EVALUATING THE EFFECT OF EXTENSION TECHNIQUES ON THE ADOPTION OF CONSERVATION AGRICULTURE IN SEMI ARID COMMUNAL WARDS 8, 10, 11 AND 19 OF SHURUGWI DISTRICT IN MIDLANDS PROVINCE, ZIMBABWE

By

Sipiwe Mabaya

A research project submitted in partial fulfilment of the requirements for the Bachelor Of Science General Degree in Natural Resources Management and Agriculture

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ABSTRACT

A survey was carried out to evaluate the effect of extension techniques on the adoption of conservation agriculture. This was done through determining the effect of farmers' knowledge and challenges they face in practicing conservation agriculture in a bid to increase adoption of conservation agriculture. Literature was gathered on conservation agriculture and extension techniques from books, internet, journals and periodicals. Primary data was collected from communal areas of Shurugwi district where conservation agriculture was being practiced.

Four out of ten wards were selected using stratified random sampling method with the wards as strata. The selected wards had a total of 945 farmers practicing conservation agriculture. Only 11% (105) of these farmers were selected as a sample. The data was collected using structured questionnaire and focused group discussions. The data were analysed using SPSS version 20. Chi-Square test was used to test association between variables. The variables tested were knowledge against adoption and extension methods against knowledge. The results showed that knowledge of farmers has significant effect on the adoption of conservation agriculture. They also highlighted that extension methods used to disseminate information have a significant effect on knowledge of the farmers. However the results showed that extension methods do not affect the adoption of CA. Therefore, the study concluded that besides extension methods there are many other factors that influence the adoption of CA among which are challenges of mulch gathering, basin digging and buying of fertilisers. It was thus recommended that farmers be provided with cheaper tools and machinery, use of manure and be encouraged to gather mulch in summer so that the challenges they face might be lessened. Further research is still needed on CA equipment that can be made locally. Further research needs to be done at district level so as to note the challenges faced by farmers in every district.

DEDICATION

This project is dedicated to my husband Nobert, my daughter Tinodaishe Panacea and my son Tawananyasha Ronald for their continued support throughout my studies even though they had to do with less financial resources during the whole period of my studies.

ACKNOWLEDGEMENT

I wish to acknowledge the assistance received from the following people and institution that made it possible for this research to be accomplished. My supervisor, Mr Sammie who tirelessly guided me throughout this research project; Mr Gwazane who assisted much in designing the questionnaire and analysis of the results. I also express my gratitude to all government personnel in the Ministry of Agriculture, Mechanisation and Irrigation Development for their unwavering support during data collection. Many thanks also go to my course mates, Mr Mudzinganyama, my husband Nobert and my family at large for assisting me throughout my research project.

DECLARATION OF PROJECT

I hereby declare that this dissertation has been a result of my own original efforts and investigations and that such work has not been presented anywhere for any academic purpose. All additional sources of information have been indicated by means of references.

Mabaya Sipiwe

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Date…….

CERTIFICATION OF THIS PROJECT WORK

I the undersigned, certify that Mabaya Sipiwe, a candidate for the degree of Bachelor of Science General Degree in Natural Resources Management and Agriculture has presented a project with the title:

Evaluating the effect of extension techniques on the adoption of conservation agriculture in Semi-Arid communal wards 8, 10, 11 and 19 of Shurugwi district in Midlands Province of Zimbabwe.

The dissertation is acceptable in form and content, and is a satisfactory display of the knowledge of the field covered.

Supervisor

Mr B. L. Sammie.

Signature……

TABLE OF CONTENTS

CONTENTS **PAGE**

CHAPTER 3 RESEARCH METHODOLOGY

CHAPTER 4 RESULTS AND DISCUSSION

CHAPTER 5 CONCLUSION AND RECOMMENDATIONS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

AGRITEX – Agriculture technical and extension services

CA – Conservation Agriculture

FACTA – Food, Agriculture, Conservation and Trade Act.

FAO – Food and Agriculture Organisation

FGDS- Focused group discussions

ICRISAT – International Crop Research Institute for Semi-arid Tropics.

NGOs – Non-government Organisations.

SPSS- Statistical Package for Social Scientists.

ZCATF - Zimbabwe Conservation Agriculture Task Force.

LIST OF APPENDICES

CHAPTER 1- INTRODUCTION

1.1 Background

Agriculture is the mainstay of many communal households in Africa. Marongwe *et al* (2012) highlighted that 70% of the Zimbabwean population depend on agriculture especially for employment and 75% of this rely on rain fed farming systems. However due to climate change, rainfall has become unreliable rendering communal agriculture unproductive (Eswaran, 1999).Therefore new technologies have since been discovered in order to reduce the effect of climate change. After analysing the trends of agriculture production in Sub-Saharan countries conservation agriculture (CA) among other technologies, was found to address the constraints faced by farmers (ZCATF, 2009).

CA describes any tillage sequence which minimises the loss of soil and water by leaving at least 30% of the crop residues as soil cover (Mazvimavi and Twomlow, 2009). CA addresses the problems of water loss and infiltration in soils in areas with little and erratic rainfall through permanent soil cover with mulch, (Marongwe *et al,* 2010). Food and Agricultural Organisation (FAO) introduced CA in Shurugwi district by providing farmers with free inputs (seeds and fertilizer). Having practised CA, a growing interest was developed by farmers in the conservation agriculture technology which has been indicated by an increase in yield of between 10-100%, (Mazvimavi *et al,* 2009). Farmers can get maximum benefits if they apply the key principles of conservation agriculture which are minimum soil disturbance, permanent soil cover with organic and crop residues and the use of rotations (Ngwira *et al,* 2014). Contrary to the CA principles of minimum soil disturbance and permanent soil cover, the people in Zimbabwe have been practising conventional farming that has led to excessive annual soil losses (ZCATF, 2009). This is caused by excessive runoff and poor infiltration of rain water.

Extension techniques play an important role in CA adoption. According to previous research by Kalineza *et al* (1999), farmers who obtained knowledge on soil conservation through extension are likely to adopt conservation technologies. CIRAD and AFD (2011) cited that any new innovation; success depends on training of local farmers by extension workers and integration of indigenous technical knowledge. ZCATF (2009) noted that although CA has

the potential to increase crop productivity, the absence of adequate extension materials has resulted in many farmers implementing incomplete CA packages.

CA was officially introduced in 2009 in Shurugwi district by FAO through Christian Care as an implementing agent and 10 wards have since implemented CA (Agritex; 2014). Extension workers were trained and these later trained farmers in the wards. The group method was used with the lead farmer and farm demonstrations as the techniques. However, since the official introduction of CA in the district farmers are being trained year after year but observations are that only a few have adopted. Therefore, there is a need for further studies on other aspects, besides lack of knowledge on CA; one such aspect is the extension techniques being used to promote CA in the district.

This study seeks to evaluate the effect of extension techniques used to facilitate adoption of CA in the semi-arid communal areas of Shurugwi district. The research endeavours to identify the relationship between extension techniques in use and adoption rate. This will identify weaknesses in the previous extension techniques and thus improve the adoption of CA and the benefits that accrue from there. Evaluation of these techniques shall also help stakeholders to choose suitable extension techniques that will enhance adoption of CA in the communal areas.

1.2 Problem Statement and justification of the study

Conservation Agriculture alleviates the effects of climate change in terms of better yields realised, timeliness in planting and saving of inputs (Marongwe *et al*, 2010). Ideally, when farmers are trained on a new technology they will adopt it. However, despite the fact that agriculture extension workers are training farmers persistently at ward level, the reality is that communal farmers are failing to adopt CA fully. If the farmers continue to get training but don't adopt CA this may result in wasted resources as well as food and livelihood insecurity. The lack of adoption might be due to the inadequacy of the extension techniques being currently employed to promote CA.

There is a global thrust to promote environmentally friendly farming techniques that enhances food and livelihood security, especially in the hunger stricken communal areas in the semi-arid regions of developing countries.

1.3 Objectives of the study

1.3.1 Main objective

To determine the effect of extension techniques on CA adoption.

1.3.2 Specific objectives

a) To determine the effect of farmer's knowledge on CA adoption.
b) To assess the effect of extension techniques on farmers' knowledge.
c) To determine the effect of resource challenges on CA practices.

1.4 Hypotheses

a_1 Knowledge of farmers has a significant effect on CA adoption

b_1 Extension techniques have a significant effect on CA adoption.

c_1 Resource challenges have a significant effect on CA adoption

CHAPTER 2- LITERATURE REVIEW

2.1 Introduction

This chapter is a review of past studies on conservation agriculture and climate change. It covers definition of terms, List of NGOs operating in the wards under study and literature review with the following main topics: Sustainable agriculture, conservation agriculture and its adoption, role of extension in adoption, extension techniques and constraints of agriculture extension in delivering CA technology.

2.2 Definition of Terms

Adoption: - is the decision to use or accept a particular idea, method, law or attitude (Macmillan dictionary, 2014). In this study adoption of CA is seen through farmers who are practicing CA.

Climate Change: - refers to a change in the average weather like rainfall, temperature or wind in a particular region or location due to natural or human activities which directly impact livelihoods and food security (Davis, 2011).

Agricultural Extension: - is primarily concerned with human resource development and technology transfer to rural household (UNDP, 1990).

Extension Method: - for the purpose of this study it only refers to any of the three methods which are Individual method, Group method and Mass method.

Extension Technique: - for the purpose of this study it refers to a skill that is used to disseminate information in any given extension method.

2.3 List of NGOs operating in the wards under study

Conservation Agriculture has been introduced in wards 8, 10, 11 and 19 in Shurugwi District with the help of the following NGOs; OXFAM, Christian Care and Help Germany. Their aim was to curb uneven and unreliable rainfall which has resulted in dry land farming in communal areas of Shurugwi District.

OXFAM- 20 agricultural extension workers and supervisors were trained in the 2009/2010 season (Agritex, 2014). The training was not effective since it does not involve hands on experience. Moisture conservation techniques such as infiltration pits, potholes and tied ridges were introduced and a field day was held in ward 5.

Christian Care-It started in Sept 2011 providing fertilizer and maize seed as inputs. By this time no full CA was practised in terms of its principles. It operated for a year and then ended. It came again in 2013 having a new strategy of training extension workers and lead farmers. Lead farmers formed a group of 10 farmers who fall under them and were given inputs (Agritex, 2014). This was done in all ten wards where Christian Care was operating. Mechanised CA was introduced and the farmers in ward 6, 8, 11, 17, 18 19, 24 were trained.

Help Germany- It started in 2012 when it implemented projects like horticultural gardens, poultry production and conservation farming (Agritex, 2014). This was done through extension services by doing farmer selection, demonstration and training. The organisation has a coverage of five wards namely wards 6,7,8,9 and 10 in Shurugwi district. Farmers who are into conservation agriculture are being given fertilizer and seed for their production.

2.4 Sustainable Agriculture

Sustainable Agriculture is agriculture which does not degrade the soil or other natural resources (Chenje, Sola, and Paleczny, 1998). According to FACTA (1990) Sustainable agriculture is integrated crop and animal production practices that satisfy human food and fibre needs while enhancing the environmental quality and natural resource base upon which the agricultural economy relies on. It mainly depends on availability of natural resources such as enough water and good fertile soil and involves economic, environmental and social components. It lessens the problem of water scarcity in dry lands cultivation which is currently a global issue (Brooks, Ffolliot, Gregersen *et al*. 1997).

Conservation agriculture is one of the sustainable agriculture approaches which increase yields while protecting and improving the natural resources. Sustainable agriculture lessens the impact of climate change. According to Davis (2011), Climate change is a change in the average weather experienced in a particular region due to natural or human activities. The changes negatively impact livelihoods and food security. Therefore in order to lessen the impact of climate change, sustainable agriculture practices like CA were introduced. Climate change has negatively impacted agriculture causing the farming community to come up with new approaches to curtail problems of water shortages and poor soil fertility whilst realizing high yields.

2.5 Conservation Agriculture as a Sustainable Agriculture practice.

CA is a concept for resource saving agriculture crop production that strives to achieve acceptable profits together with high and sustained production level while concurrently conserving the environment (FAO, 2007). As seen in many areas where it is being practiced farmers are citing several benefits associated with CA like high yields. A study by Kassam (2010) has shown that CA is benefiting both the individual farmer and the environment at large. CA practice has its main principles which are; minimum soil disturbance, timeliness of operations, efficient use of inputs, crop rotations and use of crop residues for permanent soil cover (Twomlow *et al*, 2008). It is these four principles that are sometimes referred to as CA package. The principles are in consistent with some of sustainable agriculture concepts such as maximising diversity through planned crop rotations, permanent soil cover, soil conservation practices and integrating crop and animal production (Jacobsen, 2012). Although high yield is the major benefit of CA practice, every principle has some noted benefits.

2.5.1 Principles of CA according to FAO (2012):

a. **Minimum soil disturbance** – soil is disturbed very little to reduce evaporative loss of soil moisture, soil loss by erosion, tillage expenses and damage to the soil structure. It differs from conventional tillage in that one should only disturb the portion of soil where the seed is to be placed.
b. **Permanent soil cover** – soil should be completely covered by organic matter throughout the year so as to reduce moisture evaporation loss, suppress weeds, reduce run-off while increase infiltration. This is the fundamental principle which greatly distinguishes CA from conventional agriculture. This ensures that crop do not easily succumb to moisture stress.
c. **Crop rotations and intercropping** – helps to fully utilise nutrients in the soil, reduce pests and disease as well as to improve soil structure.
d. **Timeliness** – all operations must be done in time. Land preparation should be done early before the rains, plant soon after first effective rains, control weeds in their early stages of growth while pests and diseases should be controlled at minimum threshold level. All these, reduce management costs and enhances crop establishment.
e. **Efficient use of fertilisers** – fertilisers are only placed in the root-zone area of the plant in small doses this reduces wasting of fertiliser as in conventional farming

where fertiliser is banded along the row or broadcasted. This reduces costs on fertilisers.

2.6 Adoption of Conservation Agriculture

A study by Adebayo (1995) has shown that most farmers will adopt a new technology if they have enough resources and not facing some constraints. Despite several benefits realized from CA practices, its adoption has been an issue of concern in many communities. Past studies have shown that many farmers are trained but few adopt this technology (Mazvimavi and Twomlow, 2009; FAO 2011). This is the prevailing situation in Zimbabwe's communal areas. Mazvimavi *et al* (2008) highlighted that adoption of CA technologies varies amongst communities. Whilst some are adopting the technology others are not taking it seriously due to various reasons. Where it has been adopted it is characterized by partial adoption which is referred to as distorted adoption (Giller *et al*, 2009). The major cause for distorted adoption is that some CA principles are not practical in some farming communities (Steiner, 2002). There are numerous reasons cited as possible causes of poor or partial adoption. Most of which are related to principles and practices of CA.

2.6.1 Constraints to Adoption of CA

There are a number of socio-economic factors which determine the adoption of CA by farmers (Marongwe *et al*, 2011). These include labour in the first year, pests and diseases, termites, poor resource endowment, mulch gathering and retaining as well as general CA management.

a. Labour

CA activities like basin establishment and mulch gathering require strength; and if farmers are to realize full benefit of CA they must practice all principles of CA (Mupangwa *et al*, 2012). After analyzing the adoption theory, Defrancesco *et al* (2008) concluded that for labour intensive and complex technologies such as CA to be successful they should target young farmers who are still energetic and grasp concepts more easily than the elderly. Young farmers have been found to be more innovative and less risk averse than older farmers (Mazvimavi and Twomlow, 2009). Therefore if the technology is taught to older farmers its chance of success is slim. Though the elderly farmers might have zeal to carry out the practices they may be found wanting when it comes to strength and application of learned

concepts. Once some principles are omitted the farmer cannot achieve full benefit of the technology and this can lead to the abandonment of the technology in due course.

b. Mulching gathering and retaining

FAO (2002) highlighted that communal grazing and unfenced fields make it difficult to retain crop residues for mulch from one season to the other. This is because livestock feed on the crop residues during dry season. In Zimbabwe livestock in the communal area are left unattended roaming the fields during the dry season. The situation is worsened by the fact that semi-arid conditions in most part of the country are not conducive to high biomass production (Steiner, 2002).

c. Termites

According to FAO (2012) termites can be a menace in the fields as they are attracted by mulch. During the mid-season dry spells the termites will damage the crop, if there is low organic content in the soil, leading to reduced yields.

d. Poor resource endowment

FAO (2011) cited the removal of crop residues for fodder since farmers do not have any other means as supplementary feed to their livestock, lack of appropriate equipment and unaffordable costs of herbicides as some of the constraints faced by the farmers in CA practices. This means that even if the farmers have the knowledge on CA, without adequate resources, they may fail to practice it hence poor adoption.

e. Pests and diseases

FAO (2012) indicated that diseases and pests may become dormant in the mulch and reappear later making it difficult to control them.

f. Management

CA activities require better management in precision, timeliness and standards than conventional agriculture especially during field setting, fertiliser application and record keeping (FAO, 2012).

2.7 Extension techniques

According to FAO (2011) there are three basic techniques that have been used by organisations working with CA in Zimbabwe.

a) **Extension agent system-**this is where trained extension agents work directly with groups or individual farmers through lectures. This will help the farmers in implementing CA practises in their own fields.
b) **Lead farmer system-**Farmers who have been practising CA successfully for at least two seasons are chosen as lead farmers, (FAO, 2010). These lead farmers will work with extension agents in the community and will in turn share the information with a group of farmers.
c) **Combined extension agent and lead farmer system-** Many organisations begin working with a group of farmers and lead farmers will then be selected from those farmers.

2.8 Role of Extension in Adoption

World Bank (2003) highlighted that agriculture extension plays a crucial role in informing rural farmers about a new technology. There are several models discussed in Rogers (2003) that can help to explain the importance of extension in adoption. According to Rogers (2003), one of the models; the Diffusion of Innovations Model, identifies access to information as the major factor determining adoption decision of potential adopters. It explains that innovation is easily accepted if it flows smoothly from the source to the intended community in an understandable way. In this case the source is agriculture research; the extension worker is the mode of communication and the farmers are recipients. It is generally accepted that agriculture extension assist in uplifting the living standards of rural people through increased crop production worldwide (World Bank, 2003).

2.9 Constraints of Agriculture Extension in Delivering CA Technology

Although it is perceived that agriculture extension plays a crucial role in the improvement of rural livelihoods, it has failed in diffusing new technology to farmers (Government of Malawi, 2000). This is the scenario in most developing countries like Zimbabwe and other low income countries where the extension workers are facing some challenges in executing their services. According to Sandhu (1993), the challenges include weak research-extension linkages, lack of adequate resources for on-farm demonstrations and trainings, poor mobility, inadequate research materials and lack of resources for staff induction. All these factors lead to poor delivery of extension services.

During farmer trainings, farmers should see clearly what is being taught for them to appreciate every concept (Yahaya, 2003). Abdullai (2002) explained learning situation as one with all elements necessary to promote learning. These elements were categorized as extension worker, farmers, subject matter, learning materials and appropriates venue.

The extension worker must also be motivated, well informed/educated for the job and have the zeal for the work. Where these factors are lacking, the extension worker will act like a boss and not like a missionary and servant of the nation (Onwubuya, 2005). Therefore the attitude of the extension workers also plays an important role in delivering information. Faneli and Dumba (2006) noted that introducing conservation agriculture to farmers requires patience, understanding and careful explanations to persuade the farmers to adopt the technology. This means that the extension worker needs to exhibit a positive attitude towards the farmers.

CHAPTER 3 - RESEARCH METHODOLOGY.

3.1 Introduction

This chapter outlines the procedure on how research was carried out. This involved the description of the study area, research design and instruments, sample and sampling procedures, ethical considerations and data analysis.

3.2 Description of the study area

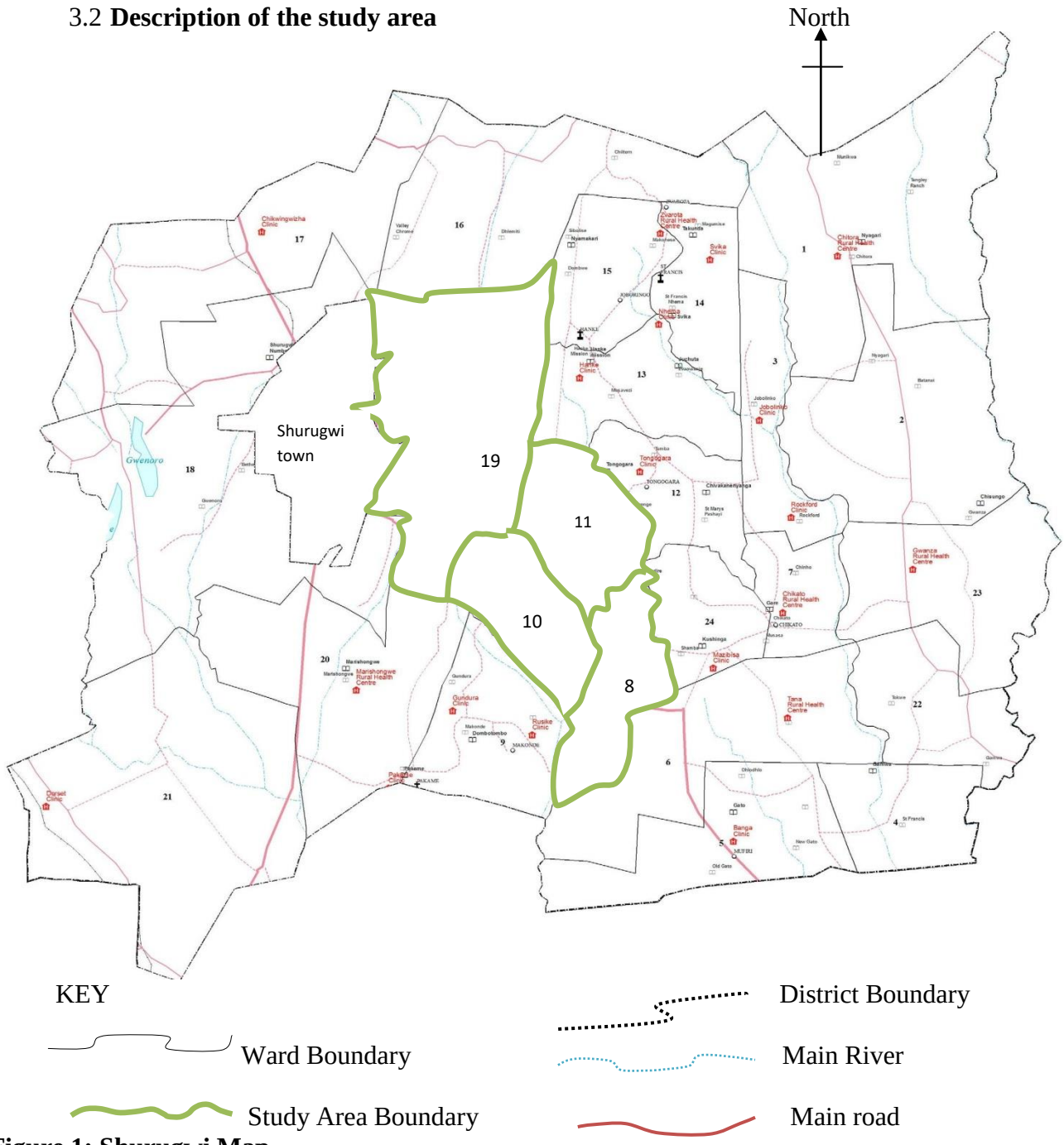

Figure 1: Shurugwi Map

The study was conducted in Shurugwi communal area which lies in the agro-ecological region IV and experiences erratic rainfall with mid season dry spells with an average annual rainfall of 450-650mm (Munowenyu, 2007). Soils are light textured sandy to sandy loams.

The study was conducted in four wards namely ward 8, 10, 11 and 19 where non-governmental organisations like OXFAM have a protracted relief programme. Ward 8 is located on 19° 53′ 34, 76″ S, 30° 12′ 55, 76″ E with an altitude of 1085 m, Ward 10 has an altitude of 1085m and is found on 19° 50′ 24.25″ S, 30° 10′ 14, 21″ E, Ward 11 is found on 19° 47′ 22, 30″ S, 30° 07′ 12, 12″ E with an altitude of 1184m and Ward 19 is located on 19° 31′ 51, 7″ S, 30° 06′ 07, 48″ E.

3.3 Research design

A survey research was carried out. Its design is a descriptive case study in nature that is, it gathers both qualitative and quantitative data. Its purpose is to gather information about the preferences and opinions of individual farmers or a group of objects by asking questions to the people who are familiar with the object of interest (Nikolova, 2011).

3.3.1 Why a survey research design was chosen

Patton (1990) highlighted a survey as an efficient method of collecting data from a broad spectrum which allows one to collect best information for the study. Weisberg (2013) further supported this idea highlighting a survey as a well designed technique for assessing prevalence and factual material by respondents in a larger population thereby minimising non responses from farmers.

3.3.2 Strengths of the survey method

Nikolova (2011) highlighted the issue of standardisation where all the respondents react to identically structured questions using the same response scales. It covers a large number of populations which makes administration process easier. The method allows tabulation and analysis easier through standardised survey tools and format, (Nikolova, 2011).It also allows division of respondents into groups which will facilitate focused group discussions.

3.3.3 Weaknesses of the survey method

The problem of bias can be faced especially in sampling when identifying respondents, (Weisberg, 2013).

3.4 Research instruments

Two instruments were used, a structured questionnaire and focused group discussions.

3.4.1 Structured questionnaire

A structured questionnaire (English) was designed basing on the objectives of the study. The questionnaire was divided into four sections: A-D. Each section of the questionnaire was translated into the local language during the interview. Interviewer- administered survey was carried out whereby the interviewers read the questions face to face to the respondent and record the answers (Nikolova, 2011).

3.4.2 Strengths and weaknesses of using a questionnaire; Nikolova (2011)

A questionnaire was chosen because it offers feedback between the interviewer and the respondent. There is also quality control through the use of a questionnaire. Its weaknesses are the problem of human errors made when recording answers and the time taken may be too long to complete a questionnaire.

3.4.3 Focused group discussions (FGDs)

These are discussions made in form of smaller groups of people focusing on a particular topic under study. FGDs were used to complement the questionnaire. The researcher visited each of the wards to conduct group discussion and only a session was conducted in each ward. Probing was done to elicit information from the respondents. FGDs brainstorm ideas on what the people suggest which results in more depth in discussions, Patton (1990).

3.5 Population of the study

The target population were the farmers trained in CA. A total population of 945 farmers were selected from four wards; where 310 farmers were in ward 8, 232 farmers in ward 10, 338 farmers in ward 11 and 65 farmers in ward 19 (Agritex, 2014)

3.6 Sample and Sampling procedures

Conservation Agriculture is being done in ten different wards in Shurugwi district. Among these, four wards have been selected purposely for the reason that this is where CA technologies were tested and promoted since 2009.

Statistics of the people who are practising conservation Agriculture in four different wards were collected and Stratified random sampling was used with the wards as our strata. The number of selected farmers was proportional to the size of the ward. A sample of 105 subjects was chosen that is at least 10% of the total population in each ward.

3.7 Data analysis

Statistical data collected from the farmers was captured into the computer for analysis. Data was analysed using the Statistical Package for Social Scientists software (SPSS) version 20. Chi-squared test was used to test the significance at a 5% significant level. The results were presented in tables, histograms and pie charts.

3.7.1 Knowledge of the farmer

Farmers who managed to answer correctly any four questions and above from Section C of the questionnaire (see Appendix IV) were regarded as farmers with knowledge on CA, while those who failed to answer any three questions on the same section are regarded as farmers without knowledge.

3.7.2 Adoption of CA

Farmers practising conservation agriculture for more than two years and responded to have adopted CA on adoption question is considered as an adopter.

3.8 Ethical considerations

The researcher obtained permission for conducting a survey from the District Administrator and the local Authority Tongogara Rural District Council (TRDC).This was done by writing a letter addressed to the local council (TRDC) declaring that the research agenda was mainly for academic purposes and not political. The researcher was granted permission to carry out a survey by gathering farmers especially when conducting focused group discussions. Entering the community without permission would have invited unwarranted attention on the part of the community leaders who might have helped in mobilising farmers to cooperate with the outsiders, (Gukurume *et al* , 2010).The study area was visited and key informants like village heads and ward councillors and individual farmers were consulted.

CHAPTER 4- RESULTS AND DISCUSSIONS

4.1 Introduction

This chapter analyses the data that was collected from the communal area of Shurugwi district wards 8, 10, 11 and 19. It looks at the farmers' responses on the effect of extension techniques to the adoption rate of Conservation Agriculture. The analysed responses are taken from the questionnaires and focused group discussions held during the survey.

4.2 Farmers' knowledge on CA.

Farmers were asked questions on section C of the questionnaire on principles, options and benefits of CA. Survey results revealed that out of 105 farmers interviewed 83.8% had knowledge on conservation agriculture and 16.2% did not have knowledge on conservation agriculture. This shows that a large number of farmers in the study area were well informed as far as CA is concerned.

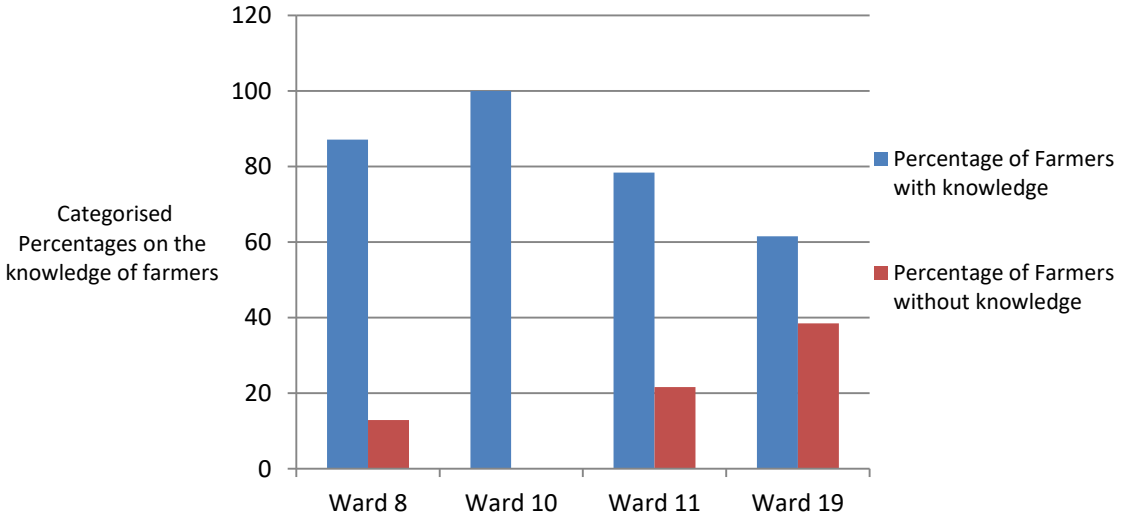

Figure 2: Farmers Knowledge on Conservation Agriculture.

The results have shown that every ward under study has the highest frequency of knowledgeable farmers. All farmers interviewed in Ward 10 have shown that they have knowledge on CA. This was attributed to the fact that Non-Governmental Organisation (NGO) funding CA projects are still in the area and farmers are still actively participating. These results are in consistent with Rogers (1995) who identified awareness and knowledge

as the first step when introducing a new technology in the adoption process. Hence this might be the reason why most farmers have knowledge about CA.

4.3 Adoption of CA

Figure 3 below shows the adoption of CA in the study area. The results show that there are more non-adopters (62.9%) than adopters (37.1%).

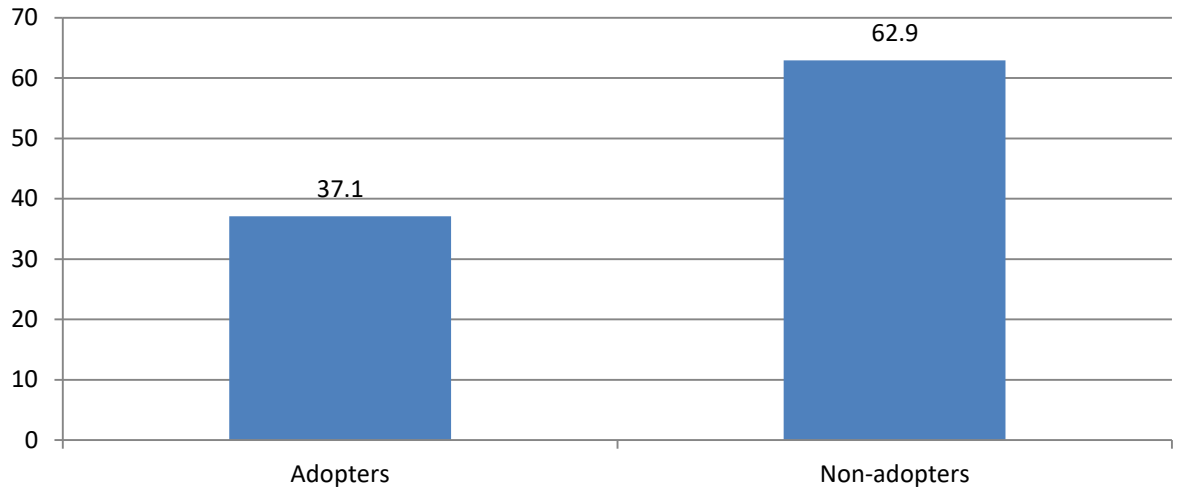

Figure 3: Adoption of CA.

The results agree with past findings by Thomlow (2007) that the level of adoption of conservation agriculture has significantly been affected. This causes the percentage of non-adopters to be higher when compared to the percentage of adopters.

4.4 Effect of extension methods on information dissemination.

This section shows the methods of extension through which farmers received CA information. The farmers were asked to identify techniques that they prefer in each method when information is being disseminated to them. The following results were found:

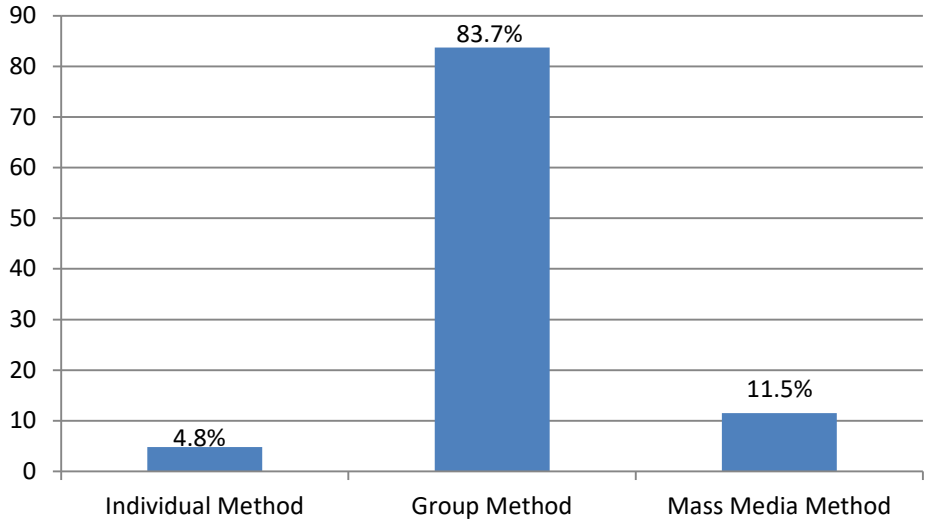

Figure 4: Methods by which farmers received CA information.

As shown in Figure 4; 83.7% of the farmers in the study area received CA information through the group method of extension, 11.5% got it through mass method and 4.8% got it through individual method. Focused group discussions revealed that the main technique that was used in the group method is the lead-farmer training technique. The use of various techniques agrees with Muhammad (1994) who cited that when disseminating information on new technology to farmers various extension methods are employed.

4.4.1 Farmers' preference on information dissemination.

All farmers in the study area indicated that they prefer all methods to be used concurrently to complement each other. After being trained in groups, they still need the extension worker to do home visitation and phone calls contacting each farmer individually. They also highlighted that mass media is always needed to cross check what they are taught with what is happening in other areas.

Table 1: Techniques preferred by farmers under Mass method.

		Ward				Total
		8	10	11	19	
Radio	n(%)	16(31.4%)	14(27.5%)	15(29.4%)	6(11.8%)	51(100.0%)
Television	n(%)	15(27.8%)	10(18.5%)	22(40.7%)	7(13.0%)	54(100.0%)
Total	n(%)	31(29.5%)	24(22.9%)	37(35.2%)	13(12.4%)	**105(100.0%)**

Farmers prefer television media to radio media as shown in Table 1. They indicated that it is ideal to see what is being taught than just hearing information through the radio. However the results in Table 1 have shown that there is no significant difference between these two preferences.

Table 2: Techniques preferred by farmers under Individual Method.

		Ward				Total
		8	10	11	19	
Home visits	n (%)	20(29.4%)	13(19.1%)	26(38.2%)	9(13.2%)	68(100.0%)
Phone calls	n (%)	10(29.4%)	10(29.4%)	10(29.4%)	4(11.8%)	34(100.0%)
Letters	n (%)	1(33.3%)	1(33.3%)	1(33.3%)	0(0.0%)	3(100.0%)
Total	n (%)	31(29.5%)	24(22.9%)	37(35.2%)	13(12.4%)	**105(100.0%)**

Higher percentage (68%) of farmers indicated that they prefer home visits than other techniques. Farmers have urged that extension workers must visit them individually at their homes so as to identify whether they are succeeding on what they are taught.

Table 3: Techniques preferred by farmers under Group Method.

					Ward	**Total**
		8	10	11	19	
Demonstration meetings	n(%)	13(38.2%)	7(20.6%)	12(35.3%)	2(5.9%)	34(100.0%)
Leader training meetings	n(%)	17(28.3%)	14(23.3%)	19(31.7%)	10(16.7%)	60(100.0%)
Lecture meetings	n(%)	1(9.1%)	3(27.3%)	6(54.5%)	1(9.1%)	11(100.0%)
Total	n(%)	31(29.5%)	24(22.9%)	37(35.2%)	13(12.4%)	**105(100.0%)**

Despite the fact that farmers were using the leader farmer training technique, farmers have shown that they prefer to meet the extension worker and carry out some demonstrations. This will give them opportunity to meet the extension worker and have practical activities like setting out of planting stations.

4.5 Major challenges to CA adoption

This section highlights results on major challenges that are faced by farmers when practicing CA in the study area. As shown in Figure 5 the results revealed that the main challenges faced by farmers are buying of fertilisers, digging planting basins and gathering of mulch. Among these major challenges, mulch gathering (76%) has been identified as the major challenge affecting conservation agriculture adoption. Lal (2009) identified that there are other constraints to the adoption of CA such as the issue of age, lack of appropriate equipment and winter weeding that competes with other house hold chores.

Farmers cited that mulch gathering competed with livestock fodder hence a challenge in allocating mulch required for CA only. This agrees with past study by Steiner (2002) that semi-arid regions are not conducive to high biomass production. Some of the farmers also highlighted the issue of old age hindering adoption. The results agree with Rukuni *et al* (2006) who identified older farmers having a conservative feeling that leads to resistance to change to new technology. Adebayo (1995) indicated that farmers will adopt new technology only if they have enough resources and not facing some constraints. The results are consistent with this finding since the challenges faced by farmers have caused poor adoption of CA.

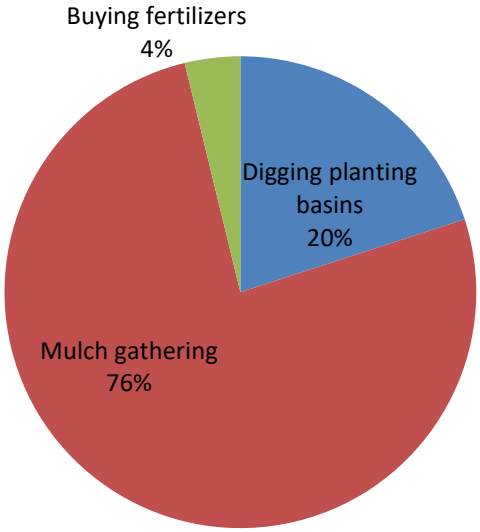

Figure 5: Major challenges faced by farmers in practising CA

Due to these challenges CA practices may be shunned by many farmers resulting in poor adoption of CA technology.

Table 4: Knowledge of farmer against Adoption.

		Adoption		Total
		Adopters n (%)	Non-Adopters n (%)	n(%)
Farmers with knowledge	Count	29(33%)	59 (67%)	88(100%)
Farmers without knowledge	Count	10(58.8%)	7 (41.2%)	17(100%)
Total	**Count**	**39(37.1%)**	**66 (62.9%)**	**105(100%)**

After running a Chi-square test it was found that there is an association between farmers' knowledge and adoption (p-value = 0.043) see Appendix I. This implies that farmers with knowledge are ready to adopt any new technology. The results agree with past study by CIRAD and AFD (2011) where a successful innovation in Agriculture depends on training of local farmers and the integration of their knowledge.

Table 5: Extension method used against knowledge of the farmers.

			Knowledge of farmer		Total
			Farmers with knowledge- n (%)	Farmers without knowledge- n (%)	
Method used	Individual	Count	3(2.9%)	3(2.9%)	6(100%)
	Group	Count	76(72.4%)	11(10.5%)	87(82.9%)
	Mass Contact	Count	9(8.6%)	3(2.9%)	12(11.4%)
Total		Count	88(83.8%)	17(16.2%)	105(100%)

The table above shows the results obtained after Chi-square test analysis of extension methods used against the knowledge of farmers. N=105. There is an association between extension method used and knowledge of the farmers (p-value = 0.038) see Appendix II. This means that if proper extension methods are used, farmers can easily access knowledge offered. The results agree with past findings done by (World Bank, 2003) where extension

has been found to assist rural population of remote areas to uplift their standard through increase in crop production.

Table 6: Extension Methods used against Adoption.

			Adoption		Total n (%)
			Adopter	Non-adopter	
			n (%)	n (%)	
Extension Method	Individual	Count	2(33.3%)	4(66.7%)	6(100.0%)
	Group	Count	32(36.8%)	55(63.2%)	87(100.0%)
	mass contact	Count	5(41.7%)	7(58.3%)	12(100.0%)
Total		Count	39(37.1%)	66(62.9%)	**105(100.0%)**

The table shows the results that were obtained after testing the association between extension methods against adoption. N=105. The Chi-Square test has shown that there is no association between extension methods used and adoption (p-value = 0.929) see appendix III. These results agree with findings of FAO (2007) that appropriateness of a technology is multidimensional; it is defined by feasibility aspects that include technical, economic, social and environmental factors. Hence extension methods alone can not address the issue of adoption unless other factors are considered.

CHAPTER 5-CONCLUSION AND RECOMMENDATIONS

5.1 Conclusions

The major challenges of CA faced by farmers are mulch gathering, digging planting basins and buying of fertilisers. These challenges have caused difficulties in practicing CA technology. The extension techniques used are individual method, group method and mass media method. These techniques are used concurrently to effectively disseminate information to the farmer. As a result many farmers are well knowledgeable on CA technology. However, CA adoption is still poor despite the fact that farmers are well informed on CA practices. Therefore the study concludes that extension techniques alone can not yield positive results on CA adoption without addressing other issues like resource challenges which faced by the farmers.

5.2 Recommendations

The extension workers must be equipped with both information and resources needed by the farmers when introducing a new technique. This will facilitate easy adoption since farmers will be motivated to practice what they are taught. Citing the challenges indicated by the farmers, it is recommended that:

a) Instead of using basins farmers can be supplied with cheaper CA equipment so as to practice other CA options like mechanised options. This equipment can be manually operated like the Jab-planter or animal driven like the Direct Seeders.
b) Farmers should also be encouraged to use locally available inputs like kraal and compost manure rather than inorganic fertiliser which they can not afford.
c) Farmers should be taught to gather mulch during summer and methods of retaining it for use later. Most farmers are informed about mulch gathering later in winter when the mulch is scarce in the field.

5.3 Areas for further research

The following areas are recommended for further research:

a) There is a need for further research in every district in Zimbabwe on challenges to CA faced by a farmer since these vary from one district to another despite the fact that some districts are located in the same agro-ecological zone.
b) There is need to further research on CA options that are amicable with locally available resources especially on the issue of equipment and tools so as to reduce labour challenges. Most of CA equipment that is used for farmer training is imported from other countries.

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APPENDICES

Appendix I

Chi-Square Tests – Knowledge against Adoption

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	8.497[a]	2	.014
Likelihood Ratio	6.367	2	.041
Linear-by-Linear Association	.574	1	.449
N of Valid Cases	104		

a. 3 cells (50.0%) have expected count less than 5. The minimum expected count is .82.

Appendix II

Chi-Square Tests – Extension Method against Knowledge.

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	6.547[a]	2	.038
Likelihood Ratio	5.134	2	.077
Linear-by-Linear Association	.390	1	.532
N of Valid Cases	105		

a. 2 cells (33.3%) have expected count less than 5. The minimum expected count is .97.

Appendix III

Chi-Square Tests – Extension Method against Adoption

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	.147[a]	2	.929
Likelihood Ratio	.146	2	.929
Linear-by-Linear Association	.143	1	.705
N of Valid Cases	105		

a. 3 cells (50.0%) have expected count less than 5. The minimum expected count is 2.23.

Appendix IV

MIDLANDS STATE UNIVERSITY

P. BAG 9055
Gweru.

Zimbabwe

Tel. (263) 54 260450/260464
260404/260331 260632/260596

FAX: (263) 54 260233

SURVEY QUESTIONNAIRE

Evaluating the effect of extension techniques on the adoption of Conservation Agriculture (CA) in Semi arid communal areas of Shurugwi: ‘‘A Case study of 8, 10, 11 and ward 19’’

Introduction

Start by greeting the respondent formally and request to talk to him/her. Introduce yourself and tell the respondent the purpose of the survey; indicating how long the discussion is expected to take.

SECTION A: DEMOGRAPHIC CHARACTERISTICS.

1.1 Sex of respondent: ☐ Male ☐ Female

1.2 Age of respondent (in years) :. .....

1.3 Sex of household head. ☐ Male ☐ Female

1.4 Age of household head (in years) :.. .....

1.5 Household size: ..... Ages : <15.... 16-25..... 26-35.... 36-45.... >46.....

1.6 Ward: .....

1.7 Village: .....

SECTION B: FARM CHARACTERISTICS

1.8 What tillage practices do you usually carry out? (*tick*)

a. Conventional	b. Conservation Agriculture	c. Both

1.9 What size of Land do you usually cultivate (*Hectares*)

a. Conventional	b. Conservation Agriculture

2.0 How do you obtain inputs like seeds, fertilisers and chemicals?

a. Buying	b. Donors	c. Loan	d. Government	e. Remittances	f. Others (specify)

2.1 **Average yields per hectare.**

Major Crops Grown Under:	**Tonnes**	**Comments/Remarks**
a. Conventional Tillage		
i. Maize		
ii. Groundnuts		
iii. Millet and/or Sorghum		
iv. Sugar beans		
b. Conservation Agriculture		
i. Maize		
ii. Groundnuts		
iii. Millet and/or Sorghum		
iv. Sugar beans		

2.2 Area under Conservation Agriculture since 2009.

Year	2009-2010	2010-2011	2011-2012	2012-2013	2013-2014
Hectares					

2.3 How reliable is rainfall in your area for dry land cultivation?

a. ☐ Very much reliable b. ☐ Less reliable c. ☐ t reliable

2.4 What is the nature of the field? : ☐ Steep ☐ Moderate ☐ Gentle

2.5 Soil depth; ☐ Shallow ☐ Moderately deep. ☐ eep

SECTION C: FARMERS' KNOWLEDGE *(tick appropriate box where necessary)*

2.6 Do you know any soil and water conservation technique? *(tick)* ☐ Yes ☐ No.

If yes, can you mention techniques that you know? *(tick)*

Conservation technique	
i. Contour ridges	
ii. Storm drains	
iii. Mulching	

iv.	Pot-holing	
v.	Tied-ridges	
vi.	Ploughing across the slope	
vii.	Grass strips	
viii.	Other (specify)	

2.7 Which of the following CA options are you familiar with? *(tick)*

☐ Planting Basins ☐ Shallow Planting Furrows ☐ Animal Powered Options

2.8 Does CA have any benefit to you *(tick)* ☐ Yes ☐ No. If yes, ca you name them.

-Moisture conservation; **-S**aves inputs; **-H**igher yields; **-R**educes weeds; **-R**educes soil erosion; **-I**mproves soil structure; **-R**educes production cost; **-B**etter crop establishment; **-I**mproves soil fertility.

2.9 Would you like to adopt it? (*tick*) ☐ Yes ☐ b.

3.0 How many years have you been practicing CA? ☐ ≤ 2 ☐ ⊦ 2

3.1 What principles of Conservation Agriculture do you know and which do you think are difficult to observe?

Principle	Known	Difficult to Observe
a. Minimum soil disturbance		
b. Provision of soil cover		
c. Crop mixing and rotation		
d. Timely implementation		
e. Precise operations		
f. Efficient use of inputs		

3.2 What do you think are the challenges of CA?

-Digging planting basins; **-M**ulch gathering; **-B**uying Fertilisers; **-M**anure application; **-S**etting out the field; **-M**ultiple weeding; **-S**caring away livestock; **-T**ermites infestation; **-L**ess Crop residues for livestock feeding; **-S**hortage of CA equipment.

SECTION D: EFFECTIVENESS OF EXTENSION TECHNIQUES.

3.3 Did you ever receive any information on conservation agriculture? *(tic* ☐ Y☐ No.

b. If yes, how did you get it? *(tick extension techniques used)*

i. ☐ Individual contact. ii. ☐ Group contact. iii. ☐ss contact.

3.4 How do you prefer to be taught or to receive information as far as CA is concerned?

a) INDIVIDUALLY		
i.		Office calls
iii.		Home visits
v.		Phone calls
vii.		Personal letters
ix.		Result demonstration
b) GROUPS		
i.		Method demonstration meetings
iii.		Leader training meetings
v.		Lecture meetings
vii.		Conference and discussion meetings
ix.		Educational Tours
c) MASS CONTACTS		
i.		Radio
iii.		Television
v.		Bulletins
vii.		Exhibits
ix.		Leaflets
xi.		News letters
xiii.		Circular letters
xv.		Posters

3.5 Which stakeholders do you usually work with? (*tick and state the technique*)

Stakeholder *(specify)*	**Extension technique used**
a. Government departments	
b. Parastatal	
c. Non-government organisation	
d. Others *(specify)*	

Thank you