that affect communal farmers’ adoption decisions. This will assist both promoters and policy makers to devise appropriate interventions if higher incremental adoption rates are to be achieved.
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<thead>
<tr>
<th>ACRONYM</th>
<th>FULL NAME</th>
</tr>
</thead>
<tbody>
<tr>
<td>AGRITEX</td>
<td>Agricultural Technical and Extension Services</td>
</tr>
<tr>
<td>AI</td>
<td>Agricultural intensification</td>
</tr>
<tr>
<td>AIDS</td>
<td>Acquired Immune-Deficiency Syndrome</td>
</tr>
<tr>
<td>AREX</td>
<td>Agricultural Research and Extension</td>
</tr>
<tr>
<td>BEAM</td>
<td>Basic Education Assistance Module</td>
</tr>
<tr>
<td>CA</td>
<td>Conservation agriculture</td>
</tr>
<tr>
<td>CADEC</td>
<td>Catholic Development Commission</td>
</tr>
<tr>
<td>CIMMYT</td>
<td>International Maize and Wheat Improvement Centre</td>
</tr>
<tr>
<td>CSO</td>
<td>Central Statistical Office</td>
</tr>
<tr>
<td>DFID</td>
<td>Department for International Development</td>
</tr>
<tr>
<td>FAO</td>
<td>Food and Agricultural Organisation</td>
</tr>
<tr>
<td>HIV</td>
<td>Human Immune Deficiency Virus</td>
</tr>
<tr>
<td>ICRISAT</td>
<td>International Crop Research Institute for Semi-Arid Tropics</td>
</tr>
<tr>
<td>NGOs</td>
<td>Non Governmental Organisations</td>
</tr>
<tr>
<td>UN</td>
<td>United Nations</td>
</tr>
<tr>
<td>ZCATF</td>
<td>Zimbabwe Conservation Agriculture Taskforce</td>
</tr>
</tbody>
</table>
CHAPTER ONE
INTRODUCTION AND BACKGROUND

1.0 Introduction

This dissertation investigates the determinants of adoption of conservation agriculture by communal farmers in Masvingo South District of Masvingo Province in Zimbabwe. Conservation agriculture is being promoted as a vehicle for poverty alleviation and improvement in food security. It has been regarded by its promoters as a viable option for smallholder farmers in Zimbabwe. The ministry of Agriculture, Mechanisation and Irrigation Development has since hailed the importance of conservation agriculture to that effect. (Sunday Mail, 16 June 2012.). Minister Joseph Made reported that farmers in communal areas are producing in marginal areas and have little resources but they are the ones contributing towards food security. He said that since independence, communal farmers have been the major producers of the country’s grain. Former white commercial farmers mainly grew cash crops like tobacco, paprika, cut flowers and cotton, while growing yellow maize for stock feed, leaving cereal production largely the preserve of communal farmers. The need to improve crop production in communal areas necessitated the introduction and subsequent adoption of conservation agriculture. However, the adoption of conservation agriculture is still perceived to be low in communal areas. (Agricultural Technical and Extension Services (AGRITEX, 2011)

Conservation agriculture is defined by the Food and Agricultural Organization (FAO) and the United Nations (UN) as “a concept of resource saving agricultural crop production that strives to achieve acceptable profits together with high and sustainable production levels while concurrently conserving the environment.” The FAO and the UN determined that conservation agriculture has three key principles.

The first principle is zero tillage. This is where farmers are encouraged to plant their seeds without tilling the land to maintain minerals within the soil. No till farming practice can save soil organic levels for a longer period of time, and still allows the soil to be productive for longer periods of time (FAO, 2007) and thus conserving the environment. However, “minimum soil disturbance” can be applied as sometimes some primary cultivation is required for weed
control, mulch management and seed bed preparation. Minimum and no tillage can be used alternatively, depending on conditions which will vary from field to field (Edward Faulkner, 1945), but either way its cost saving.

The second key principle of conservation agriculture is **mulching** which help in managing the top soil to create a permanent organic soil cover (mulch) that can allow for growth of organisms within the soil structure. The layer that is built over time helps in keeping temperature low and moisture at a higher level than if it was tilled every year. The breakdown of the mulch over time will also produce a high organic matter level which will act as a fertilizer for the soil. This will be beneficial especially to poor communal farmers who may not afford chemical fertilizers.

The third key principle of conservation agriculture is **crop rotation** which involves more than two crop species. According to an article, “The Role of Conservation Agriculture and Sustainable Agriculture” by Hobbs et al (2007), crop rotation can be used best as a disease control which helps to avoid yield reduction against other preferred crops (Hobbs et al 2007). This system of crop rotation minimizes the chances of pests such as insects and weeds setting into a rotation with specific crops. Conservation agriculture is also an effective way of conserving the environment especially in communal areas where the environment is threatened by degradation in the face of climate change.

It is on the background of the perceived benefits of conservation agriculture that the past decade has witnessed a number of conservation farming methods being introduced in Zimbabwe which however are yet to be fully adopted. Conservation agriculture offers an opportunity for poor vulnerable households with no access to draught power to produce more grain per unit area than households with full draught power and even if rainfall is below normal, farmers will be better off (Steve Twomlow and Levis, 2006). Climate change that is being experienced is threatening the food security situation especially for the vulnerable poor communal people. Therefore adaptation measures to climate change must be taken as main concern in Zimbabwe for ensuring the food security of communal residents whose income is mainly from agriculture. In this regard, conservation agriculture should be adopted to combat the adverse impact of climate change.
In conclusion, it is the potential ability of conservation agriculture as an economically viable and environmentally friendly practice to significantly increase crop yields and reduce crop production costs that make it an important technology to be adopted in Zimbabwe.

1.1 Background

Agricultural production of communal farmers has been generally declining in Zimbabwe for the past two decades due to the combined adverse impact of changes in climatic conditions and use of less innovative agricultural practices. The food insecurity situation has been coupled with considerable land degradation thus causing both humanitarian and environmental problems that require the adoption of farming methods which are productive and environmentally friendly. Several initiatives have been carried out in Zimbabwe in an attempt to address these challenges and some of these initiatives were centered on conservation agriculture.

Conservation agriculture has been gaining popularity all over the world over the past three decades. It is now applied on about 95 million hectares (Derpsch, 2005). Together with other organizations and stakeholders FAO has been promoting and introducing conservation agriculture in several countries in Latin America, Africa and Asia so that farmers adopt it and improve food security.

1.1.1 Conservation agriculture in Zimbabwe

Conservation agriculture was introduced in Zimbabwe as a panacea for ending hunger in drought prone areas. Since its inception conservation agriculture has boosted crop productivity for those who adopted it and the system has widely been accepted as a sustainable farming practice.

The number of local farmers practicing conservation agriculture has been increasing tremendously from just over 5000 in 2003 to more than 350 000 in 2012 although some dis- adoption has been witnessed. FAO estimated that the farmers are using about 150 000 hectares farm land for conservation agriculture and that about 130 000 of these farmers were implementing conservation agriculture without any input support. Zimbabwe is targeting 500 000 farmers to practice conservation agriculture on over 250 000 hectares by 2015. (FAO, 2012)
1.1.2 The Zimbabwean Conservation Agriculture Taskforce and Initiatives

In 2003, a task force called the Zimbabwe Conservation Agriculture Task Force (ZCATF) was formed with a mandate to promote conservation agriculture in Zimbabwe. The task force involved donor organizations, non-governmental organisations (NGOs), International Maize and Wheat Improvement Centre (CIMMYT), International Crop Research Institute for Semi-Arid Tropics (ICRISAT), FAO and the Department for Agricultural Research and Extension (AREX). The initial focus of the task force was to support relief initiatives in the promotion of the “Vulnerable Households Package”, a conservation agriculture package meant for households who are always prone to food insecurity and for farmers with financial and labour constraints. The specific activities of the ZCATF included monitoring and dissemination of information on conservation agriculture activities in Zimbabwe, offering advice to all stakeholders including government agencies, donors and NGOs on conservation agriculture development activities in the country, monitoring and supporting conservation agriculture training opportunities in Zimbabwe, advocating and monitoring conservation agriculture related research and studies including farmer and stakeholder survey and providing a link for stakeholders with and between national, regional and international networks. All organisations implementing conservation agriculture activities were encouraged to provide the taskforce with information on their respective conservation agriculture activities and results. These agents were mandated to participate in the taskforce mainly to foster speedy adoption of conservation agriculture depending on the natural farming region (Table 1).
Table 1: CA cropping packages recommended for natural farming regions in Zimbabwe

<table>
<thead>
<tr>
<th>Natural region</th>
<th>Rainfall(mm)</th>
<th>Rainfall characteristics</th>
<th>Cropped area</th>
<th>Crops/rotation</th>
</tr>
</thead>
<tbody>
<tr>
<td>II</td>
<td>650 to 800</td>
<td>Good distribution</td>
<td>3 x 0.25 ha</td>
<td>Maize-cotton-legume(groundnuts/soya beans)</td>
</tr>
<tr>
<td>III</td>
<td>650</td>
<td>30 to 40 rainy days</td>
<td>3 x 0.25 ha</td>
<td>Maize-cotton-legume(groundnuts/cowpea/soya beans)</td>
</tr>
<tr>
<td>IV</td>
<td>500 to 650</td>
<td>30 rainy days</td>
<td>3 x 0.25 ha</td>
<td>Maize/sorghum/Pearl millet/groundnut/cowpea/cotton/sunflower</td>
</tr>
<tr>
<td>V</td>
<td>Less than 500</td>
<td>16 to 30 rainy days</td>
<td></td>
<td>Sorghum/pearl millet/maize/ Groundnut/cowpea</td>
</tr>
</tbody>
</table>

Source: Adapted from an open access journal published by ICRRISAT, Bulawayo, Zimbabwe (2007)

1.1.3 Conservation agriculture in Masvingo District, Zimbabwe

Masvingo district is an area under Masvingo Province, which is to the south of Zimbabwe. The district has a population of approximately 219 872 people (CSO 2002). The people are mostly rural communal farmers. A large part is drought prone, set as natural region IV in Zimbabwe’s agro-ecological regions. Rainfall is erratic, unreliable and unevenly distributed ranging from 450mm in the south to 300mm in the north and is spread between November and April. The area is prone to periodic seasonal droughts and severe dry spells during the rainy season. Temperature ranges from about 15°C in winter to 30°C in summer. Despite aridness, the residents rely on crop
farming and practise animal husbandry to supplement their diet. Of the main food crops grown, there is maize, soya beans, sorghum and rapoko. Agricultural output in the area has been declining, making most households food insecure.

Conservation agriculture in Masvingo district was formally introduced in 2004 by a non-governmental organisation called CARE ZIMBABWE and was aimed at achieving a set of higher grain yields and sustained improvement in food security. In 2008, conservation agriculture saw an increase in adoption after FAO partnered the already existing CARE under CARE-FAO with the objective to bail the rural communal farmers out of the poverty cycle. Its focus was on Conservation agriculture training to AGRITEX, lead farmers, mentored farmers and adopter farmers. Demo plots were set up in 15 wards (11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 22, 24, 25, 26, and 27) with each demo plot serving about 200 farmers. The theme of the CARE-FAO project is “Extension and promotion for upscaling of CA in support of CA training and coordination activities in the districts of Masvingo, Zaka, Chivi and Bikita of Masvingo province”. The objective was to make sure that at least 70% of target households will increase their household livelihoods and food situation beyond protection level\(^1\) by 2012. This would help to reduce their dependency on humanitarian support resulting in enhanced self food sufficiency. The CARE-FAO association would contribute to the achievement of the objective alongside other government, donor funded and private enterprise initiatives in the four districts. CA techniques were meant to significantly increase productivity of smallholder farmers, while bolstering their resilience to climatic changes and preserving natural resources.

CA as introduced in Masvingo District involves farmers first clearing the lands using hoes to remove weeds instead of ploughs or tractors which damage soil structure. This is done in winter between May and June. The farmers then dig planting basins. These are holes dug in weed free field into which a crop is planted. The basins are prepared before the onset of rains mostly between July and October. Recommended dimensions of the basins are 15 cm depth, 15 cm width and 15 cm length. After the first effective rains when the basins have captured rainwater and drained naturally, seeds are placed in each basin and covered with soil. The basins help to

\(^{1}\)Level of food availability where a household can withstand medium to long term food shocks.
capture water from the first rains of the growing season and enable precise application of both organic and inorganic fertilizer as it is applied directly into the pit.

In the dry season soon after harvesting, crop residues are used to cover the soil surface. The residue must provide at least 30% of soil cover. This mulch help to keep soil temperature low and reduce evaporation thereby helping to conserve moisture. It also suppresses weeds through shading and mulch breakdown help to improve soil fertility.

Soil fertility amendments are also made soon after land preparation in the dry season. Application of both organic and inorganic fertilizers is recommended as they complement each other. Organic manure is usually applied at the rate of one handful per basin. Just before the onset of the rains, inorganic basal fertilizer is applied into the basins. Between three to six weeks after the emergency of sown crops, nitrogen fertiliser is applied (top dressing). This top dressing is done after the first weeding. The fertiliser is applied in the basins rather than broadcasting to ensure that the nutrients are precisely available for the crop. Timely weeding is practiced to control weeds. This is done by weeding when the weeds are too small to prevent them from setting seed.

The crops are rotated from one growing season to another, with a cereal-legume rotation the mostly preferred. Crop rotation helps to control weeds, pests and diseases and improve soil fertility. (CARE-FAO database 2012)

Although statistics showing the yield comparison between conventional agriculture and conservation agriculture could not be obtained for Masvingo district for this study, the benefits of adopting CA has been well realized as in all areas where CA has been adopted. Reference can be made to national statistics over a three year farming period (2005 to 2007 inclusive) for which data is available from a national wide system of 0.2 hectare plots. The statistics showed that conservation agriculture yields had consistently increased by an average of 15 to 300% (Fig 1) in more than 15 000 farm households, with the yield increase varying by rainfall regime, soil type and soil fertility. (FAO 2008)

2 The CARE-FAO project was also responsible for the supply of inputs like seeds and fertilisers to selected farmers until when they become self-sufficient
Most farmers who have so far adopted conservation agriculture have not yet abandoned conventional agriculture perhaps because of risk aversion. However, the figures presented have shown that conservation agriculture has higher yields than conventional agriculture therefore giving a strong argument for adoption by communal farmers in order to reduce their food insecurity.

In light of the practices of conservation agriculture, there are potential challenges which can act as constraints to adoption. It can be deduced that there is need for long term planning, management and commitment to sustainability. Trade offs are necessary and extra costs may be incurred in the earlier years. Herbicides and special machinery are needed in most conservation agriculture systems. Conservation agriculture systems are dynamic and calls for innovation and continuous improvement. Weed, insect and fertiliser management are required for successful conservation farming and it takes time to develop these skills. It might be the long term planning and commitment to sustainability, commitment to learning and developing a system,
management skills, the understanding of soil, plant and animal interaction and specialised or modified machinery required which act as reasons for low adoption and dis-adoption of conservation agriculture by farmers despite its highlighted benefits. It is argued that technology transfer effort in Sub-Saharan Africa is still limited to on farm demonstration trials and the current level of adoption of conservation agriculture in Sub Saharan Africa, particularly Zimbabwe is far less than the potential level of adoption (Gowing and Palmer, 2008)

1.2 Statement of the problem

Conservation agriculture is beneficial especially on its potential ability to increase agricultural productivity in small scale communal farming while concurrently conserving the deteriorating environment in the eve of climate change as explained earlier. The findings by AGRITEX, different conservation agriculture taskforces, NGOs and other researchers indicated that the level of adoption of conservation agriculture is still low. Output of maize, sorghum and other grain crops which supplement diet in communal areas of Zimbabwe is declining and largely attributed to the reluctance by farmers to implement innovative farm practices (DFID, 2009). This is inconsistent with the vision to have conservation agriculture as a poverty alleviation strategy to improve food security among poor households. More and more efforts are being done by conservation agriculture agents and the government of Zimbabwe to ensure full adoption of conservation agriculture practices but a large number of communal farmers are still practicing conventional agriculture. The environment is deteriorating, and this call for new agriculture technologies like conservation agriculture to avert the negative effects yet the now available technology (conservation agriculture) is being slowly adopted. It is yet to be adequately established how conservation agriculture should be effectively diffused. Does it matter who and how promoters target in creating the “awareness effect” and in dissemination of information about this technology?
1.3 Objectives of the study

The overall aim of this study is to identify the determinants of adoption of conservation agriculture by communal farmers in Masvingo district.

The specific objectives are:

- To identify household level characteristics of communal farmers in Masvingo District, Zimbabwe which significantly influence their adoption of conservation agriculture.
- To identify farm level and institutional factors which significantly influence the use of conservation agriculture innovations in Masvingo District, Zimbabwe.

1.4 Research questions

The key questions that this study attempts to address are:

- What factors are critical for adoption of conservation agriculture by communal farmers in Masvingo District?
  - Which individual farmer attributes act as incentives for the adoption of conservation agriculture by communal farmers in Masvingo District?
  - Which farm level and institutional factors affect adoption of conservation agriculture by communal farmers in Masvingo District?

1.5 Hypothesis of the study

The study is based on the following hypothesis:

- Access to extension, farm land size, size of household, age of the household head and farming experience positively influence the adoption of conservation agriculture.
- Level of education of the farmer, gender, membership to farmer organisations and access to off farm income increases the likelihood of farmers adopting conservation agriculture.
1.6. Justification and significance of the study

The communal farmers in Masvingo District contribute significantly to the food security situation of Zimbabwe. Their participation and involvement in conservation farming innovations is therefore essential to ensure that they generate sustainable yields. The identification and understanding of factors that could act as incentives for their involvement in Conservation agriculture is inevitably critical. It is worthwhile to determine and have an insight into the actual factors that would play a role on the farmers’ choice of adoption of conservation agriculture. Equally important is the realisation that even the government has partnered with other change agents to spread the message of conservation agriculture innovations in the country in order to improve food security. Considerable funds have been committed by the government towards agriculture against the backdrop of a tight fiscus. Improvement of rate of adoption of conservation agriculture and appropriate channeling of funds can only be made if critical factors affecting adoption of the practice are exposed. Otherwise there would be unnecessary financial expenditures and wasted human resources effort that could be avoided.

A better understanding of factors that would condition adoption and possibly restrict adoption of conservation agriculture will help in the formulation of well tailored interventions that would result in rationalisation of the scarce physical, financial and human resources that the nation most require for use in other sectors of the economy. Furthermore, the speed of adoption can be easily accelerated, something which will help the country to achieve the UN Millennium Development Goal on food security by 2015.

The study is based on Masvingo district, Masvingo province, Zimbabwe, an area under natural farming region IV where rainfall is less reliable. This is one area with vulnerable households as far as food security is concerned. The area fits well under “The Vulnerable Households Package” which is the main target of the Protracted Humanitarian Relief Initiative. The rate of diffusion of conservation agriculture in this area is relatively low and there is still more to be done to ensure incremental adoption. The adverse effects of climate change have also been felt in this area through reduced yields and there are a lot of environmental concerns that can be reduced through
increased uptake of conservation agriculture. Therefore, Masvingo district is a relevant area of study.

1.7 Organisation of the rest of the study

Chapter 2 presents both theoretical and empirical literature review. Chapter 3 focuses on the methods and procedures of how the study was conducted. Chapter 4 presents the descriptive statistical analysis of the data, followed by the econometric estimation and interpretation of the results. Chapter five presents a summary of the study’s findings and the policy implications.
CHAPTER TWO
LITERATURE REVIEW

2.0 Introduction

In this chapter both theoretical and empirical literature on factors affecting adoption of conservation innovations is reviewed. Theoretical literature review will focus on farm level characteristics and individual level characteristics and technology specific attributes affecting adoption and uptake of conservation innovations. These factors are embedded in theories on adoption and diffusion of conservation innovations which will be considered. On the other hand, empirical literature review will focus on research work that has been done on factors that influence adoption and diffusion of conservation innovations.

2.1 Theoretical literature review

Conservation farming practices’ adoption is a multi-dimensional process. A number of factors potentially can affect farmers’ willingness to adopt conservation agriculture practices. It is important to establish a theoretical base to model the relationship between factors affecting adoption of conservation agriculture and adoption status of conservation agriculture. The model chosen will dictate the form of the data that need to be gathered and its usefulness for further research in this area. Since farmers are rational consumers of agricultural innovations, they are conceptualised to choose innovation packages that give maximum utility. However, it is important to understand cognitive and behavioural factors that influence adoption decision to provide a backup to economic models.

Cognitive theories explain that adoption is like an action and is triggered through the uncomfortable tension which comes from holding the conflicting thoughts in the mind at the same time. A farmer will have to choose between continuing with old conventional methods of farming or start using new methods. Internal state factors such as motivation, problem solving, decision making and thinking and attention will become critical on the adoption decision. Behavioural theories are based on the idea that adoption is a behaviour which is acquired through conditioning. It helps adopters to learn new skills and behaviour. Adoption theories in agriculture
innovations try to conceptualise the social dimensions of knowledge, information, communication ability and rationality. They provide useful links in helping economic models to explain adoption decisions and to capture complexity of farmers’ attitudes and behaviour.

Theory of Behaviour Modification (Albrecht et al 1987) summarises forces which influence adoption of conservation innovations into inhibiting forces which negatively influence behavioural change (adoption of conservation agriculture). These factors include lack of subsidies, limited finance for labour hiring and buying herbicides and other essentials, lack of machinery and limited knowledge. Driving forces are forces conducive for positive target (adoption of conservation agriculture). These factors include financial assistance, technical advice, training, provision of inputs and linkage with outlets among others. Lastly behaviour (adoption) is seen as resulting from the psychological field of inhibiting and driving forces.

However, the theory ignored environmental factors which are very important in the farmers’ decisions on the farming method to use and crops to grow. This is a major setback of Albrecht’s theory in explaining the possible reasons of the rate of adoption of conservation technology. Their assertion though is as important as Rodgers’ Innovation Diffusion Theory which is considered by many adoption researchers as one of the most appropriate for investigating adoption of innovations. According to Rodgers (2003), an innovation is an idea, practice, or project that is perceived as new by an individual or other unit of adoption. An innovation may have been invented a long time ago, but if individuals perceive it as new, then it may still be an innovation for them.

One main obstacle to adoption of innovation is uncertainty. Potential adopters usually may not be quite aware of the consequences of adopting an innovation. To reduce uncertainty, individuals should be informed about the advantages and disadvantages of an innovation so that they are well aware of the consequences. This forms a very useful idea that is also derived from behavioural factors that adoption is a behaviour which depends on such factors as communication effectiveness, risk and uncertainty involved and expected benefits. Communication channels are very important in the diffusion of an innovation. The social system of adopters also plays an important role in adoption of innovations. Since diffusion of innovations takes place in the social system, it is influenced by the social structure of the social
system. Therefore the way how individual interact in a social system may affect diffusion of innovations. However, the level of interaction needed is not clearly specified since the interaction required in adoption of farming techniques is just through workshops and field visits.

To increase the rate of adoption of innovation which according to Rodgers (2003) is the relative speed with which an innovation is adopted by the members of a social system, the innovation must have certain attributes which are relative advantage, compatibility, complexity, trialability, and observability. Relative advantage is the degree to which an innovation is perceived than the idea it supersedes. According to Rodgers (2003), relative advantage is the strongest predictor of the rate of adoption of an innovation. If the perceived relative benefits of an innovation are high then the rate of adoption will also be high.

An innovation should be viewed as compatible. Rodgers (2003) defined compatibility as the degree to which an innovation is perceived as consistent with the existing values, past experience and needs of potential adopters. If an innovation is compatible with individuals needs, then uncertainty will decrease and the rate of adoption of the innovation will increase. An innovation should also have a clear meaning, and conservation agriculture has this trait. Complexity is defined as the degree to which an innovation is perceived as relatively difficult to understand and use (Rodgers, 2003). According to Rodgers, complexity, unlike other innovation attributes, is negatively correlated with the rate of adoption. Excessive complexity of an innovation is a serious hindrance to its adoption, and conservation agriculture cannot be taken as complex.

An innovation must also be triable, which is the degree to which an innovation may be experimented with on a limited basis. The more an innovation is tried, the faster its adoption and this might be the cause why farmers are not fully adopting the technology. They might still be waiting to see the full benefits or results of this new technology. Observability is another important attribute of an innovation that may affect its adoption. It is the degree to which results of an innovation are visible to others. Peer observation is a key motivational factor in the adoption and diffusion of innovations.

Rodgers, assertions are consistent with that of Albrecht et al(1987) and the Risk Aversion theory in that emphasis is put on the expected benefits of the technology, farmers’ attitude and
behaviour, risks expected as explained by the Risk Aversion theory and the attributes of the technology itself. All these factors are no doubt possessed by conservation agriculture and are useful in analyzing the reasons why the rate of adoption of this seemingly beneficial technology is still low. However, exogenous factors such as climate change and farmers’ characteristics were less emphasized in these theories.

Feder and Umali (1993) showed that risk aversion is an important factor explaining adoption of a technology package. Fafchamps (1999) emphasises that risk aversion is an excellent explanation for the adoption of technology by poor small scale communal farmers especially in cases of significant climatic and environmental constraints. Farmers tend to be risk averse. Farmers with limited assets, and own small pieces of land with limited financial capacity are exposed to severe risks and are inclined to adopt less risky components of the agricultural innovations. The “Safety First” approach (Lipton, 1968), shows that small farmers will use less of the specific technology per hectare because their subsistence requirements per hectare are higher than those of farmers with larger farms. The small farmers are reluctant to undertake “experimental farming” and so they take time to adopt new agricultural innovations. Adopting agricultural innovations gradually therefore minimises risk. The effect of uncertainty can also be minimised by adopting innovations in a step wise fashion. According to Byerlee and Polanco (1986), farmers who adopt some of the components of a technology incur fewer costs rather than those who adopt the full package and the chance of earning higher returns will be high. However several studies have argued that conservation agriculture practices are highly complementary and farmers will not fully benefit from adopting only one practice.

2.2 Empirical literature review

A number of studies have been carried out in different contexts to determine the factors which influence the adoption of conservation agriculture practices. The studies range from national level, regional level and small scale level. It is important to review those studies in order to have a clear direction of the factors than can potentially affect adoption of conservation agriculture in this study.
In Kenya, Mutune et al (2007) used a logit model to determine factors which significantly affect adoption of conservation tillage in Mukueni District. Farming experience positively affected adoption of conservation tillage. This is in line with the human capital theory that farmers become less risk averse as they gain more experience. Adeolla (2010) also found similar results in Nigeria although Mazvimaviet al (2008) and Lestrelinet al (2011) found experience to be insignificant in the adoption of CA. This results in an inconclusive result since other scholars like Twomlow (2008) found farmers experience to be insignificant in affecting adoption of CA. However, the measurement of experience is questionable since most communal farmers become more experienced as they grow older.

This implies that the effect of experience and age are likely to be correlated, but empirical findings show mixed results using different estimation procedures. Adeolla (2010), Lestrelinet al (2011), Asafu-Adjaye (2008) that advanced age increased the probability of adopting CA although Bonger (2001) had found that the young farmers are more flexible hence adapt quickly to new technologies than the old ones. However, Bonger’s study was done in Zimbabwe (a less economically developed country where adoption and adaptation is generally low) whereas Asafu-Adjaye’s (2008) study was done in Pacific Islands where the rate of adoption is higher. Mazvimavi and Twomlow (2008) found age and experience to be insignificant hence the need to ascertain their impact on the rate of adoption of CA.

Large households were found to be better placed to adopt conservation tillage than households with fewer members. This is because preparing the fields by removing weeds and digging basins is labour intensive. This was confirmed by Musaraet al (2012) in Madziva communal area in Zimbabwe, Mukueniet al (2007) in Kenya and Mutuneet al (2007). Thus household size is a key factor given the labour intensiveness of CA. However, some communal households may not depend on family labour but can also hire it depending on their financial stability and liquid assets ownership. This assertion was proved by Bonger (2001) Zimbabwe where household size and asset ownership were strongly correlated but slightly impacts positively on the speed of adoption of a technology. What is not certain is whether all the households members participate equally and are productive in the fields so that the big household size translates to availability of labour and hence adoption.
Some empirical studies found contact with service and technology promoters, education and training to be the most important factors that influence adoption of CA since these reduce the risk factor associated with partial or non-adoption of a technology. Bonger (2001), Chiputwa et al (2011) and Musara et al (2012) confirmed this in Zimbabwe’s communal areas of Shamva, Chinyika and Madziva respectively. This finding conforms to the propositions by the Risk Aversion theory, Rodgers and Albrecht et al’s (1987) theories. Most communal farmers in Zimbabwe who consistently receive extension service and are close to extension service centres quickly and fully adopt CA. Communal farmers who do not have adequate knowledge and do not receive expertise continue with their conventional agriculture practices and hence are reluctant to adopt CA. These results were also found in Nigeria by Adeolla in 2010. Moreso, Mukueni (2007) found similar results in Kenya showing the importance of training and access to service and technology promoters.

Other recent empirical findings in Africa showed unambiguous results about the effect of farm size on the rate of adoption. Bonger (2001), Chiputwa et al (2011) and Musara et al (2012) found that communal farmers with large farm sizes adopt CA than small land holders because those with large farm sizes can experiment CA and at the same time continuing with conventional practices to spread risk. However, the measurement of what is regarded as small or big farm size is ambiguous. New empirical evidence is necessary from these communal areas of Zimbabwe because of continued reduction in land sizes due land fragmentation and inheritance. Similarly, Brooks et al (2010) found that large farm owners in Northern Idaho and Eastern Washington adopt CA fully and faster than the communal areas. However, there might be other individual farmer characteristics which large farm owners have, and which differ significantly from the attributes of smallholder farmers but influencing adoption of CA.

These factors include access to credit and availability of off farm income. Raut et al (2011) found that commercial farmers have access to credit and are more organized to hire managers while they have more off farm income. This was regarded as collateral to large farmers hence can adopt new technologies. Off farm employment was found to positively affect adoption of conservation tillage. Farmers with off farm employment were more likely to adopt conservation tillage practices than those without. This is probably due to the fact that the presence of farm
employment is important in raising the opportunity cost of labour. However, in less economically developed nations such as Zimbabwe, access to credit is not a common feature to communal farmers and that these communal farmers only grow crops for family consumption with no any other sources of non- farm income. Thus, it remains to be seen on what factors significantly affect the adoption of CA in Zimbabwe’s communal areas.

Studies by Bonger (2001) and Adeolla (2010) found that many communal households are headed by women. Thus the level of education of women and the occupation of spouses play an important role in increasing the level of adoption. However, this could no longer be the scenario in Zimbabwe’s communal areas because most men are unemployed and rely on communal agriculture. Lestrelinet al(2011) found education and gender to be insignificant in affecting adoption of CA. In fact, Bonger (2001) found the attributes of the new technology itself determines whether risk averse communal farmers can adopt it or not. This is entirely a perception by the communal farmers.

In a study by Brooks et al (2010) in Northern Idaho and Eastern Washington, a survey of over 1500 farmers was conducted to examine conservation practices, attitudes and perceptions. An ordered logit model was used to predict the probability of adoption of each conservation practice and variables affecting farmers’ decisions to invest in those practices. The perceived effectiveness of the conservation practice and complexity had the greatest impact on adoption.

This finding is in line with the Risk Averse Theory which states that farmers who are more risk averse do not adopt seemingly complex and less beneficial new technologies. The current study is based in Zimbabwe, a tropical country where rainfall is generally low and less reliable. It is therefore possible that the findings in their research could be fitting to that particular area. An empirical test of variables that affect adoption of Conservation Agriculture locally would provide more reliable results. However the study remains an important guide on variables that warrant investigation in the current study.

At a national level, in Zimbabwe, Mazvimavi and Twomlow (2008) assessed the influence of socioeconomic and institutional factors on adoption of conservation farming. In this study, socio-economic factors played an important role in determining adoption of farm technology in
general. However this study was carried out particularly for resettled farmers. The decision making framework of resettled farmers may be different from that of rural communal farmers. Therefore although the study gives a good picture of factors that affect adoption of farm technology, it is important to carry out specific studies for specific types of farmers and for specific technologies to avoid generalisations of factors that affect adoption of farm technologies.

2.3 Conclusion

An overview of most literature on the determinants of conservation agriculture shows that factors like access to extension most likely positively affect adoption of conservation agriculture. However, factors like gender, education, off farm employment, experience and age among others can affect adoption of conservation agriculture either way. Most evidence provided by different empirical studies on determinants of CA adoption is therefore mixed. In addition the variables used in various studies cannot be generalised to affect adoption of conservation agriculture in all areas because of area specific differences. Therefore, both household and farm level characteristics, institutional and socioeconomic factors can affect adoption of conservation agriculture but there is a need to know and analyse the actual determinants of conservation agriculture in each specific area.
CHAPTER THREE

METHODOLOGY

3.1 Introduction

This chapter presents the methods and procedures applied in the study to identify the main factors that influence adoption of conservation agriculture in Masvingo District, Zimbabwe. Information concerning the study area and sampling procedures applied is presented first and then the empirical model to be estimated will follow.

3.2 Sources of Data

Data for this study is obtained from a survey carried out in Masvingo Distric, Masvingo Province in February 2013. Cross-sectional data from this area is obtained using structured questionnaires and personally administered interviews. The survey was carried out by the author and two research assistants. The necessary training, familiarisation of the study and provision of research facilities for the interviewers was done by the author. Personally administered interviews were used so that interviewer could lobby and motivate the respondents to provide accurate information. They also give the interviewer an opportunity to clarify some questions and explain the purpose of the interview to the respondents so that they can freely express themselves. The interviewer can also observe non-verbal gestures and derive meaningful links with verbal cues which help to improve the quality of information collected.

3.2.1 Study Area

Masvingo District is one of the seven administrative districts in Masvingo Province. It has a population of approximately 219,872 (CSO, 2002) who are mainly communal subsistence farmers. The district has 31 administrative wards with the majority of them in natural farming region IV and a few which are to the south in natural farming region V. The types of crops mainly grown there are maize, sorghum, rapoko, millet, groundnuts and round nuts. The varieties are short season and drought resistant. Horticultural crops grown include tomatoes and vegetables which help to supplement the diet. The district receives erratic, unreliable rainfall.
which is unevenly distributed, with the most rains occurring between November and April. A lot of rainfall is lost through water surface runoff, and this, together with poor farming practices, has resulted in low soil moisture thus low crop yields. To address this problem, conservation farming practices have been implemented in the district. CA promotion has been widely promoted in 15 wards as explained in 1.1.3

3.2.2 Sampling procedure and data collection

Both qualitative and quantitative data was collected using both primary and secondary sources in order to fully capture all the information necessary for this study and improve validity and reliability of findings. The study was carried out in ward 17 and 18 of Masvingo district out of the 15 wards in which CA has been widely promoted by FAO-CARE through demo plots. These two wards were randomly selected to ensure representativeness of the sample. Each ward would supply a proportionate number of respondents required in the sample for non adopters since adopters were many. A ward would supply a proportionate number of respondents based on the proportion of its population relative to the population of other wards. The population data was obtained from the 2012 Census Preliminary Report.

In the case of adopters, respondents in each ward would be selected purposively based on recommendations from local extension officers. The data gathered from the questionnaires include household socio-economic characteristics, farm level characteristics, institutional factors, agricultural and crop production details and farmers’ perceptions towards conservation agriculture.

The effectiveness and suitability of the questionnaire was tested in ward 19 as this was not among the selected wards for survey. The specific purpose of the pretesting was to check for questions which lacked clarity so that they can be corrected. Also pretesting would allow for corrections to be made on areas of the questionnaire which could reduce its ability to collect useful information. The pretesting exercise was done using six questionnaires and necessary adjustments were subsequently effected. These questionnaires were supported by discussions and observations. The recall method was used to collect information from respondents in cases where there are no farm records. AGRITEX and CARE-FAO offices provided most of the
secondary data. This data involve details of farmers who are known to practice conservation agriculture, details of donor funding towards conservation agriculture and other forms of support.

3.2.3 Sample size

A sampling frame of 80 farmers who have adopted conservation agriculture practices within the maize crop system was purposively sought from the farmers with the support of information from local non-governmental organizations and agricultural extension personnel. The sampling frame for the non-adopters was also 80 farmers. Thus, a total of 160 farmers were sampled and interviewed. This sample size fits the Roscoe (1975) criteria that for most research, a sample size of between 30 and 500 is appropriate and allows generalisations to be made to the study area. This is because a too small sample will not be representative while a too large sample may be too inconvenient to handle which reduce its efficiency.

3.2.4 Data Analysis Tools

The data was processed using SPSS and Stata computer programs for the purpose of statistical and econometric estimation.

3.3 Model Specification: The Logit Model

In econometrics literature, analysis of technology adoption had been frequently done using linear probability model, probit model, and the logit model. In this study, a logit model was be used. The dependant variable is taken as a binary choice variable, which takes a value of zero for non-adopters and one for adopters. This approach has been used by Mutune et al, (2011) and Adeola (2010). By using the logit model, marginal probability effects can be analysed from the regression. The model estimates the probability of a household having adopted conservation agriculture conditional upon a given set of explanatory variables.

The functional form of the model to be estimated is as follows:

\[ \text{CA adoption} = f (\text{age, gender, farming experience, education, access to extension, farm size, household size, membership to farmer organizations, number of livestock, off farm employment}) \]
The model specification is as follows:

\[ E(Y/X) = P = F(Z) = \alpha + \beta X + \mu. \]

Expectation of adoption (dependant variable Y) is a value P (probability of a household having adopted conservation agriculture) given a set of independent variables (X).

The model will be developed as follows;

\[ E(Y/X) = P = F(Z) = \alpha + \beta X + \mu. \]

\[
P(Y = 1/X) = \frac{1}{1 + e^{-z}}
= 1/[1 + e^{-(\alpha+\beta X+\mu)}]
\]

where \( P(Y = 1/X) \) is the conditional probability of a farmer being a Conservation Agriculture adopter given the values of independent variables (X); \( \alpha \) is a constant, \( \beta \) represents regression coefficients and \( \mu \) is the stochastic error term.

The logistic function above will be converted into a logit form by expressing it in terms of odds:

\[
(P/1-P) = e^z = e^{(\alpha \beta X+\mu)}
\]

In order to estimate the logit model, the dependent variable is transformed by taking natural logarithms of both sides to yield a log odds model:

\[
\ln(P/1-P) = Z = \alpha \beta X + \mu
\]

The marginal effects for the model are:

\[
\frac{\delta P}{\delta X} = \frac{\exp (z)}{1 + \exp (z)} \left( \frac{1}{1 + \exp (z)} \right) \beta
\]
3.4 Definition and justification of variables

The variables used in the study were identified and derived from adoption literature. The reviewed theoretical literature provided a conceptual framework of factors affecting adoption of conservation agriculture. The empirical literature reviewed also provided insight into factors which call for investigation as far as their influence on adoption of conservation agriculture is concerned.

3.4.1 Adoption status (ado)

Farmers’ conservation agriculture adoption status is the dependant variable in the model. It is a binary choice variable, taking the value of one if farmer has adopted conservation agriculture or zero otherwise. In this study, an adopter is identified as a farmer who had been using either zero tillage, mulching or crop rotation or both. A non-adopter is a farmer who had never used conservation farming practices and thus purely practiced conventional agriculture.

3.4.2 Age of household head (age)

This is a continuous variable which captures the age of the overall decision maker in a household. Age is hypothesized to positively increase the likelihood of adoption of conservation agriculture. Older farmers are more likely than their younger counterparts to be cognizant of and recognize the environmental benefits of conservation agriculture practices (Gould et al, 1989).

3.4.3 Education (edn)

This is a continuous variable which refers to the number of years of formal schooling by the household head. In this study, education is hypothesized to increase the probability of adoption of conservation agriculture. This is because educated farmers tend to be less risk averse and see change as critical for improvement and hence become less hesitant to try out new innovations. (Chuma et al, 1998). Educated farmers are better able to process information and search for appropriate innovations in the quest to mitigate their production constraints.
3.4.4 Gender (gen)

This refers to the sex of the household head. Gender is coded as a dummy variable where it takes value of one if the household head is male and zero if female. Male farmers are more likely to be able to provide the required labor input than their female counterparts who are sometimes involved in off farm occupations. Therefore, gender is hypothesized to increase the probability of adoption of conservation agriculture.

3.4.5 Farming experience (exp)

This is a continuous variable relating to the number of years the farmer has been in farming. Experienced farmers are more cognitive of conservational benefits and hence are more receptive to new innovations. Frank (1998) observed that individuals assess the utility of new practices by relating their perception of the practice to their experience. Consequently, years of farming experience and exposure are likely to aid adoption.

3.4.6 Access to extension (ext)

This is a continuous variable relating to the number of times a farmer has had contact with conservation agriculture promoters and extension officers. The respondents would be asked to recall or refer to farm records the number of times extension officers visited them for the purpose of helping them with information on conservation agriculture practices. According to Rodgers (2003), knowledge and awareness of a technology lead to its adoption. Without knowledge of practices associated with conservation agriculture through some information channels, adoption is improbable. Consequently, the degree of contact with extension officers would highly enhance adoption.

3.4.7 Farm size (fsize)

This a continuous variable measured as the size of land in hectares which is suitable for crop production. Farmers with a large acreage under crop production have a greater incentive to invest in conservation agriculture equipment\(^3\). Also, farmers with big farmlands may have extra land to

\(^3\)The indivisibility of equipment such as direct seeders and planters makes it economic to use the equipment on a large farm than a small farm (technical scale economies)
try new practices before they decide to switch from conventional practices (Risk Aversion Theory). Therefore, farm size is hypothesized to positively influence adoption of conservation agriculture.

3.4.8 Household size (hhldsize)

This is also a continuous variable measured as the number of full time family labor available for farming purposes. The household head would be asked to give the number of household members who help with labour in the fields. Smallholder farmers have a low propensity to hire labor outside their families because they are resource constrained. Hence, they rely on family labor for farm work. In the study area, family labor was scarce due to migration to urban areas and abroad. The quantity of family labor available is therefore hypothesized to have a positive influence on the adoption of conservation agriculture practices.

3.3.9 Membership to local organizations (mlo)

This variable is coded as a dummy variable where it takes the value of one if a farmer has membership to local organizations and zero otherwise. If a farmer has a history of respectable relationships with local welfare organisations such as CADEC, BEAM, Food for Work organisations and other donors this may positively influence adoption of innovation since information about CA may disseminate at meetings organized by such organisations. As people interact and socialize at gatherings, they may share information about new innovations which may influence its adoption. (Rogers Innovation Diffusion Theory, 2003)

3.3.10 Number of livestock : (lstock)

This variable is measured in terms of the number of cattle owned by a household. It is a continuous variable. Livestock number is commonly used as a measure of wealth in communal areas of Zimbabwe and the study area is no exception. Farmers with many livestock are in a better position to raise initial capital required to buy zero tillage equipment like direct seeders as well as herbicides for controlling weeds. They are also more likely to be able to buy external inputs such as chemical fertilisers and even to hire extra labour when necessary. The income
from the sale of livestock enables them to meet these costs. Therefore, having a large herd of cattle is expected to positively influence the adoption of CA.

3.3.11 Off farm employment (employ)

This is a dummy variable which takes a value of one if a household member is formally employed off farm and zero otherwise. Farmers who are involved in off farm and nonfarm activities have diversified sources of income which help them to buy conservation agriculture equipment. (FAO, 1999). Moreover, involvement in off farm activities results in less variances of total income. Off farm income aids on the acquisition of complex farm technology and good quality inputs which results in increased farm productivity. Off farm employment is therefore expected to increase the probability of household adopting conservation agriculture.
CHAPTER FOUR  
ESTIMATION AND INTERPRETATION OF RESULTS

4.0 Introduction

This chapter focuses on estimation and interpretation of the empirical findings of the research study. Out of a target sample of 160 households, 23 questionnaires could not be successfully completed. Accordingly, 143 questionnaires were successfully completed. The data was entered in Excel and the econometric estimation of the model done using Stata v10.

4.1 Descriptive Statistics

This section provides a descriptive analysis of the sample socio-economic characteristics. The analysis helps to suggest possible statistical relationships between the explanatory variable and adoption of CA.

<table>
<thead>
<tr>
<th>Adoption status</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non adopters</td>
<td>73</td>
<td>51.05%</td>
</tr>
<tr>
<td>Adopters</td>
<td>70</td>
<td>48.95%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>143</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

Table 2 above shows that out of 143 sampled households, 73 had not adopted CA and this represents 51.05% of the sample. 70 households had adopted CA and this represents 48.95% of the sample. A lot of meaningful effort has to be put to achieve incremental adoption of CA since the level of adoption is still low as adopters had to be purposefully sought for the sample.
### Table 3: Summary statistics for the continuous variables

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Non adopters</td>
<td>adopters</td>
</tr>
<tr>
<td>age</td>
<td>41</td>
<td>41</td>
</tr>
<tr>
<td>hhldsize</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>livestock</td>
<td>8</td>
<td>6</td>
</tr>
<tr>
<td>ext</td>
<td>8</td>
<td>21</td>
</tr>
<tr>
<td>exp</td>
<td>16</td>
<td>25</td>
</tr>
<tr>
<td>fsize</td>
<td>0.3</td>
<td>0.6</td>
</tr>
<tr>
<td>edn</td>
<td>13</td>
<td>13</td>
</tr>
</tbody>
</table>

The mean age for both adopters and non adopters was 41 years. The minimum and maximum ages of sampled households were 18 and 88, respectively. The mean age of adopters is the same as that of non adopters which may imply that age may have little influence on adoption of CA. The mean household size for adopters is 6 members while the mean household size for non adopters is 3. The lowest household size of all households sampled is 2 while the maximum is 9. The difference between the household size means shows that bigger households are more likely to adopt CA than smaller households. The highest number of livestock per head is 30, while some households do not have livestock at all. The mean livestock per household for adopters is 8, while that for non adopters is 6. The differences between the means may suggest that having few livestock may be positively associated with adoption of CA. The table also shows that mean number of extension visits for the past 3 years on the part of non-adopters is 8 times while for adopters its 21 times. The minimum number of extension visits is 0 and the maximum is 36.
difference between the two means may imply that households with more access to extension are the ones who may be better placed to adopt CA. The mean for experience is 16 years for non adopters and 25 years for adopters. The minimum household head farming experience is 2 and the maximum is 50 years. The difference between the average years of experience for adopters and non adopters is suggestive of a positive relationship between experience and adoption of CA. Household farm land sizes ranges from a minimum of 0.1 units (0.4 hectares) to a maximum of 1 unit (4 hectares) per household. The mean household farm size for non adopters is 0.3 units (1.2 hectares) while that for adopters is 0.6 units (2.4 hectares). The difference between the farm size averages may suggest that households with large farmland are in a better position to adopt conservation agriculture. The minimum number of years of formal schooling is 7 years while the maximum years of formal schooling is 18 years. This shows that all the respondents had at least completed the primary level of education. The average years of formal schooling are approximately 13 years for both adopters and non adopters. The similarity of the two means for adopters and non adopters seems to suggest that education of household head have no significant impact on adoption of CA.

Table 4.2 Distribution of sample by adoption status and gender of household head.

<table>
<thead>
<tr>
<th>Adoption status</th>
<th>Female</th>
<th>Male</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non adopters</td>
<td>18</td>
<td>55</td>
<td>73</td>
</tr>
<tr>
<td>Adopters</td>
<td>50</td>
<td>20</td>
<td>70</td>
</tr>
<tr>
<td>Total</td>
<td>68</td>
<td>75</td>
<td>143</td>
</tr>
<tr>
<td>Percentage</td>
<td>47.6</td>
<td>52.4</td>
<td>100</td>
</tr>
</tbody>
</table>

Table 4.2 shows that, out of 143 sampled households, 68 were female headed which represents 47.6% of the sample. Male headed household were 75 which represent 52.4% of the sample. Out of the 68 women headed households captured in the sample, 50 (73.5%) had adopted CA while 18 (26.5%) had not. On the other hand, out of the 75 male headed households included in the sample, only 20 (26.7%) had adopted CA while 55 (73.3%) had not. This implies that men
havenot well accepted CA. Therefore, being a male farmer may have a negative association with adoption of CA.

Table 5: Distribution of sample by adoption status and off farm employment status

<table>
<thead>
<tr>
<th>Adoption status</th>
<th>Not employed</th>
<th>Employed</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non adopters</td>
<td>37 (50.7%)</td>
<td>36 (49.3%)</td>
<td>73 (100%)</td>
</tr>
<tr>
<td>Adopters</td>
<td>48 (68.6%)</td>
<td>22 (31.4%)</td>
<td>70 (100%)</td>
</tr>
<tr>
<td>Total</td>
<td>85 (59.4%)</td>
<td>58 (40.6%)</td>
<td>143 (100%)</td>
</tr>
</tbody>
</table>

From table 5 above, 58 households have off farm employment while 85 do not(40.6% and 59.4%, respectively). However, out of the 85 households with heads with no off farm employment, 48 (68.2%) had adopted CA while 37 (31.8%) had not. On the other hand, out of the 58 households whose heads have off farm employment, 22 (37.9%) had adopted CA while 36 (62.1%) had not. The figures show that most CA adopters have no off farm employment while most farmers who have off farm employment are non adopters. These statistics are suggestive of a negative relationship between presence of off farm employment and adoption of CA.
Table 6: Distribution of sample by adoption status and membership to local organisations

<table>
<thead>
<tr>
<th>Adoption status</th>
<th>Non members</th>
<th>members</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non adopters</td>
<td>40(54.8%)</td>
<td>33(45.2%)</td>
<td>73(100%)</td>
</tr>
<tr>
<td>Adopters</td>
<td>29(41.4%)</td>
<td>41(58.6%)</td>
<td>70(100%)</td>
</tr>
<tr>
<td>Total</td>
<td>69(48.3%)</td>
<td>74(51.7%)</td>
<td>143(100%)</td>
</tr>
</tbody>
</table>

From the above table (6), 74 household heads belong to at least one local organisation while 69 do not associate with any local organisations. These figures transform into 51.7% for households with membership to a local organisation and 48.3% for those without. Out of the 69(48.3%) household heads who did not belong to a local organisation, 29(41.4%) had adopted CA while 40(54.8%) had not adopted. On the hand, out of the 74(51.7%) households whose heads has membership to local organisations, 41(58.6%) had adopted CA while 33(45.2%) had not. The table shows that more of the adopters belonged to a local organisation and they may have obtained information about CA. On the other hand, more of the non adopters did not belong to a local organisation and this may have limited their chances of learning more of CA from others. These statistics are suggestive of a positive association between membership to local organisations and adoption of CA.

The descriptive statistics presented in the above section has suggested possible relationships between the different explanatory variables and adoption of CA. The succeeding section presents diagnostic tests that have to be done to pave way for econometric estimation. The regression results may or may not prove the possible relationships suggested by the descriptive statistical analysis.
4.2 Diagnostic tests

Before econometrically estimating the regression model, the data is tested to check that variables are not correlated (multicollinearity) and to check if the regression model is correctly specified.

4.2.1 Multicollinearity Test Results

Variables are correlated if the correlation statistic between two variables is more than 0.8 or less than -0.8 (Barnes et al., 1978). To test for multicollinearity, Pearson’s correlation test was carried out for all the variables in the unrestricted model. The correlation statistics were all within the intervals -0.8 to 0.8 showing that there was low correlation between the variables in the model. (See Appendix 2)

4.2.2 RESET Test

A model miss-specification test was carried out to check whether the model is correctly specified. The model does not show any evidence of miss-specification (See Appendix 3). The Chi-squared statistic for the test is 0.09 with a p-value of 0.7637. This p-value is above the conventional levels of significant that is 1%, 5% and 10% which shows that the model is correctly specified.

4.2.3 Heteroskedasticity Test

Error terms in probability models should have a constant variance. Breusch-Pagan / Cook-Weisberg test was carried out on all variables in the unrestricted model to check for heteroskedasticity. There was no evidence of heteroscedasticity (See Appendix 4). The Chi-squared statistic for the test is 0.01 with a p-value of 0.9035. This p-value is above the conventional levels of significance that are 1%, 5% and 10% which shows that there is homoskedasticity.
### 4.3 Discussion of Unrestricted Logit Model Results

#### Table 7: Regression results for the unrestricted model

(11 vars, 143 obs pasted into editor)

```
.logit ado gen age hhldsizelstock employ extexpfsizemloedc
```

<table>
<thead>
<tr>
<th>Iteration</th>
<th>log likelihood</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>-99.088576</td>
</tr>
<tr>
<td>1</td>
<td>-38.663872</td>
</tr>
<tr>
<td>3</td>
<td>-26.147203</td>
</tr>
<tr>
<td>4</td>
<td>-21.011981</td>
</tr>
<tr>
<td>5</td>
<td>-19.179953</td>
</tr>
<tr>
<td>6</td>
<td>-18.691949</td>
</tr>
<tr>
<td>7</td>
<td>-18.629398</td>
</tr>
<tr>
<td>8</td>
<td>-18.628092</td>
</tr>
</tbody>
</table>

Logistics regression

- Number of obs= 143
- LR Chi 2 (10) = 160.92
- Prob> chi 2 = 0.0000

Log likelihood = -18.628092

| ado   | Coef.   | Std. Error | z      | p>|z|   | [95% Conf. Interval] |
|-------|---------|------------|--------|-------|----------------------|
| gen   | -2.16045| 1.092429   | -1.98  | 0.04  | -4.30157 -0.0193288  |
| age   | -1.14701| .0603002   | -2.44  | 0.015 | -2.651962 -0.288237  |
| hhldsize | 1.712166| .5373663   | 3.19   | 0.001 | .658947 2.765384    |
| lstock |-.1702571| .1453972   | -1.17  | 0.242 | -.4552305 .1147163  |
| employ |-.4891514| 1.524239   | -.32   | 0.748 | -3.476605 2.498302  |
| ext   | .3017015 | .0838178   | 3.600  | .000  | .1374216 .4659813   |
| exp   | .20892  | .0794236   | 2.63   | 0.009 | .00532527 .3645873  |
| fsize | 2.5049642| .536617    | .99    | 0.323 | -2.467301 7.477229  |
| mlo   | -.40085311| .797865   | -2.230 | .026  | -7.532282 -.4847809 |
| edc   | .1670685 | .211164    | .790   | .429  | -2.468054 .5809423  |
| cons  | -9.050619| 4.160639   | -2.18  | 0.030 | -17.20532 -.8959169 |
From the estimated unrestricted model the results shows that number of livestock of household, employment status of household head, level of education of the household head and household farm size were insignificant as far as adoption of conservation agriculture is concerned. These insignificant variables were therefore dropped and a new regression on the remaining variables showed gender of household head, age of household head, household size, number of extension visits, years of farming experience of household head and household head’s membership to local farmer organizations significantly affect adoption of conservation agriculture. These significant variables were the independent variables in the restricted model.

**Table 8: Regression results for the restricted logit model**

| Variable | Coef.   | Std. Err | z     | P>|z| | [95% Conf. Interval] |
|----------|---------|----------|-------|------|----------------------|
| gender** | -2.047797 | 0.8839665 | -2.32 | 0.021 | -3.78034 -0.3152546 |
| age***   | -0.1479067 | 0.0535115 | -2.76 | 0.006 | -0.2527873 -0.0430262 |
| hldsize*** | 1.554315 | 0.3994378 | 3.89 | 0.000 | 0.7714311 2.337199 |
| ext***   | 0.2809382 | 0.0680779 | 4.13 | 0.000 | 0.147508 0.4143684 |
| exp***   | 0.2179477 | 0.0733297 | 2.97 | 0.003 | 0.0742242 0.3616712 |
| mlo**    | -2.561903 | 1.10613 | -2.32 | 0.021 | -4.729878 -0.3939289 |
| cons***  | -7.063258 | 2.418758 | -2.92 | 0.003 | -11.80394 -2.32258 |

***, ***, * means significant at 1%, 5% and 10% levels of significance respectively
4.4 Post Estimation Diagnostic Tests

The restricted model results above show that the model converged and iterations stopped at a level where the Log likelihood was equivalent to -20.364766 which confirms the appropriateness of the model for the study. The p-value was 0.0000 which is significant at 1% and the LR Chi-Square statistic was 157.45 with six degrees of freedom. We therefore accept the alternative hypothesis that at least one of the regression coefficients in the model is not equal to zero. The McFadden’s pseudo R-squared which measures the goodness of fit was found to be 0.7945 which is more than zero showing that the model correctly predicts each observation.

4.5 Marginal Effects Results

Marginal effects from the restricted model were computed to show the quantitative effects that the significant variables have on the adoption of CA among households.

Table 9: Marginal effects Results

Marginal effects after logit \( y = \Pr \text{ (ado) (predict)} = .51501597 \)

| Variable | dy/dx   | Standard error | z    | P>|z|  | Mean    |
|----------|---------|----------------|------|------|---------|
| gen      | -0.4703508 | 0.1706         | -2.76 | 0.006 | 0.524476 |
| age      | -0.0369433 | 0.01342        | -2.75 | 0.006 | 41.1888  |
| hhldsize | 0.3882282 | 0.09902        | 3.92  | 0.000 | 4.59441  |
| ext      | 0.0701712 | 0.0169         | 4.15  | 0.000 | 14.5175  |
| exp      | 0.0544378 | 0.01129        | 2.30  | 0.003 | 20.1678  |
| mlo      | -0.5641669 | 0.01839        | 2.96  | 0.002 | 0.517483 |

(*) dy/dx is for discrete change of dummy variable from 0 to 1
4.5.1 Factors affecting adoption of conservation agriculture: Interpretation of the marginal effects results

Gender of household head (gen)

The gender of the household head is one of the factors that significantly affect adoption of conservation agriculture by rural communal farmers. It has a p-value of 0.06 thus is statistically significant at 1%. The coefficient for gender was negative and the marginal effects results shows that being a man decreases the probability of adoption of conservation agriculture by 47%. The main reason why women seems to be the ones who have accepted conservation agriculture in Masvingo District is that CA is being promoted among vulnerable households who are most likely to be female headed. These findings are in contrast with those of researchers like Mazvimavi and Twomlow (2008) and Chiputwa (2011) who found that male farmers are more likely to adopt conservation agriculture. This difference may be attributed to differences in the extensiveness of conservation agriculture in the different areas. In Masvingo district, CA is still very limited to the most vulnerable and poor households.

Age of household head (age)

Age of household head was also found to be a significant factor that affects the adoption of conservation agriculture. The p-value for age was 0.006 which shows that it is significant at all conventional levels. The coefficient for age is negative and using the marginal effects results, a one year increase in the age of the household head decrease the probability of that household adopting conservation agriculture by approximately 4%. These results are consistent with Musara et al (2012) who found out that age of the farmer negatively affects adoption of conservation farming practices. This may be because of the general belief that older farmers have shorter planning horizons and hence are more reluctant to invest in innovations whose benefits are medium and long term. Young farmers have longer planning horizons and they are curious to try out new innovations that would result in change of fortunes in the livelihoods.
Household size (hhldsize)

The number of members of a household who provide farm labour was also found to affect adoption of conservation agriculture. From the marginal effects model, this variable had a p-value of 0.000 and a positive coefficient. This shows that the size of household positively affect adoption of conservation agriculture. The variable is significant at all conventional levels. Hence, households with more members are better placed to adopt conservation agriculture than households with fewer members. The marginal effects results reveal that each additional household member increases the probability of household adopting conservation agriculture by approximately 39%. These results are consistent with Musara et al (2012) who also found a positive relationship between household size and adoption of conservation agriculture. These findings may be because conservation farming practices are labour intensive. Preparing the fields by removing weeds and digging planting basins is time consuming and therefore requires more labour.

Access to extension (ext)

As expected from literature, the number of extension visits for a household was found to positively affect adoption of conservation agriculture. The p-value from the marginal effects results was 0.000 which shows that the variable was significant at 1%. The coefficient for the variable was positive. At the mean score, a unit increase in contact with extension services increase the probability of adopting conservation agriculture by 7%. These findings were consistent with most empirical literature. It is also consistent with Rodgers Innovation Diffusion Theory which says that communication channels are very important in the diffusion and adoption of an innovation. With access to extension, farmers would get technical backing in terms of information, farm demonstrations and inputs. Extension services also help to create awareness to farmers on the benefits of adopting conservation farming practices.

Experience (exp)

Years of farming experience were found to positively affect adoption of conservation agriculture. As hypothesized the coefficient for experience was positive and significant at all conventional levels with a p-value of 0.003. This implies that as farmers gain more experience, their decisions
Towards adoption of CA are influenced positively (Adesina and Zinnah, 1993). The marginal effect shows that a one year increase in farming experience increases the probability of adopting conservation agriculture by 5%. These findings are consistent with the Risk Aversion Theory which says that farmers become less risk averse as they gain more experience. The results are also consistent with Mutune et al (2007). Experienced farmers may be more cognitive of the benefits of innovations in farming methods and hence would be more receptive to new innovations.

Membership to local farmer organisations (mlo)

Contrary to most literature, membership to local organizations was found to negatively affect farmers’ decisions to adopt conservation agriculture. The coefficient of this variable was negative and significant at 1%, with a p-value of 0.002. The marginal effects show that membership by a household to at least one local farmer organisation decrease the chance of adopting conservation agriculture. A plausible explanation of this relationship may be that not all local farmer organisations promote the adoption of conservation agriculture. This result is consistent with qualitative data gathered in the study that only CARE, a local NGO, in conjunction with FAO is actively involved in promoting CA in Masvingo district. The possible explanation why belonging to local organisations negatively affect adoption of CA is that some local organisations maybe helping farmers in different ways to ensure that they are food secure and that act as a security and safety valve to farmers as those farmers will see no reason to adopt conservation agriculture.
5.0 Introduction

The aim of this chapter is to sum up the purpose of this study and its findings. Also, a proposal of the policy implications will be made which will be followed by an outline of areas that may need further research.

5.1 Summary of the main findings

This study examined factors that influence the adoption of conservation agriculture in Masvingo District. The research was stimulated by the desire to identify socio-economic factors that affect the adoption of conservation agriculture by rural communal farmers in Masvingo District. These smallholder farmers were the target of the study because they are more severely affected by food shortages and often are trapped in a vicious cycle of perpetuating poverty. Cross-sectional data was used and it was obtained from a survey through the use of personally administered questionnaires. The data was collected in the month of February 2013. The study used a logistic regression to identify the significant variables which influence farmers’ decisions to adopt conservation agriculture.

The dependent variable was binary and a value of one was assigned if a household had adopted one or more components of conservation agriculture and a value zero was assigned if a household had never practiced conservation agriculture. The results showed that gender of the household head, age of the household head, household size, access to extension, farming experience of the household head and household membership to local organisations significantly affect farmers’ decisions to adopt conservation agriculture. Gender, age and membership to local organisations had a negative relationship with adoption of CA while household size, access to extension and farming experience had positive relationships with adoption of CA. Level of education of household head, off-farm employment status of household head, number of
livestock a household had and farm size were found to be insignificant in determining adoption of conservation agriculture.

5.2 Policy Implications

Understanding these factors facilitate a targeted approach in promoting use of conservation agriculture practices in order to enhance agricultural productivity in rural areas and alleviate poverty. Therefore, these factors should be incorporated in the design of policies and strategies developed to promote the use of conservation agriculture practices. Household size was found to positively influence farmers’ decisions to adopt conservation agriculture. Since CA activities are labour intensive, it is important for CA promoters to target bigger households who can provide the labour required to work in the fields. This sound sensible especially that rural households can hardly hire labour because of financial constraints and thus rely on family labour, so if a household has say few members it may prove very difficult for them to adopt a labour intensive farming method like CA.

It also came out from the study that most CA adopters in Masvingo District are women. Therefore, in order to rationalize scarce resources CA promoters should first target young women. These young women are enthusiastic to be successful farmers by being up to date with new innovations in order to reduce property in their families. So promoters should use these women as ‘role models’ by supporting them with inputs and facilities for them to achieve high yields. Then their male counterparts will be attracted into practicing CA by seeing the difference in yields between their traditional farming practices and CA.

Extension providers and promoters were found to enhance the confidence of farmers in adopting conservation agriculture through farm demonstrations and workshops. Direct contact with extension services providers and organizations promoting CA provided information and technical backup on to farmers on CA. Therefore, extension services and demonstration exercises as done in some wards could be intensified among farmers to achieve incremental adoption.
Experienced farmers were found to be more cognitive of the benefits of conservation agriculture in this study. It is therefore recommended that the government and other CA promoters target people or households who have been in farming for some time who understand what it means to conserve the field for continued sustainable farm productivity. These experienced farmers will portray a better picture of CA in their respective areas resulting in others being attracted to join them.

Also recommended is for CA promoters to engage local organizations and work together in supporting incremental adoption of conservation agriculture rather than having different agendas. If mutual understanding is achieved between such organizations like CARE, FAO, AGRITEX, CARITAS⁴, BEAM, CADEC (and others who may be working in the area) to work towards one goal of enhancing CA adoption then CA would achieve incremental adoption.

5.3 Limitations of the Study and Suggestions for further research

This research covers only Masvingo District, which is only one district out of several districts in Masvingo Province. Although some studies may have been done elsewhere more research need to be carried out in other areas so that the determinants of adoption of conservation agriculture can comprehensively be determined.

⁴CARITAS is not an acronym. The name is taken directly from the Latin word “caritas”, meaning love and compassion. It is the name of a confederation of 162 charities and associated organisations, all associated with the Catholic Church. (wikianswers.com)
BIBLIOGRAPHY


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G.N.Chomba (2004), Factors affecting smallholder farmers’ adoption of soil and water conservation practices in Zambia. Department of Agriculture Economics, Michigan State University, USA.


APPENDIX 1: QUESTIONNAIRE

UNIVERSITY OF ZIMBABWE

FACULTY OF SOCIAL STUDIES

DEPARTMENT OF ECONOMICS

DETERMINANTS OF ADOPTION OF CONSERVATION AGRICULTURE IN MASVINGO DISTRICT, MASVINGO PROVINCE, ZIMBABWE.

Household Survey Questionnaire:

Code________ Ward________ adopter_____________ non adopter_________

Village__________ Date of Interview_________________

HOUSEHOLD CHARACTERISTICS

Respondent:

1  What is the gender of the household head? [1]___Male [2] ______ Female

2  What is the age of the household head? __________Years

3  Marital status of household head?
   (i)____Married (ii) ___Single (iii) ___ Divorced (iv) ___Widowed

4  Fill in the table below about household composition:

<table>
<thead>
<tr>
<th>Code of household member</th>
<th>Sex</th>
<th>Age</th>
<th>Level of education</th>
<th>Occupation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
5 How many of the above assist with farm labour? ......................................................
6 Does the household have permanent employees who assist with farm labour?
7 If answer on (6) is yes what is the number of those employees? .........................
8 How much is the average monthly salary of each employee.................................
9 Do you sometimes hire in labour to supplement farm labour? [1].......Yes [2].....No
10 if yes on (9), how many times on average do you hire in labour in one season?.................
11 How much do you spent on hired labour on average per season? .........................
12 Do you sometimes hire out labour to supplement farm income [1].......Yes [2].....No
13 if yes on (12), how many times on average do you hire out labour in one season?.................
14 How much do you earn on hired labour on average per season? .........................
15 What is the highest level of education of the household head? ________
   (i) _____ Primary (ii) _____ ZJC
   (iii) _____O’ level (iv) _____A’ level (v) Tertiary ..............................
   (vi) Other Specify ____________________________
16 did the household head receive any formal or vocational qualification in farming
   [1]....Yes [2]....No
17 If the answer is yes on (16) what is the nature of the qualification (i) certificate
   (ii) diploma (iii) degree (iv) short course (v) workshop
## B HOUSEHOLD ASSETS, INCOME AND WEALTH

### Livestock endowments:

<table>
<thead>
<tr>
<th>Livestock</th>
<th>Cattle</th>
<th>Goats</th>
<th>Sheep</th>
<th>Chicken</th>
<th>Donkeys</th>
<th>Pigs</th>
<th>Other (specify)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>08/09</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>09/10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10/11</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No. sold:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>08/09</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>09/10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10/11</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sales ($)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>08/09</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>09/10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10/11</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### ASSETS:

<table>
<thead>
<tr>
<th>Type of assets and implements</th>
<th>Numbers</th>
<th>Value of assets</th>
</tr>
</thead>
<tbody>
<tr>
<td>BrickHouse</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tractor</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Car</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Item</td>
<td>Quantity</td>
<td></td>
</tr>
<tr>
<td>--------------</td>
<td>----------</td>
<td></td>
</tr>
<tr>
<td>Plough</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cultivator</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scotch cart</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seed planter</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shovels</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hoe</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Harrow</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Axe</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pick/mattock</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bicycle</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other 1</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

19. Is the household head formally employed off farm? [1]----Yes [2] --------- No
20. If the answer is yes on (19), how much income is earned per month? --------------------
22. If the answer is yes on (21), specify the source of income ........................................
23. If the answer is yes on (21), how much income is earned per month? --------------------
25. How many are those members? ...............................
26. How much income on average, do they remit to the household per month? ....................

C AGRICULTURE AND CROP PRODUCTION
27. What is the size of your total farm land? ...........................................hectares.
28. What is the size of your total farm land under crop production? -------------- hectares.

29. Do you think your farm land can produce enough yield for family consumption without chemical fertilisers? (1) Yes (2) No


31. What is the average cost of inputs per season per hectare under:
   (i) Conventional agriculture
   (ii) Conservation agriculture

32. How many years have you been in farming as an adult? ________ years

33. What is your own understanding of conservation agriculture?
   ..................................................................................................................................................
   ..................................................................................................................................................
   ..................................................................................................................................................

34. Which conservation agriculture practise do you specifically practice?
   (i) Crop rotation (ii) zero tillage (iii) mulching
   (iv) other

35. Fill in the table below about the hectarage under conventional and conservation agriculture and the respective yields per hectare

<table>
<thead>
<tr>
<th>Crop</th>
<th>Conservation Agriculture</th>
<th>Hectarage</th>
<th>Yield/hectare</th>
<th>Hectarage</th>
<th>Yield/hectare</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>08/09</td>
<td>09/10</td>
<td>10/11</td>
<td>08/09</td>
</tr>
<tr>
<td>Maize</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sorghum</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Millet</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cotton</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

66
36 When did you first hear about Conservation Agriculture? (Specify year) ......................

37 When did you first practice Conservation agriculture? (Specify year) .........................

38 For how long have you been practising conservation agriculture? ------------------- years.

39 How did you first hear about Conservation agriculture? ..........................................

40 From whom did you hear about it? .................................................................

41 What do you think are the advantages of conservation agriculture to conventional agriculture?
   (i) .................................................................................................................................
   (ii) .................................................................................................................................
   (iii) .................................................................................................................................
   (iv) .................................................................................................................................
   (v) .................................................................................................................................

42 Do you find conservation agriculture challenging as compared to conventional agriculture? [1]........Yes [2]........No.

   What are the major problems /challenges you face in practicing CA as compared to conventional agriculture?
   (i) .................................................................................................................................
   (ii) .................................................................................................................................
   (iii) .................................................................................................................................

Fill in the table below

<table>
<thead>
<tr>
<th>Crop</th>
<th>Farm consumption(kg) by season</th>
<th>Sales(kg) by season</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>08/09 09/10 10/11</td>
<td>08/09 09/10 10/11</td>
</tr>
<tr>
<td>Maize</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sorghum</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Millet</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cotton</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wheat</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rapoko</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Groundnuts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Others(specify)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

D  ACCESS TO INFORMATION AND CREDIT.

Who initiated you into practising conservation agriculture? (i) donor(s) (ii) neighbours (iii) extension officials

Did you receive any agricultural support during the 2011/2012 season [1] ----YES
47 What type of agricultural support? (i) input credit (ii) contract growing
48 Who provided the agricultural support? (i) local bank (ii) NGOs (iii) microfinance institution (iv) government institutions (v) individual (vi) private company (vii) other
49 What do you consider as barriers to accessing agricultural support? (Circle all that apply)
(i) Lack of knowledge on where to get it (ii) lack of collateral (ii) Unavailability of agricultural contractors (iv) I don’t know (v) other
50 What is your major source of agricultural extension services? (i) AGRITEX (ii) NGO (iii) contracting company (iii) other (specify)
51 In the last four years how many times did extension officers visit you for the purpose of helping with information on farming?---------times.
52 What services do you receive from AGRITEX? (Circle all that apply)
(i) Facilitate input support (ii) advice on crop production
53 Which of the following organisations are you affiliated to?
a) Agritex
b) 
c) 
d) 
e) Other  
54 Have you received any form of farmer training for which you hold any proof (eg master farming certificate)? [1] ----YES [2] ------NO.
55 Who provided the training? (i) Government (ii) NGO (iii) volunteer group (iv) other
56 Do you attend such important farmers’ events such as field days? [1] ------YES [2] -- ----NO.
Have you ever faced financial complications in your farming operations [1]........Yes [2]...........No.

Have you ever obtained credit from a bank or any financial institution? [1].........yes [2]........No.

APPENDIX 2: CORRELATION MATRIX FOR CA ADOPTION STATUS

```
correlate ado gen age hhldsize lstock employ ext exp fsize mlo edc
(obs=143)
```

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<th></th>
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<th>gen</th>
<th>age</th>
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<th>lstock</th>
<th>employ</th>
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APPENDIX 3: RESET TEST RESULTS

```
predict yf,xb
.gen yf2=yf^2
.quietly logitgen age hhldsize lstock employ ext exp fsize mlo edc yf2
.test yf2=0
```

Results:

(1) [gen] yf2 = 0
APPENDIX 4: HETEROSKEDASTICITY TEST RESULTS

.hetest

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity

Ho: Constant variance

Variables: fitted values of ado

\[
\text{chi2}(1) \quad = \quad 0.01
\]

\[
\text{Prob} > \text{chi2} \quad = \quad 0.9035
\]
APPENDIX 5: LOGIT REGRESSION FOR THE UNRESTRICTED MODEL

```
. edit
(11 vars, 143 obs pasted into editor)

. logit ado gen age hhldsize lstock employ ext exp fsize mlo edc
```

| ado     | Coef.   | Std. Err. | z     | P>|z|   | [95% Conf. Interval] |
|---------|---------|-----------|-------|-------|---------------------|
| gen     | -2.16045| 1.092429  | -1.98 | 0.048 | -4.30157            |
| age     | -0.14701| 0.0603002 | -2.44 | 0.015 | -0.2651962          |
| hhldsize| 1.712166| 0.5373663 | 3.19  | 0.001 | 0.658947            |
| lstock  | -1.702571| 1.453972  | -1.17 | 0.242 | -4.552305           |
| employ  | -0.489154| 1.524239  | -0.32 | 0.748 | -3.476605           |
| ext     | 0.3017015| 0.0831878 | 3.60  | 0.000 | 0.1374216           |
| exp     | 0.20892 | 0.0794236 | 2.63  | 0.009 | 0.0532527           |
| fsize   | 2.504964| 2.536917  | 0.99  | 0.323 | -2.467301           |
| mlo     | -4.008531| 1.797865  | -2.23 | 0.026 | -7.332828           |
| edc     | 0.1670685| 0.211164  | 0.79  | 0.429 | -0.2468054          |
| _cons   | -9.050619| 4.160639  | -2.18 | 0.030 | -17.20532           |

Log likelihood = -18.628092
Number of obs = 143
LR chi2(10) = 160.92
Prob > chi2 = 0.0000
Pseudo R2 = 0.8120

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