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An Assessment of Factors Affecting the Adoption of Conservation Agriculture as an Approach to Mitigate the Impact of Climate Change among Smallholder Farmers in Zambia: A Case of Chikankata District

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Abstract

Conservation agriculture has been promoted by many international and local organizations to smallholder farmers in Zambia as a solution to soil degradation and low productivity problems (Ng'ombe *et al*., 2017) [12]. The adoption of conservation farming practices such as reduced tillage, precise digging of permanent planting basins or ripping of soil with a Magoye ripper, leaving of crop residues on the field, rotation of cereals with legumes and dry season land preparation can improve soil fertility and crop productivity (CFU, 2017) [5]. However, most smallholder farmers in Chikankata District have not adopted conservation farming as a way of mitigating the ever rising effects of climate change. The study was conducted to assess factors affecting the adoption of conservation agriculture as a way of mitigating the impacts of climate change among smallholder farmers, which was carried out in Malala ward of Chikankata District in Southern province of Zambia, and the following factors affecting the adoption of conservation farming were reviewed: Social-economic, institutional and environmental factors. Under social-economic factors attention was given to age of the farmer, farm size, levels of education and income. The institutional factors included; access to credit and inputs, availability of extension services, market and transport; whereas temperature, rainfall pattern and soil status were considered under environmental factors. This survey involved 50 participants who were randomly drawn from a population of 600 farmers. The data collected was analyzed using the Statistical package for Social Sciences (SPSS 16).

The results of the survey revealed that the highest number of farmers who participated in conservation farming were males, representing 58%. The age group of all the farmers interviewed ranged from 18-55 years. 70% of the participants lived in families of not less than 5 members and only 30% had small families of 1-4 members. On the other hand, the study established that most conservation agricultural farmers (82%) attained primary levels of education as a minimum. In addition, 44 participants, representing 88% indicated that limited credit facilities in the area demotivated farmers from adopting conservation agriculture. 60 % indicated that limited market and transport facilities discouraged farmers from adopting conservation agriculture in the area. The study also discovered that poor rainfall pattern, poor soil status and high temperatures affected the adoption of conservation agriculture in Chikankata District.

Keywords: Factors, Adoption, Conservation Agriculture, Smallholder Farmers, Climate Change Mitigation

Introduction

Worldwide, conservation agriculture practices have been widely adopted by farmers. The broadest adoption was found in the southern cone of Latin America, especially in Argentina, Brazil and Paraguay, and in North America and Australia and later on spread to other countries such as Eastern Europe and East Asia (Rockstrom *et al*., 2009) [15]. Currently, more than 95 million hectares in the world is under CA (Rockstrom *et al*., 2009) [1]. For the last decade many African countries such as South Africa, Kenya, Tanzania, Zimbabwe, Lesotho, Swaziland, Mozambique, Malawi and Zambia, have been exposed to no-tillage systems and conservation agriculture (FAO, 2008) [6].

Zambian farmers were introduced to conservation agriculture by the Food and Agricultural Organization of the United Nations in the mid-1990s. The aim was to sustainably improve productivity, profits and food security. Ng'ombe *et al.,* (2017) [12], asserts that conservation agriculture has been promoted by many international and national organizations to smallholder farmers in Zambia as a solution to soil degradation and low productivity problems. These practices are regarded as improved soil water management practices. Minimum soil disturbance increases water productivity, mulching and crop residues improve water infiltration and planting basins maximize soil moisture buffer capacity.

One of the most notable distinctions of conservation agriculture is that it requires spending little time on the physically demanding tasks of moving the soil and it can improve the biological and physical properties of the soil through increased soil organic matter as well as maintaining the moisture by covering the soil (Umar *et al,* 2011) [16].

Statement of the problem

Conservation Agriculture (CA) has been actively promoted since the early 1990s among Zambian smallholder farmers as a practice that helps improve crop productivity, soil fertility, and mitigate against low and/or variable rainfall (CFU, 2017) [5]. Nevertheless, nationwide survey data shows that adoption rates by Zambian smallholder farmers have remained low despite many years of promotion. Most farmers have not adopted conservation agriculture as a way of mitigating the impacts of climate change and improve productivity. Hence the researcher will endeavour assessing the factors affecting adoption of conservation agriculture as a way of mitigating the impacts of climate change and improve productivity among smallholder farmers in Chikankata district of southern province of Zambia.

Justification of the study

Gupta, (2007) [9] reports that conventional agriculture is assumed to lead to soil organic matter decline, water runoffs and soil erosion. The researcher accounts conservation agriculture (CA) as one of sustainable intensification type of farming that is increasingly promoted by various international research centres, international non-governmental organizations (NGOs), faith-based organizations and governments of southern Africa among others to overcome the problem of soil degradation, drought, low and unstable crop yields and high production costs. Therefore, it is necessary to assess the factors affecting the adoption of conservation agriculture in order to understand and make appropriate recommendations as to why conservation agriculture has not, widely been adopted by smallholder farmers as a way of mitigating the impacts of climate change.

Purpose of the study

The purpose of the study was to assess the factors affecting the adoption of conservation agriculture as an approach to mitigate the impact of climate change among smallholder farmers.

Objectives of the study

General Objective

The general objective of this study was to assess the factors affecting the adoption of conservation agriculture as an approach to mitigate the impact of climate change among smallholder farmers.

Specific objectives

1. To identify the most prominent socio-economic factors affecting the adoption of conservation agriculture in Chikankata district.
2. To establish institutional factors affecting the adoption of conservation agriculture in Chikankata district.
3. To ascertain environmental factors affecting the adoption of conservation agriculture in Chikankata district.

Research questions

1. What are the most prominent socio-economic factors affect the adoption of conservation agriculture in Chikankanta district?
2. What institutional factors affect the adoption of conservation agriculture in Chikankanta district?
3. Which environmental factors affect the adoption of conservation agriculture in Chikankanta district?

Significance of the study

In this climate change era, sufficient levels of farmer participation in climate change mitigation practices are important. This however calls for extra efforts by small scale farmers to adopt and practice conservation agriculture. It is therefore important to undertake this study, so that appropriate recommendations may be generated, beneficial policies possibly created, as well as existing policies altered, on the basis of the new knowledge to be acquired from this study. For one of the elements contributing to malnutrition prevalence in Zambia is as a result of the traditional (conventional) farming practices that not only depletes the soil fertility but does not give sufficient yields for the households' consumption, (Baudron *et al*., 2005) [4]. Therefore, the findings may be important to governments, Non-Governmental Organizations (NGOs) and other development partners involved in the development and promotion of conservation agriculture technologies. The results will help them design appropriate intervention that will help increase the adoption rates of the technology among smallholder farmers in Zambia. In addition, the paper will contribute to the improvement of the existing literature related to this topic through drawing policy recommendation.

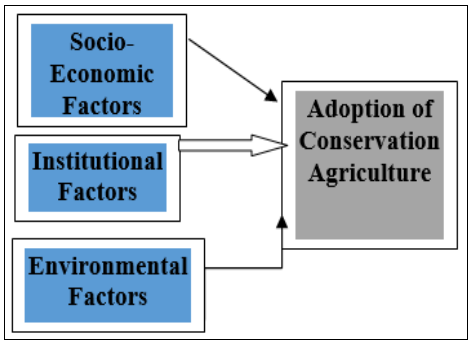
Scope of the study

The study was limited to Chikankata district of southern province, and only household heads who are smallholder farmers were selected as respondents.

Conceptual frameworks

The illustration below shows factors that affect the adoption of conservation agriculture amongst smallholder farmers as

independent variables on the left hand side and the adoption of conservation agriculture by smallholder farmers as dependent variable. In the process of assessing each single factor in the selected study area, attention was given to the following; socio-economic factors, institutional factors and/or environmental factors.



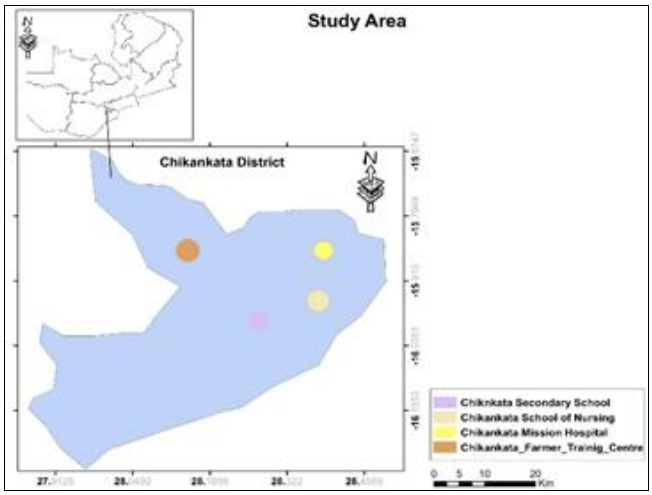
Ethical consideration

The research was submitted and presented before the Information and Communication University research committee for scrutinizing whether it mets research standards. The purpose of the study was explained and approved to collect data to the ministry of agriculture through the office of District Agriculture Coordinator (DACO). The researcher did not publish the names of respondents throughout the report.

Material and Methods

This chapter outlines the methods and procedures that were used to achieve the objectives of this study. It presents the study area, the method of data collection and the analytical methods that were used to accomplish the goals of this study.

Study area



Research Design

A cross-sectional research design was used in this study. A cross-sectional design involves a collection of data at a single point in time; it can be used in descriptive study for the determination of relationships of variables (Barley, 1998). This design was used because of the limited time in the process of data collection.

Sample Technique

Total population sampling was used. This type of sampling technique involves examining the entire population that have a particular set of characteristics (Saunders *et al.*, 2007) [17].

Target population

Since total population sampling involves all members within the population of interest, it is possible to get deep insights into the phenomenon of interest. Total population sampling has a wide coverage of the population of interest reducing risk of missing potential insights from members that are not included (Shank, 2002) [20]. The total population targeted was 600 farmers from Mapangazya Farming block in Malala ward of Chikankata district.

Sample Size

Sidhu (2005) [18] defines a sample as: A small sub set of a population selected for observation and analysis. It is a pool comprising of a part or subset of the objects or of the population which is selected for the express purpose of representing the population. He noted that by observing the characteristics of the sample, one can make certain inferences about the characteristics of the population from which it is drawn. In this study the sample size were 50 farmers.

Sampling Methods

The respondents were selected using stratified random sampling at all levels in order to collect the desired information. By using Stratified Random Sampling, any member of the sample can be selected from the total population in a manner that all members of the population have basically the same probability of being selected.

Data Collection

Data was collected using questionnaires. Questionnaires were administered to respondents. The questionnaire included close-ended questions for gathering information that the researcher intended to collect.

Data Analysis and Presentation

Both descriptive and inferential statistics were used to analyse the data collected data from questionnaire were coded and entered into the Statistical Package for Social Science (SPSS Version 16) computer software for analysis.

Triangulation

To facilitate validation of the data, pre-testing of questionnaire was done in order to see if the questions set were understood. The collected data was cross verified by comparing it to the data that was obtained from a parallel source (pilot study) that involved respondents that were not part of the actual targeted population.

Results and Discussion

Socio-economic factors affecting the adoption of conservation agriculture

The descriptive analysis done on the socio-economic factors affecting the adoption of conservation agriculture reveals that 58% of the participants in the conservation agriculture were male ranging from the age 18-55 years old (figure 1).

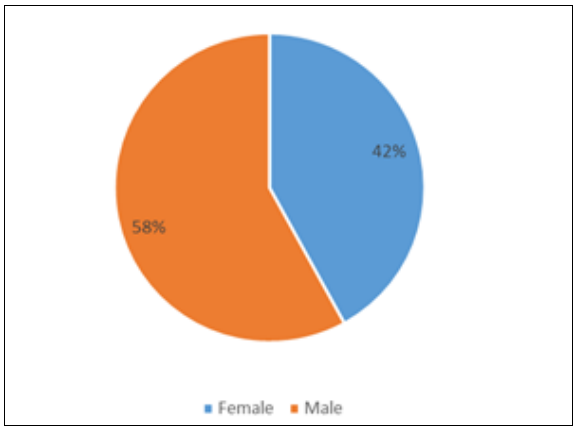


Fig 1: Gender of respondents

Akudugu *et al*, (2012) [2] underscores age as an important factor that influence the probability of adoption of new technologies as it is a primary underlying characteristic in adoption decisions. The findings are also in agreement with the findings of Amir, (2006) [3], who revealed that in a dynamic economic environments younger farmers tend to adopt new technologies more willingly than their older counterparts.

This study disclosed that size of the household also influenced the adoption of conservation agriculture. In the study 70% of the participants lived in families of not less than 5 members and only 30% had small families of 1-4 members. The findings are supported by Woziniak, (1984), who contends that a larger household size will influence the decision of acceptance because of the availability of labour required during the adoption process; hence household size increased the chance of farmers to adopt conservation agriculture.

On the other hand, this study reports that most conservation agricultural farmers (82%) attained minimum of primary level of education and only 18% had no formal education. This entails that education has influence on the adoption of conservation agriculture. Norman (2005) [14], claims that education is a major factor that can influence the adoption of any innovation. The researcher claims that through education farmers may know the rationale for managing land through better farming practices and other social economic factors. Swamson *et al.*, (1984) [19] also supports that farmer's education background is an important factor that determines the readiness to accept and properly apply technologies. Therefore, the more educated the farming community is, the more preparedness to adopt new technologies.

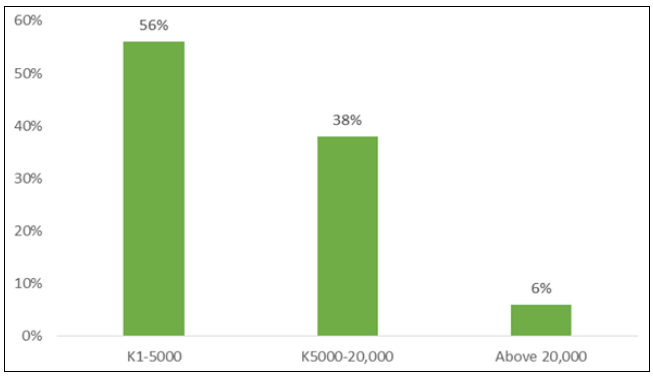


Fig 2: Farmers` income and size of land

The study also exposed farmer's income and size of land as substantial factors affecting the adoption of conservation agriculture in the district. Majority of the respondents (56%) interviewed had their annual income ranging from k1– 5,000 and 1-4 acres of land for their farming activities. This implies that inadequate farm size and limited resources affected farmers decision of adopting conservation agriculture. This was also reported by Feder *et al.*, (1985) [8], who contends that farmers with large arable land have the opportunity to spare some sections to try out new practices at less risk.

Institutional factors affecting the adoption of conservation agriculture

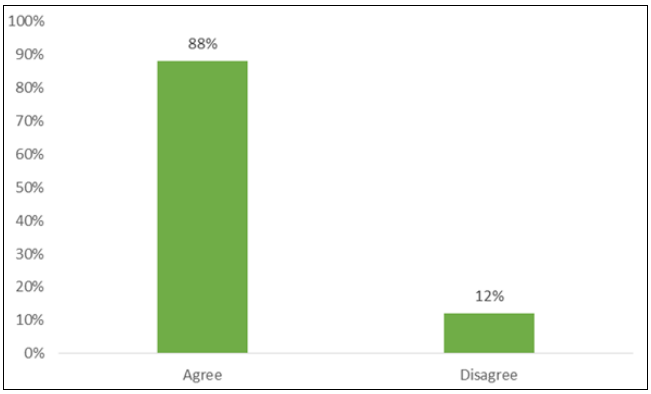


Fig 3: Institutional factors

The graphic analysis done on the institutional factors affecting the adoption of conservation agriculture showed that 44 participants representing 88% indicated that limited credit facilities in the area demotivated farmers from adopting conservation agriculture. 32 participants representing 64% indicated that limited access to farm inputs discouraged farmers from adopting conservation agriculture. These findings correlated with the findings of Adjei *et al.*, (2003) [1], who reported that access to credit affects the adoption of conservation agriculture, as it is an important factor in acquiring basic inputs required for conservation farming. The conservation agriculture techniques involve purchase of new equipments necessary for direct planting. The farming inputs has a significant impact on cash demand of farmers during the farming season.

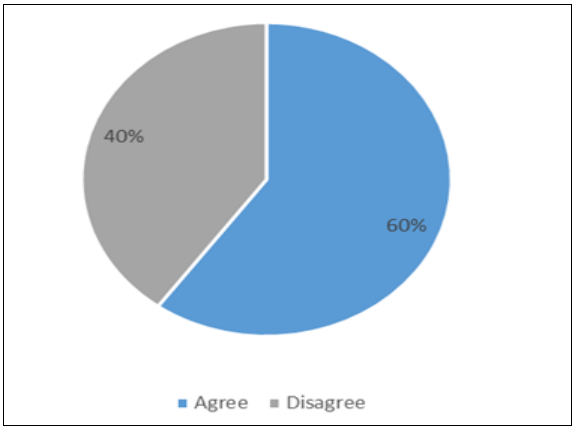


Fig 4: Responses on market and transport facilities

Respondents were also asked to indicate whether limited market and transport facilities in the area affected the adoption of conservation agriculture. The findings obtained showed that 30 participants representing 60 % indicated that limited market and transport facilities demotivated farmers from adopting conservation agriculture in the area. Howel *et al.* (2012) [11] found that markcet interventions such as price supports can speed up the adoption of new technologies. Market access plays an increasingly important role in the determination of adoption. Availability of market and reliable transport for agriculture products increases the adoption rate of conservation agriculture (Heisey *et al.*, 1998) [10].

Environmental factors affecting the adoption of conservation agriculture

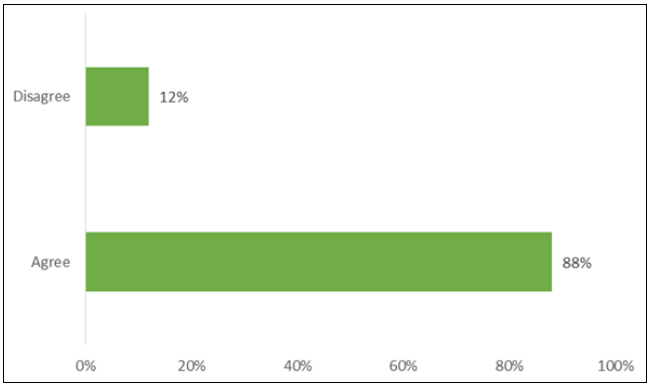


Fig 4: Responses on environmental factors

The descriptive analysis done on the environmental factors affecting the adoption of conservation agriculture. Respondents were asked to show whether poor rainfall pattern, soil status and temperature affected the adoption of conservation agriculture in the area. The findings revealed that majority of participants (44 or 88%), (32 or 64%) and (33 or 66%) respectively indicated that poor rainfall pattern, poor soil status and too high or too low temperatures discouraged farmers from adopting conservation agriculture. These results were supported by FAOAGL, (2002) [7], who revealed that in tropical, sub-tropical and temperate climates the highest production, occurs between 21 and 27° C with annual precipitation of 500 to 2000 mm. The researcher contends that soil water availability is the main factor limiting production. FAOAGL, (2002) [7], further asserts that most crops can tolerate a wide range of temperatures (from 5 to 45^0C), but very low or very high temperatures can have a negative effect on yield. Nielsen (2007) [13] found that maximum temperatures greater than 32^0C around tasseling and pollination speeded up the differentiation process of their productive parts and resulted in higher rates of kernel abortion and yield reduction.

Limitations of the study

The study faced a number of limitations such as delayed returning of questionnaires by respondents, refusal of being interviewed by some participants and/or poor network to get feedback from the research assistant.

Conclusion

The Overall objective of this study was to assess factors affecting the adoption of Conservation Agriculture among smallholder farmers in Chikankata district. To achieve this objective the frequency analysis was employed. After running the analysis, the results obtained indicated that those in the age of 18-55 years old accepted practicing conservation agriculture. This means that age affected the adoption of conservation agriculture. The study also revealed that 70% of conservation agricultural practicing farmers lived in families of more than 5 members and 82% of these farmers attained a minimum levels of primary education. Keeping other variables constant those who had stable income (K5000 and above annually) adopted conservation agriculture than those who had low income (less than K5000 annually). On the other hand, smallholder farmers who had access to market, credit and extension agriculture services had accepted conservation agriculture than respondents who did not have access to market, credit and extension agriculture services respectively. Furthermore, the study revealed that poor soil status, high temperature and/or poor rainfall patterns in the area affected the adoption of conservation agriculture by smallholder farmers.

Recommendations

Based on the results obtained it was recommended that the government should consider employing more agriculture extension staffs in an effort to reduce camp officer ratio to farmers. It was noticed that there was inadequate exposure to extension services among small holder farmers.

Lack of access to credits among smallholder famers is one important reason of sluggish adoption of conservation agriculture. Therefore, there is need to improve access to agricultural and rural finance. In addition, government should put in measures to lower the cost of borrowing and enable smallholder farmers to access credit without collateral demands so as to encourage conservation agriculture practices adaptation.

The government should intervene in the market and expand market accessibility for farmers and provide an enabling environment for farmers to produce more and sell profitably to generate enough income to enable them adopt conservation agriculture.

Acknowledgement

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