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ADOPTION OF CONSERVATION FARMING TECHNOLOGIES AS A CLIMATE CHANGE ADAPTATION STRATEGY AMONG SMALLHOLDER FARMERS IN ZAMBIA: A CASE STUDY OF CHIKANKATA DISTRICT IN THE SOUTHERN PROVINCE OF ZAMBIA

A THESIS
Submitted to The Zambian Open University In partial fulfilment of the requirements for the degree of Master of Arts in Transformative Community Development

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Abstract:-

This study was conducted to investigate what determines the adoption of conservation farming technologies as an adaptation strategy to climate change among small holder farmers in Chikankata district of Zambia. It specifically looked at the level of awareness of climate change and conservation farming technologies by small holder farmers, the prevalence of, and type of adoption of conservation farming technologies, the nature of household characteristics and how they influence the adoption of conservation farming technologies, factors which influence the adoption of Conservation farming technologies and the nature of farming challenges continually faced by adopters and non-adopters of conservation farming technologies in the district.

The study used both qualitative and quantitative design. Primary data was collected using semistructured questionnaires administered to smallholder farmers. An interview guide was used on agriculture/ camp officers and conservation farming field officers who are the key informants. A focus group discussion was also conducted with the lead farmers or farmer coordinators. A total of 116 small holder farmers from the total population of 2301 were selected to participate in the study using simple random sampling method (table 2). The data collected was coded using a coding scheme. It was later processed and analysed using the Statistical Package of the Social Sciences (SPSS). Secondary data was collected from published and unpublished(online) reports.

The study revealed that most of the smallholder farmers have heard and are aware of climate change and conservation farming respectively. The results indicate that sixty two per cent (62%) of the respondents are aware of climate change and eighty five per cent (85%) of the respondents are aware of conservation farming technologies. However, the level of adoption is still low despite the awareness and knowledge. Only thirty two per cent (32%) of the respondents have adopted Conservation farming technologies or Conservation Agriculture (CA) as it is sometimes called. The empirical evidence in this investigation does not support the assumption that most smallholder farmers in Chikankata district of Zambia have adopted conservation farming technologies but supports the notion that the adoption of conservation farming technologies by smallholder farmers is influenced by socio-economic and institutional factors. It can therefore be deduced from the findings that just sensitising the farmers and training them on conservation farming technologies is not adequate but the trainings should go hand in hand with the alleviation of the many challenges that are faced by the smallholder farmers.

The study therefore recommended that the government and other stakeholders, including NGOs should consider enhancing the adoption of conservation farming technologies by investing in appropriate agro equipment such as tractors, rippers and fiterelli planters (zero till Machinery) and also in farmer extension support considering that farmers need support in order for them to understand the concepts that come along with conservation farming technologies.

Additionally, the government should increase the smallholder farmers' access to farming inputs through FISP and should also consider increasing the FISP pack. The government should revisit the FISP so that the most vulnerable people benefit from the programme and not only those with capital or who are already rich. There is also need to intensify sensitisations on conservation farming, trainings and field days. Furthermore there is need for field officers to monitor agricultural activities so that they can give timely advice to farmers.

CERTIFICATION OF APPROVAL

The Zambian Open University approves this dissertation of Memory Hanyinde as fulfilling part of the requirement for the award of the degree of Master of Arts in Transformative Community Development (MATCD).

Supervisor: Dr. Khumbi R. Chinonge: …… ……
Signature Date

Dean, School of Graduate Studies and Research

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Signature Date

DECLARATION

I declare that this research report which is being submitted to the Zambian Open University in partial fulfilment of the degree of Master of Arts in Transformative Community Development (MTCD) is my own work and to the best of my knowledge has not previously been submitted for any degree or examination to any other University.

Memory Hanyinde: ……

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Above all, I thank the Almighty God for the guidance and protection He bestowed upon me and my family.

DEDICATION.

I would like to dedicate this thesis to my little angels; Michelo, Mayeba, Paul and Daniel Hambizi; my brothers and sisters; my nephews and nieces and lastly but not the least, my loving and caring husband Diallo. I was able to work for long hours in the night because of his patience and understanding. Thank you my dearest for having been there for me.

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CHAPTER ONE
INTRODUCTION

Climate change and environmental degradation are of threatening concern globally today because the impacts of which exert challenges on the environment, ecosystems and peoples' livelihood in general. According to the Intergovernmental Panel on Climate Change (IPCC 2007), temperatures are likely to increase by 2 to 11.5 degrees by 2100 and this according to Maslin and Mark (2004) is the biggest challenge to human beings because of our inability to predict the future. These argue that future changes in climate will have huge impact on all aspects of human society where coastal areas will sink or sea will rise and areas will be flooded; increase in occurrences and strengths of storms and hurricanes, health and sanitation will also be affected, agricultural production will be impacted in certain areas and biodiversity will be destroyed. This is also in line with Parry, Rosen Zweig, Iglesia, Livermore, Fischer (2004) who argue that climate variability and climate change will have direct impact on reducing food production and affect food security. This threat that is posed by climate change and environmental degradation which have consequently lead to food insecurity especially in Africa and in Zambia in particular has given rise to the initiation of adaptive measures. One of the adaptive measures that are being promoted is conservation farming which encompasses reduced or no tilling, permanent soil cover, crop rotations and intercropping practices. Conservation farming, which is viewed by its promoters as a climate resilient technology and management system, has demonstrable potential to secure sustained productivity and improvement of livelihoods for millions of climate-dependent farmers in semi-arid areas around the world as it is based on sustainable integrated soil and water management.

Ngwira, Johnsen, Aune, Mekuria and Thierfelder (2014) contend that adoption of conservation agriculture has the potential to increase smallholder farms' resilience to rainfall variability, address soil degradation and increase food production in an efficient, productive and profitable manner. This is in line with Aagaard and the CFU team (2011) who contend that conservation farming is one of the many options available to farmers responding to perceived changes in their production environment. Another option may be relocation. A few or all of the members of the household may decide to migrate. If households choose to migrate, they may reduce the intensity with which they farm their land or may abandon their old lands and open up new lands for cultivation .For example most of the small holder farmers in the Southern Province of

Zambia have relocated to Chaamuka in Central province where they believe the land is still highly productive. However, this is not a long term solution as it has serious implications if farmers transfer unsustainable farming practices to new areas. It is for this reason that conservation farming is increasingly being promoted as it is seen as a farming system that should enable farmers to increase their productivity, adapt to climate change and reverse environmental degradation (Aagaard and the CFU Team, 2011).

It view of the above most national governments in Africa are advocating for conservation farming technologies in order to reduce vulnerability to climate change. Climate related hazards affect the poor people directly by impacting their livelihoods through for instance, reduction in crop yields. However, it is believed that adoption of these conservation farming technologies in most developing countries and in Zambia in particular, have been hindered by a number of factors which include the following: awareness/knowledge of conservation farming technologies; financial resources/ capital; farming implements ownership; cattle ownership; land tenure; education level and age of the farmer (Nyanga , Johnsen, Aune & Kalinda (2011); Ngombe, Kalinda, Tembo and Kuntashula (2014), Ngwira et al (2014). It is against this background that the study investigated factors that determine the adoption of conservation farming technologies among the small holder farmers in Chikankata district in the southern part of Zambia.

1.1. BACK GROUND TO THE STUDY

Conservation Farming (CF) started as Conservation Agriculture (CA) in the United States (US) out of ecological and economic hardships caused by catastrophic droughts during the 1930s and became popular among farmers because of the escalating fuel prices during the 1970s.This lead many commercial farmers to adopt minimum tillage technologies as a means of combating the drought induced soil erosion and also to save on fuel costs. In Africa Conservation Farming (CF) was developed in response to continuously declining land productivity under "conventional" systems based on soil tillage. In Zambia Conservation Farming emerged as a by-product of technology transfer by commercial farmers who adopted foreign minimum tillage systems for their own use and later supported scaled down versions for small holder farmers living in regions Iia and Iib of Zambia's agro- ecological regions which receive low to medium rainfall. Zambia is divided into three major agro-ecological regions. These are as elaborated below:-

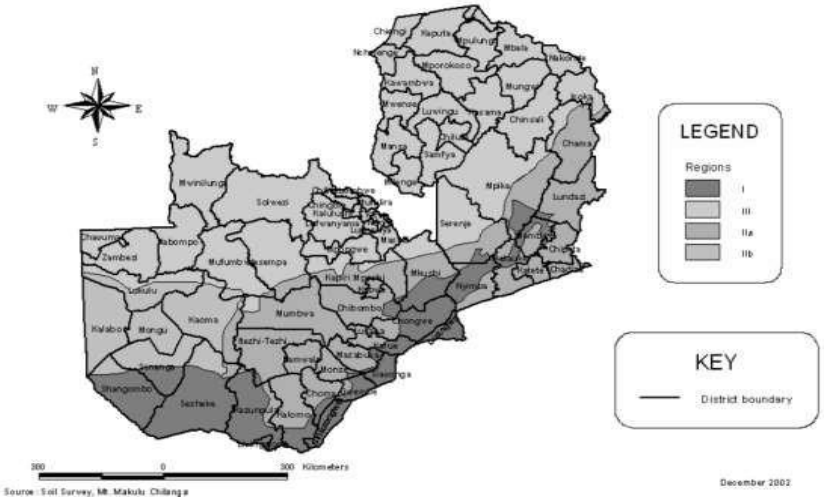
Region one (I) constitutes 12 % of Zambia's total land area. . It covers the Southern Province and parts of Eastern and Western Provinces. It covers the country's major valley areas; Gwembe, Lunsemfwa and Luangwa, and the southern parts of Western and Southern provinces. It is a drought-prone area characterized by low rainfall of less than 800mm annually and It consists of loamy to clay soils on the valley floor and course to fine loamy shallow soils on the escarpment. The Region is suitable for production of drought resistant crops like cotton, sesame, sorghum and millet and has potential for production of irrigated crops, like winter maize.

Region two (II) is the medium rainfall area covering the Sand-veld Plateau of Central and Eastern Lusaka and Southern Province; Kalahari Sand Plateau; and Zambezi Floodplains of Western Province. This region receives between 800 to 1,000 mm of annual rainfall and constitutes 42 % of the country. It is sub divided into two regions namely, Region Iia and Iib. Region Iia covers Central Lusaka, Southern and Eastern fertile plateau of the country and generally contains inherent fertile soils. Permanent settled systems of agriculture are practiced. A variety of crops are grown in this region and these include maize, cotton, tobacco, sunflower, soya beans, irrigated wheat, groundnuts and other arable crops. The area is also

highly suitable for flowers, paprika and vegetable production. Region Iib covers Western province and consists of sandy soils. It is suitable for production of cashew nut, rice, cassava and millet, including vegetable and timber production. This region is also highly suitable for beef, daily and poultry production.

Region three (III) receives between 1,000 mm and 1,500 mm of rainfall annually and constitutes 46 % of the country's total land area comprising the Copperbelt, Luapula, Northern and North Western Provinces. With the exception of the Copperbelt, the zone is characterized by highly leached, acidic soils. It has good potential for the production of millet, cassava, sorghum, beans and groundnuts. Coffee, sugarcane, rice and pineapples are also grown in this area. The agricultural potential of the region can be enhanced by application of lime and its perennial streams can be utilized for small-scale irrigation (Aregheore1994). The ecological regions are shown in Figure 1. Below:-

Figure 1: Zambia District Boundaries and Agro-ecological regions (I, Iia, Iib, III



In Zambia Conservation farming was formally introduced in 1996 by the Conservation Farming unit, an affiliate of the Zambia National Farmers' Union (ZNFU) in response to the 1995 drought (IFAD 2011) mainly in region two. Sibale and Remme (2014) contend that the spread of conservation farming crop management practices started in low rainfall areas of Agro Ecological region I and II because the practices were perceived to help in capturing and maintaining soil moisture. According to the MTENR (2007), the agriculture sector in Zambia has been in the doldrums for several years due to overwhelming dependence on rain fed agriculture which is also dominated by a mono maize production system. There is empirical evidence that the farming methods that are commonly used to grow crops destroy the land and hence undermine the future (Aagaard 2007). Hence since 1996 there has been emphasis on programmes that promote development of farming technologies and practices including conservation farming (CF) technologies which are more productive, efficient and environmentally sustainable among small holder farmers who are the most vulnerable to the impact of climate change. According to MTENR (2007) the combination of high food insecurity, relatively low yields, high deforestation and localized land degradation leave Zambia particularly vulnerable to climate change. According to recent estimates, it is expected that the country will face higher temperatures, shortened growing seasons and increased frequency of severe climate events. Substantial increases in food insecurity, particularly in the southern and central regions are predicted and it is estimated that by 2055 maize yields will decline while variability of yields will increase perhaps dramatically

In Zambia the promotion of Conservation Farming is stipulated within the 2004-2015 Zambian National Agricultural Policy. The Ministry of Agriculture and Cooperatives has a climate change adaptation and mitigation agenda, and potential adaptation areas have been identified. Conservation Farming is one of such areas. Conservation farming aims to make better and efficient use of the agricultural resources through the integrated management of available soil, water and biological resources (IFAD 2011). Conservation farming is also associated with lower labour (since weed management is done by the use of herbicides), and farm power inputs, more stable yields and improved soil nutrients exchange capacity. It also conserves soil and terrestrial biodiversity. Furthermore, conservation farming contributes to environmental conservation and consequently to sustainable agricultural production by the maintenance of a permanent or semi-permanent organic soil cover through the use of the zero or minimum tillage systems and this in turn leads to an increase in crop production profitability with time. Kelly et al (1996) contend that strictly no till (zero tillage) produces higher returns than conventional tillage and reduces an environmental hazard index from 78.9 to 64.7. The index also takes into consideration soil erosion risk, phosphorus and nitrogen losses and potential pesticide contamination. Additionally, conservation farming sequesters carbon, thereby decreasing carbon dioxide in the atmosphere and consequently helping to ameliorate climate change.

1.1. STATEMENT OF THE PROBLEM

The Zambian National Farmers Union (ZNFU) in conjunction with a consortium of other international donor agencies including the Norwegian Government have been advocating for the use of conservation farming technologies in Zambia since 1996 with a view to reverse food insecurity and environmental degradation while enabling small holder farmers to adopt and integrate farming systems that increase productivity and mitigate set existing and future climatic change impacts. Chikankata District in Southern Province is one of the 16 districts in the country that have benefited from conservation farming projects.

In Africa, South of the Sahara and in Zambia in particular, conservation crop management practices have been extensively promoted. However despite all the efforts to promote and encourage small holder farmers to adopt conservation farming technologies which according to the advocators have the technical potential to contribute to food security and adaptation to climate change, the adoption of the technology has lagged behind. Hence concerns have been raised as to the suitability of the technology within the smallholder farming context (IFAD 2011). It is estimated that no tillage is practiced on 116 million ha (287 million ac; 2.4% of all cultivated land) worldwide, and only a meagre 0.3% of no- tillage is practiced in Africa mostly on smallholder farms (Ngwira et al 2014). This proves that most of the small holder farmers worldwide are still using the conventional farming methods which according to Aagaard (2007) are destructive in nature and hence undermine the future. Therefore it is for this reason that this study was designed to investigate what determines the adoption of conservation farming technologies among small holder farmers in Chikankata district of Zambia.

1.2. RATIONALE OF THE STUDY

The study investigated the factors that determine the adoption of conservation farming as a climate change adaptation strategy among small holder farmers in Chikankata district in the Southern Province of Zambia. Most studies have focused on comparing conservation farming methods with the conventional farming methods with minimal attention to factors that determine the adoption of the Conservation farming strategies. Nyanga et al (2011) contend that most of the studies have focused on comparing conservation farming systems with the convention farming methods. Furthermore, a hand full of studies has compared output differences between conservation farming (CF) and conventional tillage plots (Nyanga et al. 2011) and most results indicate that there are substantially higher yields on CF plots. It has also been observed that most studies have relied on very small numbers of farmers that are trained in CF technologies and the majority of the farmers are left out. This observation is in line with (Aslihan Arslan, 2013) who contend that most of these studies on the adoption of CF in Zambia rely on small samples purposefully selected from regions where CF was promoted, which risks confounding the effects of various interventions on adoption . So far there is a paucity of generalizable documentation on factors that determine adoption of the CF technologies. Ng'ombe et al (2014) contend that past studies on factors that affect adoption of CF by small holder farmers were often not based on adopters and non–adopters with statistically similar distribution of their observable characteristics so it is possible that their results might be biased and inconsistent. This study therefore endeavoured to determine the reasons that influence the adoption of conservation farming technologies among the small holder farmers in Mapangazya Farming block in Chikankata District. These smallholder farmers included adopters and nonadopters of conservation farming technologies.

The study adds to the body of knowledge about the adoption of conservation farming technologies and the factors that determine adoption in Chikankata district and in the country at large since the results can be generalized to regions with similar ecological conditions. The study also generated knowledge needed for identifying interventions that can help speed up the adoption of CF by smallholder farmers in Zambia and other developing countries. The findings of this study makes important contributions to Conservation farming promotion policies in Zambia and are very relevant to policy makers as they try to formulate policies that can mitigate climate change impacts on smallholder farmers.

1.4.0. STUDY OBJECTIVE

The overall objective of the study was to investigate what determines the adoption of conservation farming technologies among small holder farmers in Chikankata district of Zambia.

1.4.1. SPECIFIC OBJECTIVES

1. To assess the level of awareness of climate change and conservation farming technologies by small holder farmers in Chikankata District.
2. To establish the prevalence of, and type of adoption of conservation farming technologies.
3. To determine the nature of household characteristics and how they influence the adoption of conservation farming technologies
4. To determine factors which influence the adoption of Conservation farming technologies.
5. To establish the nature of farming challenges continually faced by adopters and nonadopters of conservation farming technologies.

1.5. RESEARCH QUESTIONS

1. How knowledgeable are the small holder farmers in Mapangazya farming block about climate change and conservation farming technologies?
2. What are the widely adopted conservation farming technologies in Mapangazya and why?
3. What are the household characteristics that influence the adoption and non-adoption of specific conservation farming technologies?
4. What factors determine the adoption of conservation farming technologies among smallholder farmers in Chikankata District?
5. What are the major farming challenges continually faced by adopters and non-adopters of Conservation farming technologies?

1.6. SIGNIFICANCE OF THE STUDY

The study adds to the body of knowledge about awareness of climate change and conservation farming and the adoption of conservation farming technologies in Chikankata district and in the country at large since the results can be generalized to regions with similar ecological conditions. The study also established the challenges that are faced by small holder farmers in adopting conservation farming technologies and hence strengthen government and aid agencies to develop effective preparatory measures to prevent and minimise climate change consequences. It is believed that a better understanding of factors that influences the adoption and possibly restrict the adoption of conservation farming technologies would allow the formulation of well-tailored interventions.

The study further creates awareness among stakeholders who are involved in the promotion of conservation farming technologies on factors that determine the adoption of conservation farming technologies by the smallholder farmers in Zambia and this will enable them to design strategies that will scale up adoption. The knowledge generated also contributes to a more precise understanding of the vulnerability of the small holder farmers which is crucial in policy making and also in the development of strategies to foster sustainable adaptation to climate change. Consequently, a better understanding could also facilitate close monitoring and evaluations of conservation farming activities.

The study also discusses the household characteristics that determine the adoption of conservation farming technologies and also the challenges that are continually faced by small holder farmers in general in order to develop a rational for intervention at National level considering that appropriate improvements and corrective measures in the promotion of conservation farming technologies can only be made when there is a way of determining factors that are critical in the practice.

1.7. HYPOTHESIS

The study was conducted under the notion that:

i. Most small holder farmers in Chikankata district of Zambia have adopted conservation farming technologies.
ii. The adoption of Conservation farming technologies by the small holder farmers in Chikankata district is influenced by socio-economic and institutional factors and/or household characteristics.

1.8. LIMITATIONS OF THE STUDY

1. Inadequate finances. This affected the sample size since it would have been very costly to get a large sample.
2. Limited time to do the research
3. Lack of transport to move around to collect data. The road network is also very bad and slowed down the movements.
4. Some of the sampled respondents have moved and others have died hence could not be interviewed and this affected the sample size.

1.9. OPERATIONAL DEFINITION OF TERMS

i. **Climate change:** any change in climate over time either due to natural variability or human activity. Climate change refers to a change in the state of the climate that can be identified (e.g., by using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer.
ii. **Climate change mitigation** consists of actions to limit the magnitude and/or rate of longterm climate change. Climate change mitigation generally involves reductions in human (anthropogenic) emissions of greenhouse gases (GHGs) Mitigation may also be achieved by increasing the capacity of carbon sinks, e.g., through reforestation. Mitigation policies can substantially reduce the risks associated with human-induced global warming (Wikipedia).
iii. **Conservation farming**: a farming system that involves dry season land preparation using minimum tillage systems and /or with crop residue retention or use of fertilizer trees.
iv. **Conservation Agriculture:** the practice of minimizing soil disturbance, maintaining soil cover, and rotating crops – is a proven technique that improves soil ...maintains a permanent or semi-permanent organic soil cover. This can be a growing crop or dead mulch. Its function is to protect the soil physically from sun, rain and wind and to feed soil biota. The soil microorganisms and soil fauna take over the tillage function and soil nutrient balancing. Mechanical tillage disturbs this process. Therefore, zero or minimum tillage and direct seeding are important elements of CA. A varied crop rotation is also important to avoid disease and pest problems. (See FAO web site). In this study Conservation Farming (CF) and Conservation Agriculture (CA) will be used interchangeably.

v. **Convention farming**: a production system involving ploughing and the repeated use of acidifying fertilizers leading to depletion of nutrients and loss of soil structure.
vi. **Awareness:** knowledge that something exists or understanding of a situation or subject at the present time based on information or experience.
vii. **Adoption**: acceptance and using the learned technology or innovation. It is a decision of full use of an innovation as the best course of action available. In this study, adoption means the use of the zero or minimum tillage system or the use of fertiliser trees or maintenance of crop residues. Crop rotation by itself in this study is not considered to be an adoption of CF technology because it has been used even under convention farming.
viii. **Adaptation to climate change**: actions aimed at coping with climatic changes that cannot be avoided and at reducing their negative effects. It is the process of adjustment to actual or expected climate and its effects. In human systems, adaptation seeks to moderate or avoid harm or exploit beneficial opportunities. The IPCC defines adaptation as "adjustment in natural or human systems in response to actual or expected climate stimuli or their effects, which moderates harm and exploits beneficial opportunities," Anne T. Kuriakose, Rasmus Heltberg, William Wiseman,. Cecilia Costella, Rachel Cipryk, and Sabine Cornelius (2012). In some natural systems, human intervention may facilitate adjustment to expected climate and its effects. Adaptation responses seek to reduce or mitigate adverse impacts of climate change.
ix. **Small holder farmers**: Those farmers who cultivate or use up to 20 hectares of land and are mainly subsistence. They use the land resource in varied proportions to meet both subsistence needs and/or cash needs. Food security is dependent on their ability to produce sufficient amounts of food crops on their fields for their own consumption and they rely on rain fed farming.
x. **Advocate:** support strongly/encourage, recommend, urge by argument.
xi. **Vulnerability**: the degree of exposure to risk (the likelihood of shocks and stresses occurring and their potential severity) and the capacity of households or individuals to prevent, mitigate or cope with its effects. It is the propensity or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts and elements including sensitivity or susceptibility to harm and lack of capacity to cope and adapt.
xii. **Sustainability** – meeting current human needs while preserving the environment and natural resources needed by future generations.
xiii. **Resilience**- the ability to manage and adapt; ability to learn, cope and maintain future options.

CHAPTER TWO LITERATURE REVIEW

It is generally held that climate change is real and is one of the greatest threats facing the world today. Climate change is widely acknowledged as one of the greatest environmental and developmental challenges of our time. It has the potential to impact negatively on almost all sectors of the economy, thereby hampering economic growth and development; essentially, climate change reduces development effectiveness. (Egenhofer and Georgier, 2009). Recent years show increasing temperatures in various regions, and/or increasing extremities in weather patterns. Significant advances in the scientific understanding of climate change now make it clear that there has been a change in climate that goes beyond the range of natural variability.

Climate related hazards exacerbate stressors often with negative impacts especially on the poor. It is further reviewed that climate related hazards mostly affect the rural poor directly through impacts on livelihoods and reduction in crop yields as they depend on rain fed agriculture and this calls for adjustments in farming methods as one of the adaptive measures. Climate change affect crop production, water access and availability, human and livestock health and may also cause damage to dwellings and infrastructure. Climate change is said to have resulted in changes in yields, water shortages, and possible increases in pests and livestock disease incidence whereby affecting small holder farmers' incomes (GRZ 2013). This is in agreement with Kanyanga (2008) who states that vulnerability to climate change can be exacerbated by other stresses which arise from, for example, current climate hazards, poverty and unequal access to resources, food insecurity, trends in economic globalization, conflict and incidence of diseases such as HIV/AIDS.

According to Mwanza (2013), up to 80% of the people of Sub Saharan Africa largely depend on agriculture for their livelihoods and survival, making them profoundly vulnerable to natural and socio economic shocks that affect agricultural production. These shocks arise in part from low crop and soil productivity, the effects of extreme weather events and changing climate on food production, and high prices of agricultural inputs and food commodities. The implication of such shocks and effects is that attaining food security and development goals at the household, national, regional and global levels requires a shift from conventional to more efficient and sustainable food production practices. The common farming practices by the majority of farmers in sub-Saharan Africa are characterised by extensive soil disturbance through ploughing, low use of inputs and exploitation of fragile lands (Mwanza 2013). Burton et al (2006), contend that the production of food crops is the most climate-dependent economic activity.

According to (Mwanza 2013) more than 60% of Zambians live in rural areas, with the majority depending on subsistence rain-fed agriculture, and relying on a good precipitation for their livelihoods. The use of solid fuels is also a huge concern which stands at 80% of Zambian's population and about 300,000 to 400,000 trees are cleared annually through unsustainable practices and that puts enough pressure to our forestry which plays an important role both in sustaining our rural families and absorbing carbon dioxide. Saasa (2003) contend that small and Medium (Smallholder farmers) combined contribute about 60% of agricultural output and therefore increasing these farmers' productivity has the potential to make an important contribution to agricultural output and general economic growth of the country. He furthers points out that in many parts of Africa including Zambia, stagnant productivity, population pressure, environmental

degradation and the threat of climate change suggest an increasingly bleak future for millions of rural families whose livelihoods largely depend on farming.

According to the IPCC (2007), adverse effects of climate change continue to be a major threat to rural livelihoods and this poses a challenge of developing innovative technologies to improve rural livelihoods and environmental conservation and ensuring adoption of such technologies. Other scholars also argue that in an era where climate change is central in development policies and practice, conservation agriculture appears to potentially contribute in addressing the challenge of adapting agricultural practices to climate change (Haggblade, Steven Kabwe & Christina Pleroples (2011). The threat that is posed by climate change and environmental degradation which have consequently lead to food insecurity especially in Africa and in Zambia in particular have given rise to the initiation of adaptive measures. According to the Pilot Programme for Climate Resilience (PPRC), Zambia experienced a 6 per cent decline in rainfall during the period 1971-2005 relative to 1940-1970. It is further reported that the rainfall seasons in the southern part of Zambia have become less predictable and shorter, most notably in the South-Western region, with the rains being received in fewer, more intense, events. One of the adaptive measures that are being promoted is conservation farming which encompasses improved tilling and planting methods; crop rotations and intercropping practices.
Scherr (1999) contend that changes in climate can be expected to have significant impacts upon crop yields through changes in both temperature and moisture. As climate patterns shift, changes in the distribution of plant diseases and pests may also have adverse effects on agriculture. At the same time, agriculture has proven to be one of the most adaptable human activities to varied climate conditions. Table 1 below shows that there are potential global benefits associated with the adoption of conservation farming. For example, there is a link between carbon sequestration in soil and global warming as the long-term capture of carbon in organic matter reduces the atmospheric load of carbon. However, the benefits associated with carbon sequestration in soil may be elusive if soil degradation results in a transfer of carbon from one location to another with no net release to the atmosphere. Conservation farming advocators encourage zero or minimum tillage farming practices because they believe that the benefits to be gained from carbon sequestration will depend on the soil remaining undisturbed.

Table 1: Ecosystem functions of lands under conservation agriculture and the global consequences of non-adoption

Ecosystem functions of soil (indirect use values)	Potential global or regional consequences of soil degradation
Supports domesticated plants (e.g. crop) and animals (e.g. livestock)	Loss of crop/livestock production, leading to eco-refugee problems & famine; international intervention required
Supports wildlife habitat	Loss of globally important biodiversity
Source of micro-nutrients for human consumption (e.g. food quality vs. quantity)	Dietary deficiencies and diseases, requiring international intervention
Buffering & moderation of hydrological cycle (e.g. drainage, temporary storage, etc.); watershed protection	Flooding, soil transport and trans-boundary sedimentation problems; poor infiltration leads to reduced crop yields (see above)
Decomposition & recycling (e.g. waste disposal)	Loss of significant soil microbe & earthworm biodiversity (e.g. *penicillin, streptomycin*); waste accumulation of global proportions
Regulation of atmospheric gases & elemental cycles (e.g. carbon sequestration)	Greenhouse gas releases and global warming linkage as organic matter is removed

Source: adapted from Scherr, 1999.

It is further reviewed in literature that conservation farming as promoted in Sub-Saharan Africa and in Zambia in particular is donor driven and mostly deals with very small study sample sizes. According to Nyanga et al (2011), most of the studies have focused on comparing conservation farming systems with the conventional farming methods. These scholars also lament that a handful of studies have compared output differences between conservation farming and conventional tillage plots and these studies have mostly relied on very small numbers of farmers that are trained in these conservation farming technologies (Nyanga et al 2011).

It is also clear from the available literature that not much study has been conducted on the factors that determine the adoption of conservation farming technologies. There are very few researchers on conservation farming if any that have tried to understand why smallholder farmers are not adopting the new technology.

Aagaard (2007) contend that conservation farming methods are easy to follow and farmers who adopt them will reduce costs and increase yields, improve their nutrition, minimise the chances of crop failure in drought years, increase their profits and in time improve soil fertility of their land. It is for this reason that small holder farmers are encouraged to shift from the conventional methods of farming which destroy the land and undermine the future to conservation farming which is a more productive, efficient and environmentally sustainable way of production.

In a number of developing countries the conservation farming technology is being adopted by communities or is being introduced by pilot projects as a measure of adaptation to climate change." However, the level of adoption is still very low, with the total area of coverage estimated to be less than 1%. Despite the sound technical, agronomic and environmentallyfriendly merits of conservation farming, its uptake in Africa has been hindered by a number of factors. Key among them is an inadequate enabling policy environment to promote its adoption "(IFAD 2011:16). Other factors include ownership of farming implements, land tenure systems, access to technological knowledge just to mention a few. Consequently, the uptake of conservation farming technologies has mainly been driven by donors and NGOs. However, these efforts are frequently not well coordinated and there is a need for more coordinated support of Conservation farming/agriculture. (Ibid 28)

Haggblade, Steven Kabwe and Christina Plerhoples (2011) explain that conservation farming started as conservation agriculture in the United States (US) out of ecological and economic hardships caused by catastrophic droughts during the 1930s and became popular among farmers because of the escalating fuel prices during the 1970s.This lead many commercial farmers to adopt minimum tillage technologies as a means of combating the drought induced soil erosion and also to save on fuel costs. Conservation agriculture was also seen to have the technical potential to increase productivity by improving water retention capacity, fixing nitrogen and enabling timely planting.

According to IFAD (2011), in Africa conservation Farming (CF) was developed in response to continuously declining land productivity under "conventional" systems based on massive soil tillage. Conservation farming practices revolve around three principles: (i) minimising soil disturbance, (ii) maintaining a permanent soil cover and (iii) practising crop rotations. Simultaneous application of these principles allows farmers to better manage available soil, water and biological resources as well as farm inputs and labour.

However, the adoption of technology in Sub Saharan Africa has lagged behind. Concerns have been raised as to the suitability of the technology within small holder farming context (IFAD 2011). In Zambia Conservation Farming emerged as a by-product of technology transfer by commercial farmers who adopted foreign minimum tillage systems for their own use and later supported scaled down versions for small holder farmers living in regions II a and II b which receive low to medium rainfall and it was formally introduced in 1996 by the Conservation Farming unit, an affiliate of the Zambia National Farmers' Union in response to the 1995 drought (Ibid). According to the MTENR (2007), the agriculture sector in Zambia has been in the doldrums for several years due to overwhelming dependence on rain fed agriculture which is also dominated by a mono maize production system.

Sharmalene et al (2003) argue that increasing knowledge and awareness of potential implications of climate change may enable us to better prepare for changes that our future generations will face.

Awareness, knowledge and skill are some of the factors influencing the adoption of conservation farming. Nyanga et al (2011) contend that technology adoption has been guided mainly by innovation-diffusion paradigm, economic constraint paradigm and the adopter perception paradigm. These further allude that Rogers' innovation-diffusion paradigm identifies information dissemination as a key factor in influencing adoption decision.

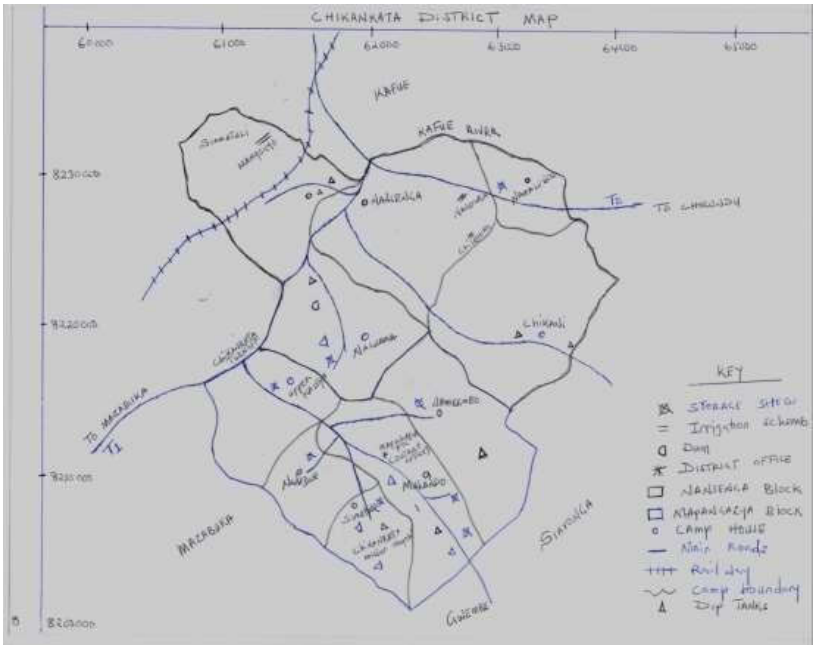
What this means is that if information about climate change and conservation farming is not disseminated to the smallholder farmers, they will not be aware and hence they will not adopt the much preached CF technologies. Nyanga et al (2011) further argue that the adoption process starts with the adopters 'perception of the problem and technology proposed and these perceptions are context and location specific due to other factors that affect them such as culture, education, gender and age.

However it is argued that smallholder farmers in Zambia are aware of climate change through their experiences (Nyanga et al 2011) and in a study by Vincent et.al (2011) on smallholder farmers` response to past and current climate change conditions, it has been observed that farmers have been carrying out a wide range of response strategies to maintain their livelihoods and these strategies are; modifying farming practices; modifying crop types and varieties; resource management; and diversification of activities despite having many constraints.

From the literature reviewed, it is clear that there has been research carried out especially on conservation farming in Zambia but nothing much has been recorded to have been done on awareness of both climate change and conservation farming. It is also realised that sample sizes have been small and therefore not representative enough. It is also clear from the available literature that despite the efforts by public and private organizations in Zambia to promote adoption of conservation farming (CF) among smallholder farmers in Zambia, the adoption rate has been generally low. It is estimated that 10% of the smallholder farmers adopt some form of CF practices in Zambia (Haggblade & Tembo, 2003; CFU, 2005). It is also documented by Arslan, McCarthy, Lipper, Asfaw, & Cattaneo, (2013) that there are high levels of dis adoption (around 95%). Hence there is still need for more research on climate change and suitable adaptation measures and also on how best we can motivate the smallholder farmers to adopt conservation farming which according to Derpsch, Fredrick. Kassam, and Hongwen, (2010) offers ways of optimising productivity, responding to climate change, environmental degradation and increasing costs of energy, production inputs and food. As Arslan et al (2013) argue the rigorous analysis of determinants of adoption / dis adoption of the CF practices are still scarce. This calls for more research.

CHAPTER THREE
METHODOLOGY
3.1. RESEARCH DESIGN
The study used both qualitative and quantitative design. Qualitative and Quantitative data was collected using a questionnaire with both open and closed ended questions. Qualitative data was also collected using focus group discussion on farmer trainers and also using an interview schedule on Key Informants.
The study was conducted in Chikankata district in the southern province of Zambia. Chikankanta district lies within ecological region Iia and receives low to medium rainfall.it is line of the 16 districts where conservation farming was established. Figure 2 below shows the map of Chikankata district.

Figure 2: Chikankanta District Sketch Map



Source: Author's Field research 2016

3.2. TARGET POPULATION
The study targeted small holder farmers in Chikankata district, thus it was conducted in Chikankata district which lies in the southern province of Zambia. Chikankata district has been purposively selected because it is the researcher's area of practice. The area also falls within ecological region Iia which receives between 800 to 1000mm of rainfall per annum (low to medium) and this makes it vulnerable to droughts. Furthermore, the area is vulnerable to land degradation resulting from deforestation. Chikankata is a rural district as a result most of the land has been cleared for farming practices. The district comprises of two farming blocks namely Mapangazya and Nansenga farming blocks with a total population of 22,911 smallholder farmers on register as at 2015 farming season. Each block has five agricultural camps.

3.3. SAMPLE SIZE
A total of 116 small holder farmers were selected using simple random sampling method. Simple random sampling was used because it yields research data that can be generalized to a larger population. It also allows the researcher to apply inferential statistics to the data and provides equal opportunity of selection for each element of the population (Kombo and Tromp, 2006). This is also in line with Singh (2006) who asserts that ideally, a representative or random sample would be desirable to provide maximum information in order to be able to generalize the findings of research data.

3.4. SAMPLING PROCEDURES
Purposive sampling was employed to select the farming block to be studied. This method was applied due to the geographical localities of the blocks and also the population of farmers in these blocks. According to Singleton et al (1988) in Creswell (1994), purposive sampling is a sampling procedure which is based entirely on the judgment of the researcher in which a sample is composed of elements that contain the most characteristics, representative or typical attributes of the population. Mapangazya farming block has been purposively sampled because it has the largest number of farmers on register in the district. Three camps have been selected using simple random sampling method. Simple random method has been used so as to give each camp in the district an equal chance of being included in the sample. Then two villages were purposively selected per camp. This was determined by the population of registered farmers in these villages. Villages with the highest number of farmers on register were purposively selected. The smallholder farmers were selected using systematic sampling method per village. The sample size was determined by using the recommendation by Boyd et al (1981) of at least 5%. The samples were as shown in table 2 below:-

Table 2: Target population per sample village and sample size

CAMP	VILLAGE	TARGETPOPULATION	SAMPLE SIZE
NAMEEMBO	HAPWAYA. A.	292	15
	NAMEEMBO	212	11
SIMUTWE	CHIKANKATA	669	33
	HAMPANDE	563	28
UPPERKALEYA	CHOOMBE	313	16
	MUNYIINYA	252	13
TOTAL		**2301**	**116**

3.5. 0. TYPES AND SOURCES OF DATA
In this study, both primary and secondary data was collected.

3.6.1. PRIMARY DATA
According to Churchill (1987), primary data is originated by the research for purpose of the investigation at hand. In this study, primary data was obtained by using structured questionnaires with closed and open ended items which were administered to the randomly sampled farmers. Primary data was also obtained from agricultural camp officers, conservation farming field officers and lead farmers using Key Informants interview and focus group discussions.

3.6.2. SECONDARY DATA
The secondary data was collected from the published and unpublished literature, the print and the electronic Medias were used and these included various electronic journals and research papers available on the internet.

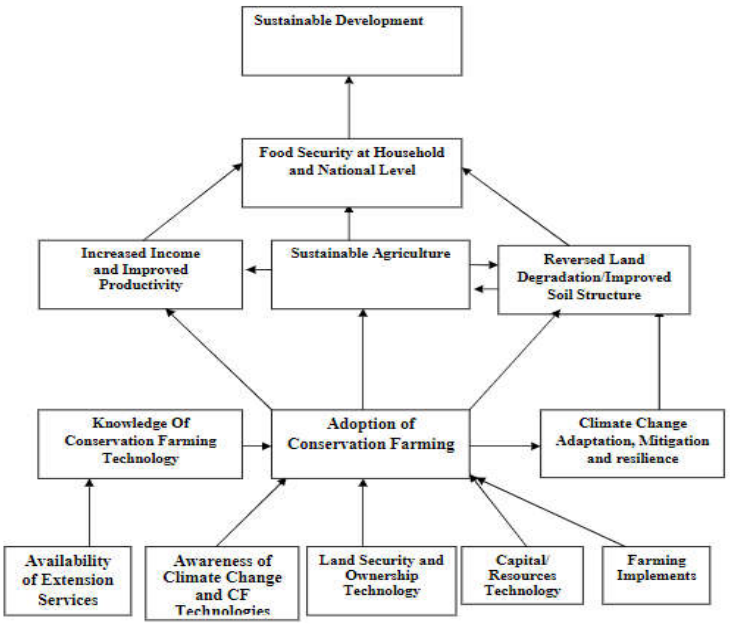
3.7.0. RESEARCH INSTRUMENTS
Semi-structured questionnaires were used to collect relevant data from smallholder farmers. This method was used because it helps in collecting more detailed and rich information from the respondents. An interview guide was used on agriculture/ camp officers and conservation farming field officers who are the key informants. A focus group discussion was conducted with the lead farmers from the various villages or communities.

3.8.0. DATA ANALYSIS
The data was coded using a coding scheme. It was later processed and analysed using the
Statistical Package of the Social Sciences (SPSS).

3.9.0. THEORETICAL FRAMEWORK ON THE ADOPTION OF C F.
This study is based on the theory that the decision of a farmer to adopt conservation farming is largely influenced by a number of factors which can be classified as socio-economic and institutional factors. Socio-economic factors are age; gender; marital status, education level; household size; household income and farmer's perception, whereas institutional factors include membership to a farmer organization, access to extension services and access to credits/loans.

The theory of change in this case is that if extension services are available to farmers and they become aware of conservation farming as an adaptation measure to climate change and they have adequate land and other farming implements, then they will adopt conservation farming technologies. The adoption of conservation farming will make the farmers more resilient to the impacts of climate change. This adaptation measure will in turn lead to improved soils and increased productivity. As a result there will be sustainable agriculture which in turn will lead to improved income and also food security at household and national level. This will contribute to sustainable development. This is shown in the conceptual framework in figure 3 below:-

Figure 3: Conceptual Framework on the Adoption of Conservation Farming in relation to climate change



3.9.1. ETHICAL ISSUES

The study adhered to ethical issues in research. The purpose of the study was explained to the respondents before undertaking the exercise and the respondents were not forced to participate in the study. The names of the respondents were not published or recorded. Thus confidentiality was highly upheld.

CHAPTER 4
FINDINGS OF THE STUDY

4.1.1. CHARACTERISTICS OF THE RESPONDENTS
4.1.1.0. GENDER OF RESPONDENTS

Table 3 Gender of respondents

Gender	Frequency	Percent	Valid Percent	Cumulative Percent
Male	64	60	60	60
Female	43	40	40	100
Total	107	100	100	

Of the total sample of 116 small holder farmers, sixty per cent (60%) of the respondents were males and forty (40%) were females. However, only 64 males and 43 females were interviewed as the other 9 had either moved or died at the time of the study.

4.1.1.1 AGE

Respondents were categorized in different age groups in order to assess whether age has an influence on the adoption of conservation farming technologies. Table 4 below shows the various age groups of respondents:-

Table 4: Age of respondents

Age	Frequency	Percent	Valid Percent	Cumulative Percentage
15-25	11	10.3	10.3	10.3
26-36	29	27.1	27.1	37.4
37-47	33	30.8	30.8	68.2
48-58	27	25.2	25.2	93.4
59-69	5	4.7	4.7	98.1
70-80	2	1.9	1.9	100.0
Total	107	100.0	100.0	

Of the total number of respondents that answered the questionnaires, 89 respondents fall between the ages 26 and 58 representing 83.2%, followed by ages 15 to 25 with 11 respondents representing 10.3% and ages 59 to 69 with 5 respondents representing 4.7%. The least represented age is that of respondents aged 70 and above. This category had 2 respondents representing 1.9%. Generally most of the respondents fall between ages 37 and 47 and this under normal circumstances is the most productive age.

4.1.1.2 MARITAL STATUS OF RESPONDENTS

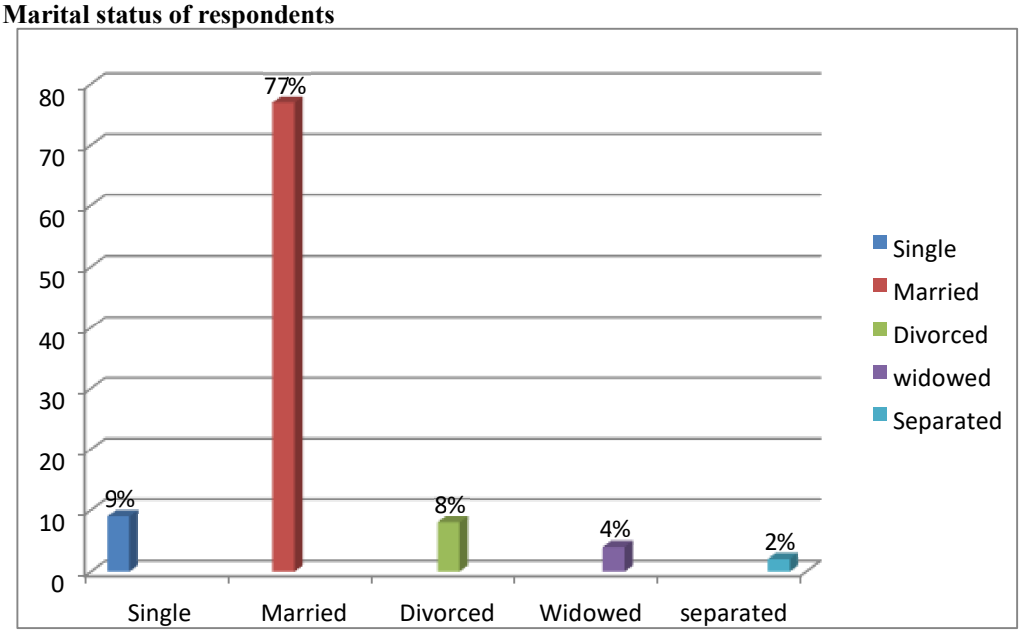
The respondents were also asked to state their marital status. This was in order to asses where marital status had an influence on the adoption of conservation farming. The results are presented in table 5 below:-

Table 5: Marital status of respondents

	Frequency	Percent	Valid Percent	Cumulative Percent
Single	10	9.3	9	9 86
Married	82	76.6	77	94
Divorced	9	8.4	8	98
	4	3.7	4	100
Widowed	2	2.0	2	
Separated				
Total	107	100.0	100.0	

The findings presented in Table 5 above review that seventy seven percent (77%) of the respondents are married, nine percent (9 %) are single, eight percent (8 %) are divorced, four percent (4%) are widowed and two percent (2%) are on separation representing. Hence the study has revealed that most of the respondents were married. This is graphically presented in figure 4 below:-

Figure 4 : Marital status of respondents



4.1.1.3 LEVEL OF EDUCATION

Table 6: Level of education

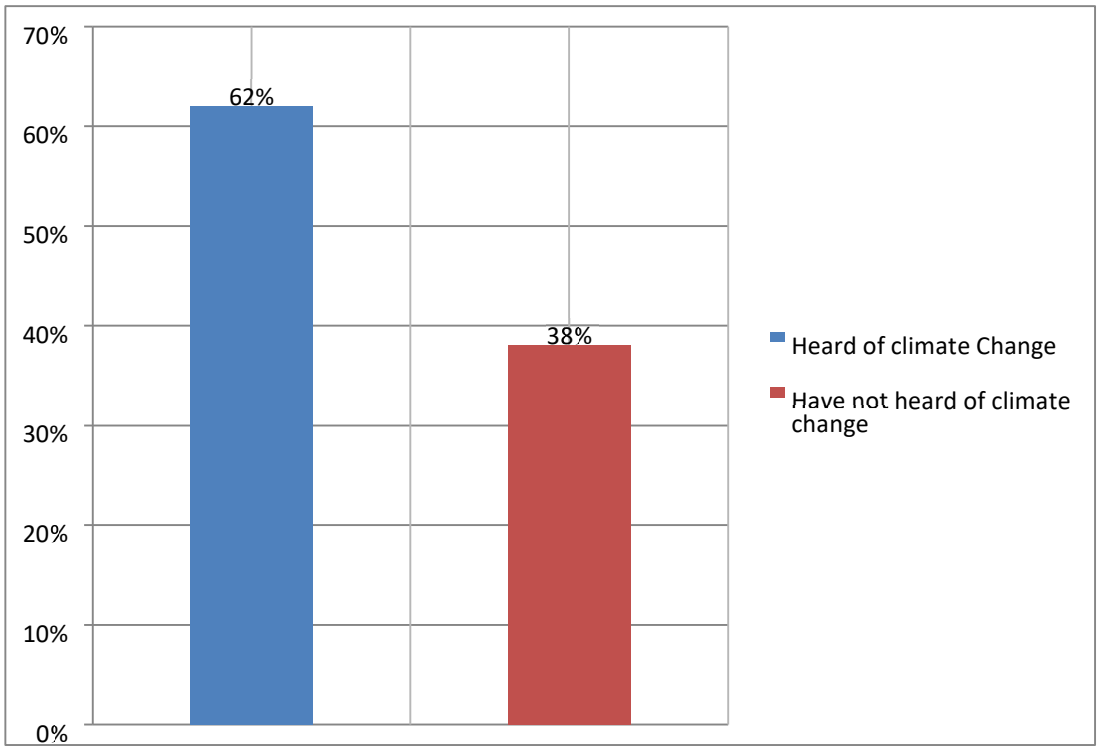
Education level	Frequency	percent	Valid Percent	Cumulative percent
Non Formal	6	5.6	5.6	5.6
Primary	47	43.9	43.9	49.5
Secondary	48	44.9	44.9	94.4
Tertiary	6	5.6	5.6	100.0
Total	107	100.0	100.0	100.00

The table above shows that 43.9 % of the respondents have attended primary education and 44.9 % have attended secondary education. However, only 5.6% of the total respondents have managed to reach tertiary level. The findings further reveal that most of the adopters have attained either primary education or both primary and secondary education.

4.2 LEVEL OF AWARENESS OF CLIMATE CHANGE AND CONSERVATION FARMING TECHNOLOGIES BY SMALL HOLDER FARMERS IN CHIKANKATA DISTRICT.

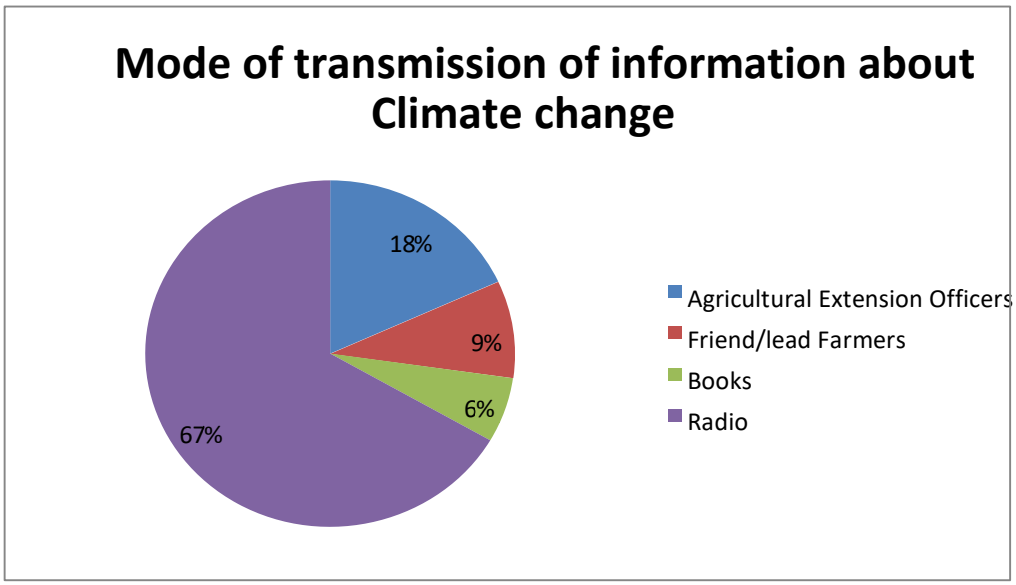
In order to achieving this objective, respondents were asked whether they have heard about climate change. Sixty two per cent (62%) of the respondents said they have heard of climate change and thirty eight percent (38%) of the respondents said they have not heard of climate change. This is shown in figure 5 below:-

Figure 5: Respondents that have heard of climate change



Those that have heard about climate change were further asked how they came to know about climate change. Twelve (12) respondents said they heard about climate change from extension officers, six (6) heard from friends/lead farmers, four (4) from books and forty four (44) from the radio. This is illustrated in figure 6 below:-

Figure 6: Mode of transmission of information about climate change



Respondents were also asked to mention if they have heard about conservation farming technologies. Sixty six (66) representing eighty five percent (85%) of the respondents said they have heard and are aware of conservation farming technologies and fifteen percent15% of the respondents said they have never heard of conservation farming technologies. This is illustrated by figure 7 below:-

The respondents were further asked to state how they learned about conservation farming. This was in order to assess the modes of transmission of agricultural information.

The findings review that forty five percent of the respondents received the information from agricultural extension officers/CFU officers, thirty two percent heard from the radio, nineteen percent heard it from friends or lead farmers and four percent read from books as tabulated in table 7 below:-

Awareness was also measured by the number of respondents that have attended field days where information about climate change and conservation farming is disseminated. During field days, farmers are trained or sensitized on conservation farming technologies. Out of the one hundred and seven (107) respondents, fifty three (53) have attended field days before and fifty four (54) respondents have not.

Figure 7: Respondents that have heard of conservation farming

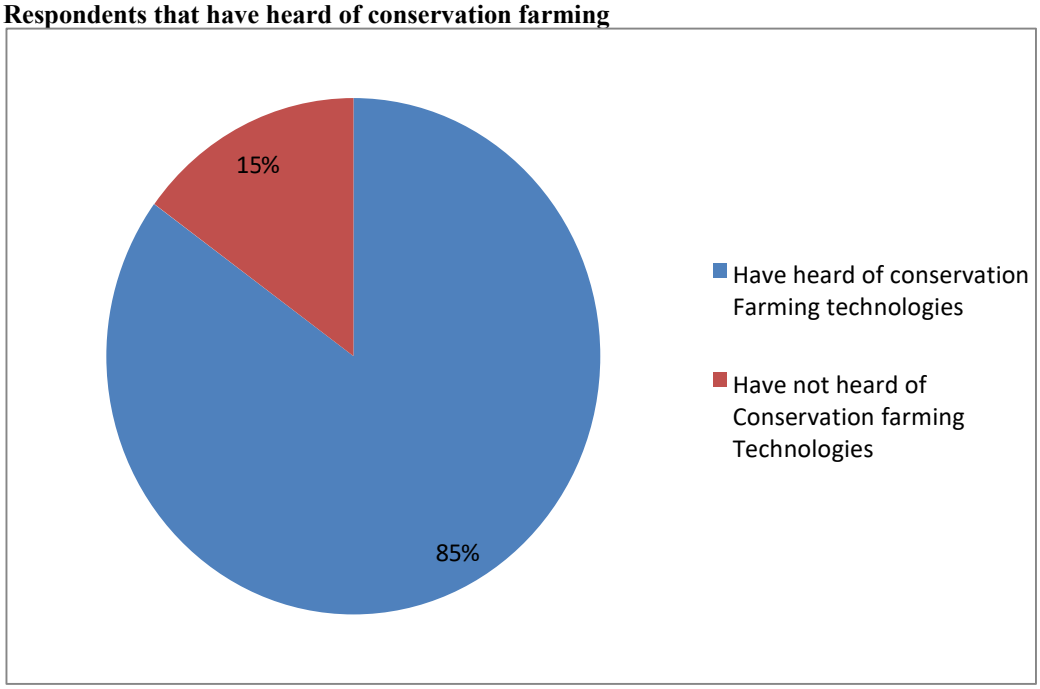


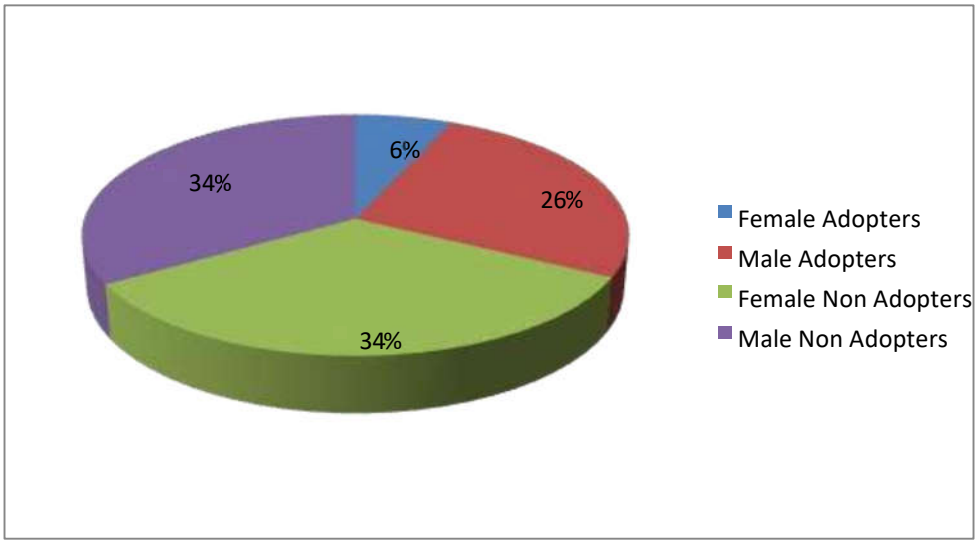
Table 7: Mode of transmission of information about conservation farming

Mode of transmission	Frequency	Percentages
Agricultural Extension Officers/CFU	41	45
Friends/lead Farmers	17	19
Books	4	4
Radio	29	32
Total	**91**	**100**

4.3. PREVALENCE AND TYPE OF ADOPTION OF CONSERVATION FARMING TECHNOLOGIES

Out of the 107 respondents that answered the questionnaires, thirty four (34), representing 32 % have adopted conservation farming technologies and seventy three (73) have not adopted the technologies representing 68%. Twenty eight (28) of the adopters are males representing 26% and six (6) are females representing 6% as clearly shown in figure 8 below:-

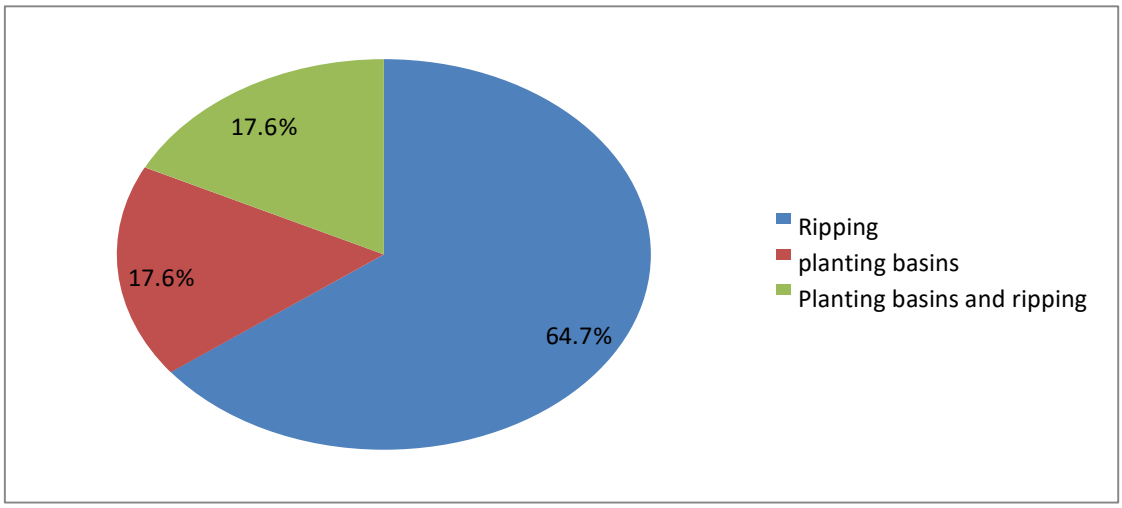
Figure 8 : Gender of Adopters and Non-adopters



Adopters of conservation farming technologies were further asked to mention whether they were using any of the following conservation farming methods; No till, ripping, planting basins, maintenance of crop residues and use of fertilizer trees. Twenty two (22) of the thirty four (34) adopters are using ripping, six (6) are using planting basins and six (6) are using both ripping and planting basins.

Figure 9 below shows the commonly used conservation farming technologies in Chikankata district. The results indicate that ripping is commonly used, followed by planting basins.

Figure 9: Commonly used conservation farming technologies in Chikankata District



4.4.0. THE NATURE OF HOUSEHOLD CHARACTERISTICS AND HOW THEY INFLUENCE THE ADOPTION OF CONSERVATION FARMING TECHNOLOGIES

Respondents were also asked to state what farming assets they have, livestock and their level of income. The tables 8 and 9 below show the number of farmers that own different farming assets and live stocks.

4.4.1. FARMING ASSETS OWNERSHIP

The study revealed that 17 out of the 107 respondents own rippers, 67 own ploughs, 41 own harrows, 89 own hand hoes, 8 own ridgers, 8 own cultivators 44 own sprayers 1 owns a Sheller and 1 owns a Chaka hoe. Notable here is that each asset is independent and as such each individual farmer can own more than one item. It is how ever important to note that the highest percentage (62.6%) of small holder farmers own ploughs which are not recommended for use in conservation farming. This is presented in Table 8 below:-

Table 8: Farming assets ownership

Farming assets ownership	Frequency	Percentage
Ripper	17	15.9
Plough	67	62.6
Planter	00	00
Harrow	41	38.3
Tractor	00	00
Sheller	1	0.9
Hoes	89	83.2
Chaka Hoe	1	0.9
Ridger	8	7.5
Cultivator	8	7.5
Sprayer	44	41.1

4.4.2. LIVESTOCK OWNERSHIP

Respondents were asked to state whether they owned any livestock. Livestock ownership is a measure of wealth in a traditional set up. Those farmers with a larger number of livestock are considered to be rich as they can sell their livestock when need arises. Cattle are also used for draught power and those farmers with cattle have readily available draught power and they are more likely to adopt conservation farming technologies. Table 9 below shows the types of livestock owned by the small holder farmers in Chikankata District:-

Table 9: Livestock ownership

Livestock	Frequency	Percentage
Cattle	57	53.3
Draught Oxen	57	53.3
Goats	65	60.7
Chickens	71	66.4
Turkeys	23	21.5

The above table reveals that most of the respondents own small livestock i.e. goats and chickens with 60.7% and 66.4% respectively and 53.3% own cattle and/or oxen.

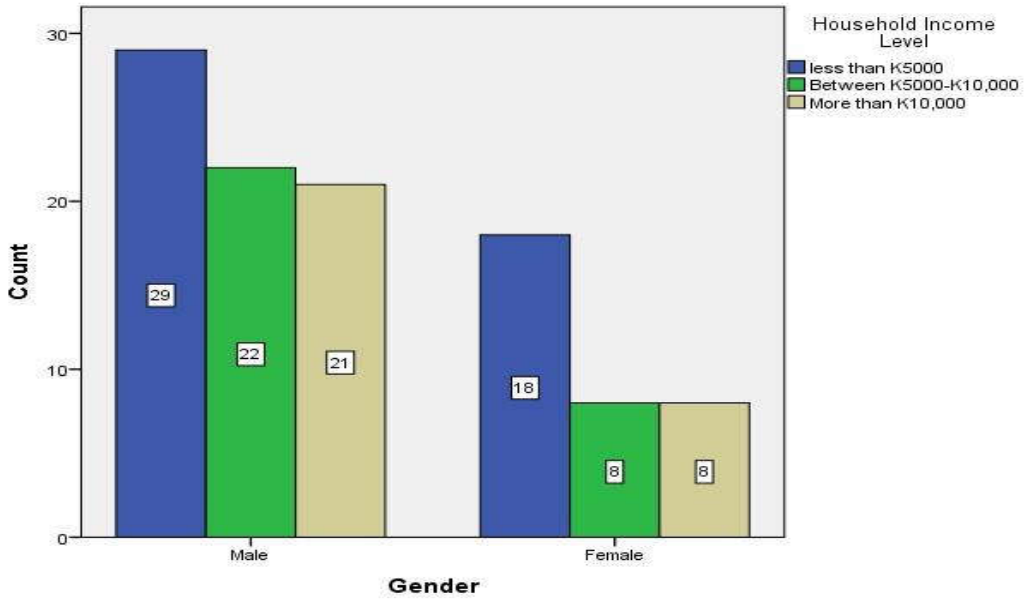
4.4.3. HOUSEHOLD INCOME

Respondents were also asked to state their annual income and the sources. The figures below show the household income levels and the sources of income. The findings reveal that forty seven respondents, representing forty four percent (44%) get less than K5000.00 household income per annum, thirty representing twenty eight percent (28%) get between K5000 and K10 000 and twenty nine, representing twenty seven percent (27%) get above K10 000 as shown in table 10 below:-

Table 10: Household income levels by gender

		what is the average annual household income			Total
		less than K5000	Between K5000K10,000	More than K10,000	
	Male	29	22	21	72
	Female	18	8	8	34
Total		47	30	29	106
Missing data					1

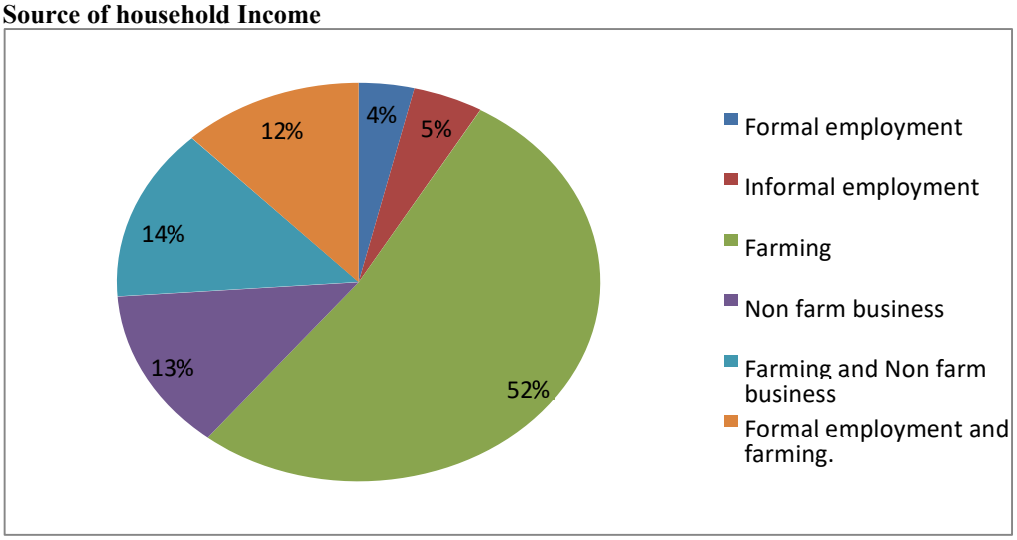
Figure 10: Household income levels by gender



4.4.4. SOURCE OF HOUSEHOLD INCOME

The findings of this study reveal that farming is the main source of income for most of the smallholder farmers in Chikankata District. Farming in this study refers to both crop and livestock production. Fifty two percent (52%) of the respondents have farming as their main source of income, fourteen percent (14%) get their income from both farming and nonfarm businesses. None farm businesses include any other business other than farming such as retail business. Thirteen percent (13%) of the respondents get their income from nonfarm business; twelve percent (12%) get their income from formal employment and farming, five percent (5%) from informal employment and four percent (4%) from formal employment. Informal employment comprise of employment outside the formal sector (daily employment). This is shown in figure 11 below:-

Figure 11: Source of household Income



4.5. FACTORS WHICH SIGNIFICANTLY INFLUENCE THE ADOPTION OF CONSERVATION FARMING TECHNOLOGIES

In order to achieve the above objective, respondents were asked to rate how the following factors affect the adoption of conservation farming. The factors include the Age, Gender, level of education, Ownership of land, knowledge/awareness, Capital/household income, and ownership of farming equipment, availability of labour, and membership to a farmer organisation, availability of extension services, availability of donor aid, livestock ownership and the availability of draught power. From the findings, it is clear that capital is rated as a major factor that influences the adoption of conservation farming technologies, followed by availability of extension services, knowledge/awareness and ownership of farming equipment, availability of draught power, availability of family labour and membership to farmer organization. These results are presented by Table 11 below:-

Table 11: Rating of factors that influence adoption of Conservation farming

Factors that affect adoption of conservation farming technologies.	Respondents' ratings of the factors that influence the adoption of conservation farming technologies				
	Strongly disagree	Disagree	Not sure	Agree	Strongly agree
Age	11	10	37	32	17
Gender	9	16	51	21	10
Level of Education	6	6	18	34	43
Land Ownership	0	3	15	43	46
Knowledge/Awareness	0	0	2	14	91
Capital/ Income	3	0	2	7	95
Ownership of farming equipment	1	2	2	11	91
Availability of labour	2	5	17	30	53
Membership to a farmer organisation	3	4	5	43	52
Availability of Extension services	3	2	6	4	92
Donor aid availability	8	13	19	25	42
Livestock Ownership	2	7	3	15	80
Availability of draught power	2	4	5	13	83

4.6. THE NATURE OF FARMING CHALLENGES CONTINUALLY FACED BY ADOPTERS AND NON-ADOPTERS OF CONSERVATION FARMING TECHNOLOGIES.

As a way of achieving this objective, respondents were asked to state the challenges they were continually facing in farming. Table 12 below shows the major challenges that were raised by the farmers:-

Table 12: Challenges continually faced by farmers

Challenges	Frequency	Percentage
Lack of Capital (finances)	77	72
Lack of farming Equipment (Assets)	72	67
Lack of draught power	59	55
Lack of information	54	51
Inadequate farming inputs	78	73
Lack of Labour	20	19
Climate change	65	61
Inadequate extension services	57	53
Delays in receiving farming inputs (FISP pack)	71	66
Shortage of land	23	22

Source: Field Research 2016.

The findings review that inadequate farming inputs, lack of capital (financial resources), lack of farming equipment and delays in receiving farming inputs under the Farmer Input Support Programme (FISP) are the major challenges that are continually faced by the smallholder farmers in Chikankata district. Most of the challenges above are faced by both adopters and non-adopters of conservation farming technologies as shown by Table 13 below:-

Table 13: Challenges faced by both Adoptees and non-Adopters

Challenges	Adopters	Non-Adopters
Lack of Capital	✓	✓
Lack of farming Equipment	✓	✓
Lack of draught power	✓	✓
Lack of information		✓
Inadequate farming inputs	✓	✓
Lack of Labour		✓
Climate change	✓	✓
Inadequate extension services		✓
Delays in receiving farming inputs (FISP pack)	✓	✓
Shortage of land	✓	✓

4.7. FINDINGS FROM THE KEY INFORMANTS AND THE FOCUS GROUP DISCUSSION.

All the key informants and discussants acknowledged that the majority of the smallholder farmers in Chikankata District are aware of climate change and of Conservation farming as an adaptation measure to climate change. They also admitted that there are organizations working currently working in the district to promote conservation farming such as the Conservation Agriculture Scaling Up (CASU) funded by the FAO and the Conservation Farming Unity (CFU) funded by the Norwegian Government. The key informants also lamented that despite the promotions, the adoption of conservation farming in the district is still low.

Both the key informants and the focus group attributed the low adoption rates to the many challenges that are faced by farmers and these include lack of farming implements, lack of draught power, land ownership, lack of capacity to diversify, shortage of labour and lack of capital. However, the officer from the Conservation farming unit attributed the low adoption rate to the attitude of farmers. According to the CF field officer, even those farmers that have been trained and have knowledge and the capacity to adopt have not adopted. They are still using the conventional methods of farming and they don't want to change. He pointed out that most smallholder farmers do not take farming as a business hence they do not really plan and budget for farming. He further pointed out that most small holder farmers consider conservation farming to be an expensive undertaking, hence they continue with the traditional methods even after receiving the training.

CHAPTER 5
DISCUSSION OF THE FINDINGS

5.1. LEVEL OF AWARENESS OF CLIMATE CHANGE AND CONSERVATION FARMING TECHNOLOGIES BY SMALL HOLDER FARMERS IN CHIKANKATA DISTRICT.

The study has revealed that the majority of the smallholder farmers in Chikankata district have heard and are aware of climate change and conservation farming respectively. The results indicate that sixty six (66), representing sixty two percent (62%) of the respondents are aware of climate change and 91 respondents representing eighty five (85%) said they are aware of conservation farming technologies. Sharmalene et al (2003) argue that increasing knowledge and awareness of potential implications of climate change may enable us to better prepare for changes that our future generations will face. So those farmers who are aware and have knowledge about climate change and conservation farming technologies are more likely to adopt conservation farming technologies.

However, results from the study indicate that even farmers that are very knowledgeable and have received training on conservation farming technologies have not adopted the technologies. This clearly shows that it is not the lack of knowledge or awareness that is preventing smallholder farmers in Chikankata district from adopting conservation farming technologies. This implies that knowledge and awareness alone cannot drive a smallholder farmer to adopt conservation farming technologies. This to some extent is in agreement with Long and Long (1992)'s assertion that decisions take place within the information and constraints existing in society. There are other underlying factors that need to be taken into consideration. The findings of this study are also in in agreement with the findings of Nyanga et al (2011) who documented a wide spread awareness of climate change and conservation farming. This mainly qualitative study documented a widespread awareness of increased climate variability and the use of conservation farming as an adaptation and mitigation measure of climate change. There was a positive correlation between perception of increased climate variability and the use of CF, but no correlation between attitudes towards climate change itself and CF (Aslihan Arslan, 2013).

5.2. PREVALENCE AND TYPE OF ADOPTION OF CONSERVATION FARMING TECHNOLOGIES

The research findings show that very few of the smallholder farmers in Chikankata district are practicing conservation farming. Out of the one hundred and seven (107) respondents, only thirty four (34) have adopted conservation farming technologies representing thirty two (32%) of which twenty two (22) representing sixty four percent (64%) are using ripping, six (6) representing eighteen. (18%) are using planting basins and six (6) representing eighteen percent (18%) are using both ripping and planting basins. All these are minimum tillage systems. The other conservation farming technologies are not practiced such as the use of crop residues and planting of fertilizer trees. This is mainly due to land

tenure systems in the area. Fields are in most cases communally owned and they are not fenced and hence they are open for grazing immediately after harvesting and so crop residues are eaten by the grazing animals thereby disadvantaging the farmers who may have wanted to use crop residues. This is in agreement with Giller et al. (2009) who contend that in reality, farmers in Africa do not adopt all the principles of conservation agriculture for various reasons. These include land tenure systems; limited access to inputs; labour constraints; or insufficient resources to grow cash crops.
Therefore, what farmers practise may be quite different from the 'ideal' conservation agriculture?

The results further indicate that the level of adoption of conservation farming by small holder farmers in Chikankata district is still low despite the high yields under conservation farming. Those who have adopted ripping explained that ripping retains a lot of moisture in the rip lines there by making the crop to grow well even when there are dry spells due to climate change. They further explained that under ripping, yields are usually high because crop growth is not affected by the dry spells. They also explained that ripping reduces soil erosion since most of the land remains undisturbed and is also less labour intensive since weeds are usually being managed by spraying with herbicides. This is also in agreement with (IFAD 2011) which states that minimum mechanical soil disturbance through minimum or no-tillage, making basins or ripping planting lines helps to maintain soil organic carbon and its aggregates. The long-term benefits of minimum tillage systems include improved organic soil matter and structure; the establishment of a system of continuous macro pores, facilitating water infiltration and aeration of the soil, as well as root penetration into deeper zones; and the reintroduction of macro- and micro fauna and flora within the soil, resulting in better soil fertility. Those using rippers further explained that it is also less costly when you hire a tractor drawn ripper since you cover a large area within a short time and this enables one to plant well in good time. An example of a tractor drawn ripper and an ox/ animal drawn ripper (Magoye ripper is given in figures 12 and 13 below:-

Figure 1: Mechanised Min Till (Tractor drawn ripper)

Source: Aagaard P.J and the CFU team (2011)

Figure 13: Minimum tillage using the Magoye ripper.

A family practises small-scale conservation farming during the dry season by ripping furrows using a Magoye ripper.
Source: Conservation Farming Unit, Zambia.

However those that are using basins complained that digging of planting basins was labour intensive and they are just doing it because they had no draught power or capacity to hire. They further explained that they try to manage weeds by weeding using hand hoes and it is not an easy thing and hence they usually manage to cultivate just small portions and yields are usually small. Nevertheless, they pointed out that basins are good as they collect a lot of water when it rains enabling the maize to grow even during dry spells. These admitted that CF technologies are good if a farmer had the capacity to use them. Figure 14 below show how potholing is done using a hand hoe:-

Figure 14: Dry season potholing using a hand hoe.

Source: Piet Stevens (2009): Rain water harvesting Soil and Water Conservation.

5.3.THE NATURE OF HOUSEHOLD CHARACTERISTICS AND HOW THEY INFLUENCE THE ADOPTION OF CONSERVATION FARMING TECHNOLOGIES.

Most literature on conservation farming shows that household characteristics of the head of the household influence the farmer's decision to adopt the new technology. These characteristics include the following:- gender, age, level of education, household income, farming equipment ownership, livestock and draught power ownership, land ownership, access to FISIP/ loans and availability of family labour.

5.1.1 Gender

Generally female headed households are less likely to adopt a new technology than male headed households. This could be attributed to the differences in their wealth and other cultural factors. Ng'ombe et al (2014) contend that males are usually in a better position to attend extension meetings in a traditional set up where women are expected to stay at home and take care of the children and other house chores and thus men have more access to information on new agricultural technologies. The results of this study reveal that most of the adopters are males. Twenty eight (28) of the thirty four (34) adopters are males, representing 82.4%. This is a clear indication that to some extent gender is a factor in the adoption of conservation farming technologies.

5.1.2 Age

There is likelihood that the age of the household head can influence the adoption of conservation farming. Older farmers may not be enthusiastic to adopt new technologies such as CF as compared to young farmers who are expected to be more willing to try the new technologies (Ng'ombe et al 2014). This is so because older farmers have a lot of experience even this issue of climate change is not new to them. They say droughts have always been there and they have been managing even without the new technology. In this study thirty two (32) of the adopters fall between ages 26 and 58 and only one respondent was above the age of 59 and one was below 26 years.

5.1.3. Farming assets ownership and draught power.

Farmers who own farming assets are more likely to adopt than farmers who do not own farming assets and draught power. Out of the 34 adopters, 17 own and use rippers, 6 use hand hoes and 6 hire rippers which are either ox drawn or tractor drawn. The findings of this study indicate that ownership of the required farming assets such as rippers was a prerequisite for adoption. This is so because those farmers who own farming assets are able to plant early while those without are forced by circumstances to wait and hence may be caught up in the dry spells that usually occur. The study further revealed that only one of the adopters own a tractor. This implies that most of the adopters use ox drawn rippers which are slow as compared to a tractor drawn ripper.

5.1.4 Income levels

Results of this study reveals that of the 34 adopters of conservation farming technologies, 16 receive annual income of above K10 000, 10 have their annual income ranging between K5 000 and K10 000 and 8 receive annual income of below K5 000. This to some extent indicates that income level has a bearing on the adoption of conservation farming technologies. Farmers with high income levels are more likely to adopt conservation farming technologies because these have the capacity to buy or hire labour, farming implements and even draught power.

5.1.5. Membership to farmer Organization

Eight of the one hundred and seven respondents (representing 82.2%) said they were members of farmer organizations and nineteen (representing 17.8%) said they were not members of any farmer organization. Those who said are not members of any organization were further asked as to why and most of them said had no capacity to pay the membership fees. Others said that they were members of some farmer organizations at one time but later decided to stop because of observed corruption in these organizations. These explained that poor members of the groups are usually swindled of the

subsidized farming inputs so it was as better not to belong to any. The findings of this study reveal that most of the farmers had access to the subsidised farming inputs by being members of farmer organizations in their respective communities. Notable also here is that not all members of farmer organizations are able to benefit from the subsidized farming inputs under the Farmer Input Support Programme (FISP). Of the 107 respondents, only 50 benefit from the FISP, 6 get loans from other organizations,18 buy from agro dealers,6 are not able to access the FISP pack or buy from the agro dealers but just buy small quantities(medas/gallons) from the black market,18 are able to access the FISP pack and also buy cash to supplement and 2 are able to get loans from lending institutions and also have no capacity to access the FISP pack or buy cash from other sources. For any smallholder farmer to benefit from the FISP pack, he/she has to be a member of a registered farmer Organization. So those farmers who benefit from FISP are more likely to adopt conservation farming technologies as they will have adequate fertilizer which one requires at the time of planting.

5.4. FACTORS WHICH SIGNIFICANTLY INFLUENCE THE ADOPTION OF CONSERVATION FARMING TECHNOLOGIES

From the focus group discussion with lead farmers and farmer coordinators, and also from the research findings, the following factors were identified to be significantly influencing the adoption of conservation farming in Chikankata district:-

5.4.1. Capital/ income

It was evident from the study that farmers with capital (financial resources) or with high income levels are more likely to adopt conservation farming because they are able to hire labour and farming equipment where they don't own. Farmers with a larger capital resource will be in a position to buy farming inputs such as seeds, fertiliser and chemicals required for weed management. In this study, it has been established that poor farmers are less likely to adopt CF as a resource conserving practice and climate change adaptation. This is contrary to Scherr (1999)'s assertion that researchers have demonstrated that poor farmers adopt resource conserving practices nearly always as they contribute to increased productivity or output stability and are also economically viable in the farmers' context and resource constraints. In this study eight nine percent (89%) of the respondents strongly agreed that capital can influence the adoption of CF. This is in agreement with the findings of this study which has revealed that farmers with capital or high income are more likely to adopt conservation farming technologies. This is presented in the Table 14 below:-

Table 14: Average annual household income and CF adoption

Average annual ho	usehold income	Are you practicing conservation farming?		Total
		Yes	No	
	Less than K5000	9	38	47
	Between K5000-K10,000	11	19	30
	More than K10,000	14	15	29
Total		34	72	06 1
Missing data				

A chi- square test was also run to determine whether levels of income influence the adoption of conservation farming. The working hypothesis here is that farmers with high income levels will adopt conservation farming technologies. The chi-square test indicates that the level of significance is less than 0.05 or 5% and this proves the assertion. This is presented in Table 15 below:-

Table 15: Chi-Square test on influence of income levels

	Value	difference	Significance. (2-sided)
Pearson Chi-Square	6.221[a]	2	.045
Likelihood Ratio	6.291	2	.043
Linear-by-Linear Association	6.119	1	.013
N of Valid Cases	105		

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 10.50.

5.4.2. Availability of extension services/knowledge/information

92 of the respondents strongly agreed that availability of extension services and 91 strongly agreed that awareness and knowledge influence the adoption of conservation farming technologies to a larger extent. The findings of this study reveal that only 41 out of the 91 respondents who have heard about conservation agriculture heard it from the agriculture extension officers or field officers from NGOs. The implication here is that most of the smallholder farmers have no

access to extension services. However, support for any production systems should be oriented towards solving farmers' problems that inhibit productivity. However, when the transformational change occurs with the adoption of CF by farmers who have only known and practiced tillage agriculture, a new challenge is created. Hence, farmers need to be supported through extension services in order to help them to understand the new concepts and principles and also enable an intellectual change in their mind-set, commit to a longer term process of change in their production system, test and adapt new practices, and change equipment and machinery. In establishing different cropping systems and farm operations, they also need to manage new production input and output relationships involving crop, soil, nutrients, and water, pest and energy management practices. Thus, engaging with farmers and providing them with the necessary support is critical for successful adoption and uptake of CF (Kasama, 2014)

5.4.3. Availability of draught power.
In this study, the availability of draught power was measured by the farmer's ownership of cattle or oxen. Research findings reveal that fifty three percent of the respondents own cattle/ oxen.

5.4.4. Livestock ownership
Ownership of livestock is cardinal to rural households as they can be exchanged for other services or they can be sold to raise funds to pay for other services or commodities. In this study, 57 respondents own cattle, 65 own goats, 71 own chickens and 23 own turkeys. Most of the respondents pointed out that usually they sale these to raise money for school fees for their children and dependants and not for agricultural purposes because they don't even have enough.

5.4.5. Availability of family labour
Family labour in this study refers to the number of people aged above 14 years in each household. This study has indicated that on average there are 4 people aged above 14 years per household and the implication is that there is a shortage of labour.

5.4.6. Membership to farmer organization.
Membership to farmer organization is also considered to be one of the major factors influencing the adoption of conservation farming technologies. The current situation in Zambia is that for one to benefit from FISP, he/she is supposed to be member of a cooperative or other farmer organization such as a club. However, this requirement disadvantages farmers who are not able to pay group membership fees (Burke et al. 2011a). This study has revealed that 19 out of the 107 respondents were not members of any farmer organization and hence it follows that they are not beneficiaries to the FISP.

5.5.THE NATURE OF FARMING CHALLENGES CONTINUALLY FACED BY ADOPTERS AND NON-ADOPTERS OF CONSERVATION FARMING TECHNOLOGIES.
The up-take of CF practices among smallholder farmers was very low despite them noting and acknowledging the benefits from those practicing. Some most prominent challenges noted were as follows:-

5.5.1. Lack of CF tools and equipment
This is a critical issue in the adoption of conservation farming. Ripping and making of planting basins or potholing as it is usually called requires minimum tillage equipment. For zero tillage one requires a fiterelli planter whereas for potholing, one requires a Chaka hoe.
Figure 13 below shows an ox drawn zero till machine.

Figure 15: Zero till machine

Source: Piet Stevens (2009)

For ripping, one requires a tractor drawn ripper or an ox drawn Magoye ripper as shown in figure 15 above and for potholing one requires a special type of hoe called Chaka hoe. However, these farming implements are not readily available and they are very expensive, making them unaffordable by most smallholder farmers. Some of the farmers also lack information and knowledge about possible equipment options which they can use in the application of CF practices. Within the challenge of lack of appropriate CF equipment, there are other challenges with different implications from community to community. Generally, this would be in the form of (i) lack of information/not aware of possible options, (ii) appropriate equipment simply not available in accessible markets, or (iii) inaccessible due to what comes as high cost to the local farmers. Poor community networks for machinery use also make availability and accessibility to equipment

limited. Even hiring is normally perceived as undependable as often the owner would still be using the equipment at the time and hence may only be able to release the equipment for hire after working on their own fields and this may be too late for others farmers. This challenge was echoed by most of the respondents, field officers and even in the focus group discussion. The findings of this study reveal that only one of the respondents owns a tractor and only one owns a Chaka hoe. Thus we can as well say that there is limited access to mechanized equipment and without the appropriate equipment, it is not possible to practice the minimum tillage practices.

5.5.2. Lack of capital

This challenge was also raised by most of the respondents including lead farmers and agricultural extension officers. The extent of the problem is also portrayed by the levels of household annual incomes of most of the respondents. The findings indicate that 72.9% of the respondents said that lack of capital was one of the major challenges faced by smallholder farmers. The findings further reveal that the majority (44%) of the smallholder farmers get below K5 000, twenty eight percent (28%) get between K 5000 and K10 000 while only twenty seven Percent (27%) get above K 10 000 as household annual income. This implies that most of the small holder farmers have no capacity to buy or hire the required farming equipment and other farming inputs. Furthermore, some of the smallholder farmers fail to join farmer organizations in their communities because they cannot afford the upfront membership fees and shares.

5.5.3. Delays in receiving the FISP pack

Most of the smallholder farmers depend on the subsidised farming inputs which they receive under FISP. Hence the delay in the delivery of the farming inputs is a major challenge to them as they have no option but to wait. The other challenge that comes with this challenge is that by the time they receive the inputs, the rain season may be in its final stage and the farmer is faced with the dilemma of debating as to whether to plant or just keep the inputs for the following season.

5.5.4 Inadequate farming inputs

In its endeavour to reduce poverty in the country especially in the rural areas, the Government of Zambia through the Agriculture sector introduced subsidies on farming inputs in 2002/03 through the creation of the Fertiliser Support Programme (FSP). The aim of the programme was to increase maize production through the provision of the subsidised fertilizer and maize seed. When the programme started, the pack size given to farmers was eight (8) 50 kilogram (50kg) bags of fertilizer and 20 kilograms (20kg) bags of maize seed. However, in 2009, the programme was reviewed, reformed and renamed to farmer Input Support Programme (FISP). Under FISP, the pack given to each individual farmer was reduced to four (4) 50 kilogram bags (50kg) of fertilizer and 10 kilogram (10kg) bags of maize seed. This was done in order to increase the efficiency of input use by farmers and increase the number of beneficiaries. This reduction however, was a draw back on the side of smallholder farmers because with the four bags (two basal and two top dressing fertiliser), they are barely managing to produce for home consumption and under climate change it is very hard for the smallholder farmers to meet the household food security level. This is in agreement with other researchers who contend that despite the subsidies, rural poverty has remained consistently high at around 80% (CSO, 2010; Burke *et al*., 2010; Mason *et al* 2011). This has been attributed to other factors which include among others poor targeting of beneficiaries, delays in input distribution, lack of an exit strategy for weaning of farmers and also lack of monitoring mechanism(Rhoda MofyaMukuka, Stephen Kabwe, Auckland Kuteya and Nicole M. Mason 2012).

5.5.5. Climate change.

In the focus group discussion it was established that Climate change had significant impact on smallholder farmers. In fact it was also among the major challenges that were mentioned by farmers. During the focus group discussion, discussants lamented that the rain season has become very short and unpredictable and this was affecting their production. They further pointed out that the dry spells that occur during the rainy season affect crop yields since the crop growth become retarded during the dry spells. They also mentioned that the effect of climate change is worsened by the delays in the distribution of farming inputs under the FISP to which they have no control and most of them have no capacity to find alternative means. This is also in line with the observation reported in the Zambia National Adaptation Plan, that the majority of Zambian farmers lack the capacity, resources and financial assistance to adapt to and overcome worsening climatic conditions (National Adaptation Programme of Action (NAPA, 2009).

Results from the Key Informants indicate that there are intervention measures being undertaken but mostly they were donor funded and currently there are no government programmes that are being implemented in the district. The key informants acknowledged the efforts by the Non-Governmental Organisations working in the area to promote conservation farming such as the Conservation Farming Unit which is being funded by the Government of Norway.

5.5.6. Lack of draught power

It was established by the findings of this study that most smallholder farmers do not own oxen or cattle which are used for ploughing. Most smallholder farmers lost their animals through cattle diseases as such they rely on animal hire from a few farmers that still have animals. However, some of the farmers do not even have the capacity to hire draught animals and hence they just wait upon well-wishers to help them or they do piece jobs by working on other people's fields. This also delays their working on their own fields and may even be caught up by the dry spells that usually occur. This is in agreement with Haggblade and Tembo (2003) who points out that the economics of conservation farming differ between the various groups of farm households because the owners of animal draught power choose their time of tillage and

planting and they prefer to plant first while households that need to borrow or rent plant much later and suffer significant yield loses as a result.

5.5.7. Inadequate extension services.

The lead farmers lamented that extension services were inadequate. They further alluded that extension services were usually provided by the NGOs hence they were wondering whether the Government was in support of Conservation farming activities. This was also echoed by the CF field officer who admitted that the officer /farmer ratio was too large. It is at two (2) officers against over 15 000 farmers in the district. The CF U field officer also explained that they usually rely on farmer coordinators to disseminate information but it has been observed that at times these farmer coordinators do not share the information correctly and promptly due to lack of incentives and also perceived jealous.

5.5.8. Lack of information/knowledge

It has generally been observed that most of the information is transmitted through the local radio station and some of the farmers may not own a radio so the miss out on certain communications. This was revealed by farmers who have never attended field days. These pointed out that usually field days are announced on the radio and sometimes due to other reasons power outages or in availability of a radio in the household, they may miss out the announcements and come to learn about it long after. As Mendis, Mills and Yantz (2003), increasing knowledge and awareness of potential implications of climate change may enable us to better prepare for changes that our future generations will face.

CHAPTER 6
CONCLUSION AND RECOMMEDATIONS

6.1. CONCLUSION

The objective of this study was to investigate what determines the adoption of conservation farming technologies among smallholder farmers in Chikankata district of Zambia. Conservation farming is seen as one of the measures available for climate change mitigation and adaptation. However, this study and a few other studies that were carried out by other researchers previously have established that the adoption level is still low despite the fact that most people are aware of climate change and the need to switch to new agricultural technologies. This study tried to understand the underlying factors that determine the adoption of conservation farming technologies.

The results suggest that smallholder farmers have knowledge about climate change and the conservation farming technologies which are being promoted as a climate change adaptation measure. The empirical evidence in this investigation does not support the assumption that most smallholder farmers in Chikankata district of Zambia have adopted conservation farming technologies but supports the notion that the adoption of conservation farming technologies by smallholder farmers is significantly affected by socio-economic which include lack of capital, lack of suitable farming equipment and many others. It can therefore be deduced from the findings that just sensitising the farmers and training them on conservation farming is not adequate but the trainings should go hand in hand with the alleviation of the many challenges that are faced by the smallholder farmers.

6.2. RECOMMEDATIONS

The government, NGOs and other stakeholders should consider enhancing the adoption of conservation farming technologies by investing in appropriate agro equipment such as tractors, rippers and fiterelli planters (zero till Machinery) by providing loans for farming equipment to farmer groups or to individual farmers at a low interest rate. Furthermore, the Government, NGOs and other stakeholders should scale up the provision of extension support to farmers considering that farmers need support in order for them to understand the concepts that come along with conservation farming technologies.

The government should also increase the smallholder farmers' access to farming inputs through FISP and should also consider increasing the FISP pack. This will motivate the farmers to adopt the technology since they will have the required inputs. The government should also revisit the FISP so that only those smallholder farmers who are more venerable should benefit from the programme and not only those with capital or who are already rich. According to Mofya-Mukuka, Kabwe, Kuteya and Mason (2012) approximately 73% of smallholder farmers in Zambia cultivate 2 hectares of land or less and these tend to be the poorest hence more venerable. According to the findings of this report these smallholders account for only 56% of the total number of smallholder households receiving FISP fertilizer. In contrast, households cultivating more land are more likely to receive FISP. Moreover, among FISP beneficiaries, households cultivating less land tend to receive significantly less FISP fertilizer than households cultivating more land.

There is also need to intensify sensitisations on conservation agriculture shows, trainings and field days. Furthermore there is need for field officers to monitor agricultural activities so that they can give timely advice to farmers.

This study has established the factors that significantly influence the adoption of conservation farming and the many challenges that are faced by smallholder farmers. This calls for more research so as to come up with better ways of relieving the challenges and also to come up with interventions that will enable smallholder farmers access the appropriate equipment and tools for conservation farming.

Just sensitising the farmers about CF is not enough. Hence there is need also to sensitize the policy makers, institutional leaders and other stakeholders so that they become aware of the benefits of CF and of the need to support the programmes to promote it.

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APPENDIX I
NO……
THE ZAMBIAN OPEN UNIVERSITY
SCHOOL OF POST GRADUATE STUDIES AND RESEARCH
RESEARCH QUESTIONNAIRE FOR SMALL HOLDER FARMERS

Dear Respondent,

I am Memory Hanyinde, carrying out a research on the factors that determine or influence the adoption of conservation farming technologies in Chikankata District.

You have been randomly selected to assist in this research by filling in this questionnaire. The information that will be collected is strictly for academic purposes and will be treated with maximum confidentiality. Therefore your honest and truthful responses will be highly appreciated.

The research findings will be of benefit to policy makers and will help our Government with information needed to support the adoption of conservation farming technologies.

Therefore your participation in this research is highly valuable.

INSTRUCTIONS

1. Do not indicate your name on this questionnaire.
2. Answer the questions according to the given instruction.
3. Only one response is required for each question unless indicated otherwise.
4. Please answer all questions.

Thank you.

Please answer the following questions by ticking or crossing out the relevant box or writing your answer in the space provided.

SECTION A: BACKGROUND INFORMATION

1. What is your gender?

1. Male [ ]

2. Female [ ]

2. What is your age?

15-25 years	26-36	37-47	48-58	59-69	70 and above
1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐

3. What is your marital status?

Single	Married	Divorced	Widowed	Separated
1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

4. What is your highest level of education attained?

No formal education	Primary	Secondary	Tertiary	Other (Specify)	
1 ☐	2 ☐	3 ☐	4 ☐		

SECTION B: CLIMATE CHANGE AND CONSERVATION FARMING

5. Are you a member of a farmer Organization/Club/Co-operative society?

1. Yes
2. No

6. Do you own any land? 1. Yes

2. No.

7. If yes, how much land do you own?

1. Less than 1 hectares
2. Between 1 and 5 hectares
3. Between 6 and 10 hectares 4. Between 11 and 20 hectares.
5. More than 20 hectares.

8. How much of your land is under cultivation?

1. Less than 1 hectares
2. Between 1 and 5 hectares
3. Between 6 and 10 hectares 4. Between 11 and 20 hectares.
5. More than 20 hectares.

9. How do you access your farming inputs?

1. Through FISIP
2. Through loans from lending organizations
3. Buying cash from Agro dealers.
4. Other (specify)

……..
……..

10. Have you ever been visited by an agriculture extension officer?

1. Yes.
2. No

11. If yes, what information did you receive from the officer?

1. Information about conservation farming
2. Concerning FISIP
3. Climate change

12. Have you ever heard of climate change?

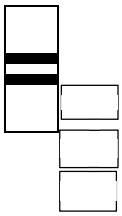
1. Yes
2. No

13. If yes, from whom?

1. Agriculture extension officer
2. Friend
3. Neighbour
4. Books
5. Radio
6. Others (specify) ……..

14. Have you ever heard of Conservation Farming?
1. Yes
2. No

15. If yes, from whom?
1. Agriculture extension officer
2. Friend
3. Neighbour
4. Books
5. Radio/Television
6. Others (specify) ……..



16. Have you ever attended any extension training for conservation farming or field days?
1. Yes
2. No

17. Are you practicing any of the Conservation Farming technologies?
1. Yes
2. No

18. If your answer to question 17 is no, give reasons and then go to question 22.
……
…….

19. How long have you been practicing conservation farming?
1. Less than five years
2. Between 5 and 10 years
3. More than 10 years.

20. Which of the following conservation farming technologies are you practicing? (Tick where applicable)

No till	Ripping	Planting Basins	Crop rotation	Maintenance of crop residue	Fertiliser trees

21. Give reasons why you have adopted the technology you are using.
……
……

22. Which crops have you grown in the last three years?(tick where applicable)

23.

Cereal	Legumes	Root/tuber	Fibre/Oil crops	Fertilizer trees/crops
Maize Sorghum Millet Rice Wheat Other (specify): …… ……..…… ……	Mixed beans Cow peas Soy beans Groundnuts Bambara nuts Other (specify): …… ……	Cassava Sweet potato Irish potato Other (specify) …… …….	Sunflower Cotton Other (specify) …… …… ……	Sun hemp Velvet beans Pigeon peas Sesbania –sesban Other (specify) …… ……...

24. What is the source of your farm labour?
1. Family members
2. Hired labour 3. Neighbours
4. Others.

Specify……

25. What is the number of people in your house hold?

Male 14 years and below…….. Above 14 years ……..

Female 14 years and below …… *Above* 14 years ……

26. What is the main source of income for your house hold?
1. Formal employment
2. Informal employment
3. Farming
4. Non- farm business
5. Other. Specify ……

27. What is the average annual house hold income? ZMW

……..

28. What is the average monthly household expenditure? ZMW

……

29. Livestock ownership (Indicate number where applicable only).

30.

Total cattle	Draught oxen	Donkeys	Goats	Sheep	Chickens	Turkeys	Other (Specify)

31. What farming assets do you own? (Tick where applicable).

Ripper	plough	Planter	Hallow	Sprayer	Tractor	Sheller	Hoe	Other(Specify)

FARMERS'PERCEPTION OF CONSERVATION FARMING

30. To what extent would you agree that the factors listed below influence the adoption of conservation farming by the small holder farmers in Chikankata District?

31.

Rate the extent to which the following listed factors influence the adoption of conservation farming	Cross out or tick your choice				
	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
1. Age	1	2	3	4	5
2. Gender	1	2	3	4	5
3. Level of Education	1	2	3	4	5
4. Land ownership	1	2	3	4	5
5. Knowledge	1	2	3	4	5
6. Awareness	1	2	3	4	5
7. Capital	1	2	3	4	5
8. Ownership of farming equipment	1	2	3	4	5
9. Availability of family labour	1	2	3	4	5
10. Membership to a farmer Organization	1	2	3	4	5
11. Availability of extension services	1	2	3	4	5
12. Donor Aid availability	1	2	3	4	5
13. livestock ownership	1	2	3	4	5
14. Availability of draught power	1	2	3	4	5

32. What do you think should be done to encourage small holder farmers to adopt conservation farming technologies?

……

……

Thank you for your Participation.

May God Bless you.

APPENDIX II

INTERVIEW SCHEDULE FOR KEY INFORMANTS

1. How long have you been in Chikankata District?

…….

2. Are the small holder farmers in Chikankata District Practicing Conservation farming technologies?

……..

3. How do you view/ rate the adoption of conservation farming technologies?

……

……..

4. What programmes are in place to try and promote conservation Farming in Chikankata District and who are the funding agencies?

……

……

5. What do you think are the major challenges in the adoption of conservation farming by small holder farmers in the district?

……

……

6. What do you think should be done to address these challenges?

……

……

7. To what extent would you agree that the factors listed below influence the adoption of conservation farming by the small holder farmers in Chikankata District?

8.

Please indicate your level of agreement on the Influence of the listed factors on the adoption of conservation farming	Cross out where appropriate				
	Strongly Agree	Disagree	Neutral	Agree	Strongly agree
15. Age	1	2	3	4	5
16. Gender	1	2	3	4	5
17. Level of Education	1	2	3	4	5
18. Land ownership	1	2	3	4	5
19. Knowledge	1	2	3	4	5
20. Awareness	1	2	3	4	5
21. Capital	1	2	3	4	5
22. Ownership of farming equipment	1	2	3	4	5
23. Availability of family labour	1	2	3	4	5
24. Membership to a farmer Organization	1	2	3	4	5

9. In your opinion, do you think Conservation farming is a good adaptation measure to climate change? Explain your answer.

……

……

10. What do you think should be done to promote the adoption of conservation farming technologies?

……

……

Thank you.

APPENDIX III

FOCUS GROUP DISCUSSION CHECK LIST

(Target- farmer trainers, Lead farmers, and farmer coordinators)**)**

1. How do people own land in your area?
2. Is there any problem associated with land ownership in your area?
3. What kind of farming systems are practiced in your area?
4. How do the prevailing weather conditions influence the farming system/practices?
5. What is your understanding of Conservation farming as compared to conventional farming?
6. Do you think conservation farming is suitable in your area? Explain briefly.
7. How does agriculture technological information get transmitted in your farming community?
8. What is it that farmers look at to adopt or not adopt technologies like Conservation Farming?
9. What do you think should be done to make farmers adopt technologies like Conservation Farming?

Thank you.