International Journal of Science and Research Archive

eISSN: 2582-8185

Cross Ref DOI: 10.30574/ijsra

Journal homepage: https://ijsra.net/

(Research Article)

Adoption factors of conservation agriculture for sustainable farming in southern Zambia

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International Journal of Science and Research Archive, 2025, 16(01), 2187-2199

Publication history: Received on 22 June 2025; revised on 28 July 2025; accepted on 31 July 2025

Article DOI: https://doi.org/10.30574/ijsra.2025.16.1.2267

Abstract

The study investigates the factors influencing the adoption of conservation agriculture (CA) among smallholder farmers in the Livingstone District, Southern Zambia, with a focus on promoting sustainability and resilience in farm production. Utilizing a regression model, the analysis identified six significant covariates impacting the adoption of CA practices. Notably, access to extension services emerged as a critical factor, exhibiting an odds ratio of 13.94, indicating that farmers with better access to these services are substantially more likely to adopt conservation agriculture. Other significant factors included the decision-maker within the household (odds ratio of 3.11), gender (6.26), number of dependents (3.27), frequency of extension services received (4.95), and the number of training sessions attended (2.06). The findings suggest that the determinants affecting CA adoption are diverse and context-specific; therefore, enhancing government extension services in Zambia could play a vital role in facilitating greater adoption rates among smallholder farmers. This research highlights the importance of tailored support mechanisms in fostering sustainable agricultural practices and enhancing resilience in farming systems within the region.

Keywords: Adoption; Conservation agriculture; Extension services; Resilience; Smallholder farmers; Sustainability

1. Introduction

Environmental management and agricultural sustainability are a key concern today. Conservation agriculture (CA) has been emerged as a pivotal approach in promoting sustainable agricultural practices, particularly in regions vulnerable to climate variability and environmental degradation. Climate on the earth is changing and this has led to a series of impacts on the environment and society (Bargali et al 2007; Arora et al 2012; Shahi et al 2023). One of the main challenges of the next decade is to find the sustainable agriculture/development path; ensuring economic prosperity is linked to social progress and environmental protection (Bargali et al 2019; Manral et al 2020; Vibhuti et al 2022; Bisht et al 2025). The land use systems effectively influence fertility and stability of an ecosystem and has been accepted widely as a vital source of nutrients due to its quick turnover (Padalia et al 2018 & 2022; Karki et al 2022; Fartyal et al 2025a). Population pressure, agricultural expansion/intensification, development of infrastructure and introduction of invasive species have been suggested as major threats to biodiversity and sustainable agriculture (Davidar *et al*. 2010; Baboo et al 22017; Karki et al 2021).Vulnerability to the impacts of climate change is a function of exposure to climate variables, sensitivity to those variables and adoptability of the affected community (Manral et al 2022; Negi et al 2023 & 2025; Bisht et al 2025; Fartyal et al 2025b).

The focus was on the Livingstone District of Southern Zambia in this study, where the adoption of CA is critical for enhancing farm productivity and resilience. The principles of CA—minimal soil disturbance, permanent soil cover, and crop rotation—are designed to improve soil health, increase biodiversity, and optimize water use efficiency (González

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et al., 2020). These practices not only contribute to higher yields but also mitigate the adverse effects of climate change (Lal, 2015).

The adoption of conservation agriculture is influenced by a myriad of factors that can be categorized into socio-economic, institutional, and environmental dimensions. Socioeconomic factors such as farmers' education level, access to credit, and land tenure security play a significant role in determining the willingness and ability of farmers to adopt CA practices (Kassam et al., 2019; Pandey et al 2011; Thierfelder & Wall, 2010). In Southern Zambia, where smallholder farming predominates, these factors are particularly pronounced. For instance, studies have shown that educated farmers are more likely to embrace innovative agricultural techniques due to their better understanding of the long-term benefits associated with CA (Manda et al., 2021).

Institutional support is another critical determinant influencing the uptake of conservation agriculture. Government policies and extension services can either facilitate or hinder the adoption process (Zhou et al., 2022). In Zambia, various initiatives aimed at promoting sustainable agricultural practices have been implemented; however, their effectiveness often hinges on local governance structures and community engagement (Farrow et al.,2019). Furthermore, access to markets for sustainably produced goods remains a challenge that affects farmers' decisions regarding CA adoption (Kuhl,2020).

Environmental factors also play a crucial role in shaping the adoption landscape for conservation agriculture. The unique climatic conditions in the Livingstone District—characterized by seasonal rainfall patterns—necessitate adaptive strategies that enhance soil moisture retention and reduce erosion risks (Mugwe et al., 2009). Research indicates that regions experiencing increased weather variability are more likely to see a shift toward conservation practices as farmers seek methods to safeguard their livelihoods against climatic uncertainties (Ngwira et al.,2013).

1.1. Research Objectives of the study

The main objective of this study was to assess the adoption of Conservation Agriculture for sustainable Farming: A case study of Livingstone District, Southern Zambia, while the Specific objectives were to,

- Identify the socio-economic factors influencing the adoption of conservation agriculture among farmers in Livingstone District.
- Assess the smallholder farmers' likelihood to adopt Conservation Agriculture
- Analyze farmers' perceptions and attitudes towards conservation agriculture.

1.2. Research Questions

The key questions guiding the study were:

- What are the key socio-economic factors that affect farmers' decisions to adopt conservation agriculture in Livingstone District?
- How do factors influence the adoption rates of conservation agriculture?
- Influences the likelihood of smallholder farmers to adopt Conservation Agriculture?
- How do farmers perceive conservation agriculture compared to conventional farming methods?

1.3. Statement of the Problem

Despite its recognized benefits for sustainable farming and resilience against climate change impacts, conservation agriculture has not been widely adopted by farmers in the Livingstone District. This low adoption rate raises concerns about food security and environmental degradation in a region already facing challenges related to climate variability (Mason et al., 2021). Understanding why farmers are hesitant or unable to adopt these practices is crucial for developing effective strategies that encourage sustainable agricultural development.

1.4. Justification of the Study

This study is justified on several grounds. First, it addresses a critical gap in understanding local dynamics affecting agricultural innovation uptake in Southern Zambia (Chikowo et al., 2015). Second, by focusing on Livingstone District—a region with unique socio-economic characteristics—the findings will provide tailored recommendations that can enhance policy formulation aimed at promoting sustainable agricultural practices (Sibanda et al., 2020). Finally, this research contributes to broader discussions on climate resilience by exploring how improved agricultural practices can mitigate risks associated with climate change.

1.5. Hypothesis

Access to extension services, gender of the household head, and household demographics significantly influence the adoption of conservation agriculture practices among smallholder farmers in the Livingstone District of Southern Zambia.

2. Literature Review

2.1. Introduction

This literature review synthesizes relevant studies that provide context and support for the findings presented in the article.

2.2. Importance of Conservation Agriculture

Conservation agriculture is defined by its three core principles: minimal soil disturbance, permanent soil cover, and crop rotation (Kassam et al., 2019). These practices contribute to improved soil health, increased biodiversity, and enhanced water retention (González et al., 2020). The significance of CA is underscored by its potential to mitigate climate change impacts on agriculture, making it a critical focus for sustainable farming initiatives (Lal, 2021).

2.3. Factors Influencing Adoption

Several empirical studies have identified specific factors affecting the adoption of conservation agriculture: Some of these include the following

- Economic Incentives: Research indicates that financial benefits associated with reduced input costs and increased yields motivate farmers.
- Access to Information: Access to extension services and information about CA techniques is critical for successful adoption (Kassam et al., 2009
- Cultural Attitudes: Cultural beliefs regarding traditional farming methods can either promote or inhibit the acceptance of innovative practices like CA (Mazzucato & Niemeijer, 2000).
- Environmental Awareness: Increased awareness about environmental degradation has led some farmers to consider sustainable practices like CA as viable alternatives (Pretty et al., 2011).
- Peer Influence: Studies show that farmers are more likely to adopt new practices if they observe their neighbours successfully implementing them (Pannell et al., 2006)

2.4. Conceptual Framework

The conceptual framework for this study can be derived from several key theories and models that explain agricultural innovation adoption. These include:

- Diffusion of Innovations Theory: Developed by Rogers (2003), this theory posits that the adoption of new technologies is influenced by factors such as perceived attributes of innovations, communication channels, social systems, and the rate of adoption. In the context of CA, attributes like relative advantage, compatibility with existing practices, complexity, trialability, and observability play crucial roles in determining whether farmers will adopt these practices (Rogers, 2003).
- Technology Acceptance Model (TAM): This model suggests that perceived ease of use and perceived usefulness significantly affect users' decisions to accept new technology (Davis, 1989). In conservation agriculture, if farmers perceive CA as easy to implement and beneficial for their productivity and sustainability goals, they are more likely to adopt it.
- Sustainable Livelihoods Framework: This framework emphasizes the importance of various forms of capital—natural, physical, human, financial, and social—in shaping livelihoods (Scoones, 1998). The adoption of CA can be influenced by how these capitals interact within farming communities in the Livingstone District. For instance, access to financial resources may determine a farmer's ability to invest in new technologies.
- Social Learning Theory: Bandura's Social Learning Theory highlights the role of observational learning and modelling in behavior change (Bandura, 1977). Farmers often learn about CA practices through peer interactions or community demonstrations. The influence of social networks can significantly impact their willingness to adopt new agricultural methods.

- Institutional Theory: This theory focuses on how institutional structures, such as policies, regulations, and support systems, affect agricultural practices (North, 1990). In Zambia, government policies promoting sustainable agriculture could facilitate or hinder the adoption of conservation agriculture among local farmers.

2.5. Barriers to Adoption

Despite the recognized benefits of conservation agriculture, several barriers impede its widespread implementation. These include limited access to inputs such as seeds and fertilizers specifically suited for CA systems (Kassam et al., 2019), as well as cultural resistance among communities accustomed to traditional farming methods. Addressing these barriers requires targeted interventions that consider local contexts.

Conservation agriculture (CA) is increasingly recognized as a sustainable farming practice that enhances agricultural productivity while promoting environmental health. The study titled "Factors Affecting Adoption of Conservation Agriculture in Promoting Sustainability and Resilience to Farm Production: A Case Study of Livingstone District, Southern Zambia" explores the various factors influencing the adoption of CA among farmers in this region. This literature review synthesizes existing research on the conceptual and theoretical frameworks relevant to understanding these factors.

3. Methodology

3.1. Description of the study area

The study was carried out in Livingstone district of Southern province in Zambia located at latitude S 17^0 50' 30.98'' and longitude E 25^0 51'15.3''. Southern province is one of Zambia's ten (10) provinces, and home to Zambia's premier tourist destination. It is divided into thirteen districts as indicated in Figure 1.

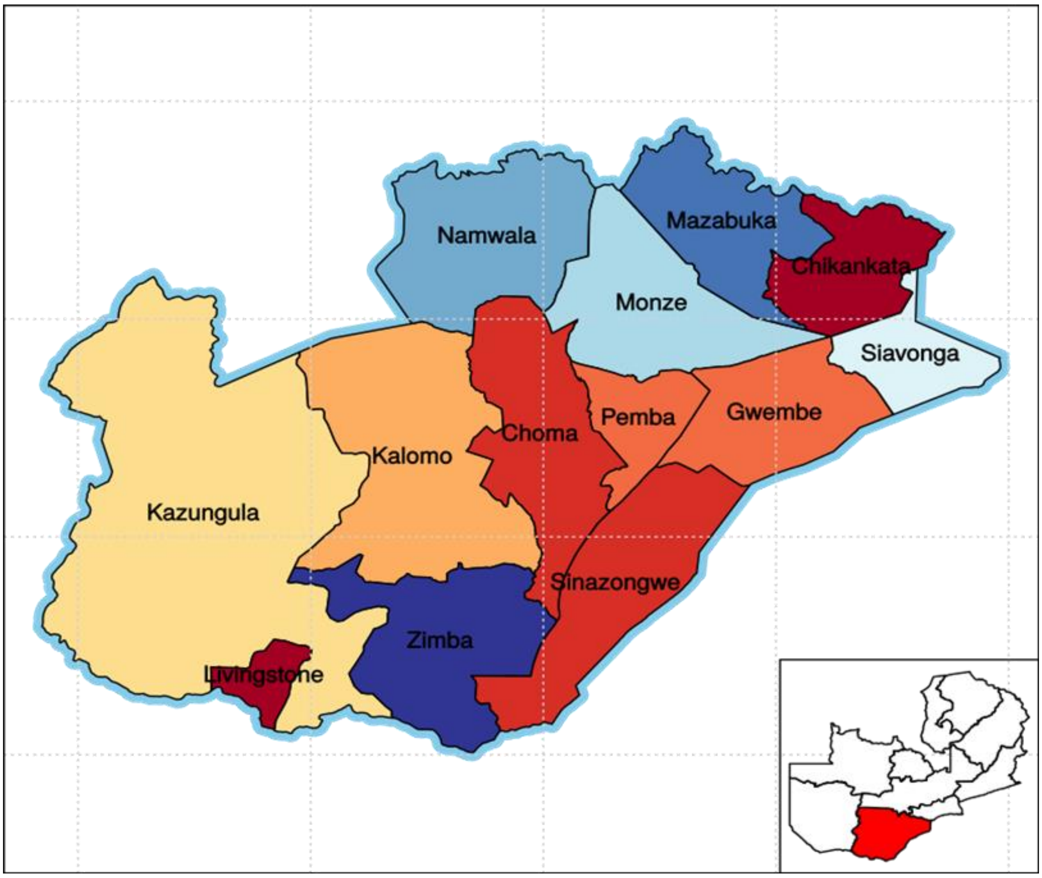


Figure 1 The Livingstone district in the southern province (Source: Wikipedia)

The area of the Livingstone district is 695 Km^2 with a population of 136,897 (Central Statistics Office (CSO) 2010).

3.2. Research design, Sampling technique, and sampling size

A mixed model design was used in this study. Simple random sampling and purposive sampling were used as techniques. The target respondents were farmers from the eleven farming blocks in Livingstone district who were practicing conservation agriculture. The farming blocks had a total of four hundred and twenty (420) lead farmers who were practicing conservation agriculture. Each lead farmer had a total of 15 other farmers who were also practicing and implementing the principles of conservation agriculture. This therefore gave a total population of 6300 farmers in this district who were involved in one way or another with some form of conservation agriculture.

3.2.1. Selection of Sample Size

The formula used to calculate the sample size was derived from Taherdoost (2016), which is a widely accepted method for determining sample sizes in social science research. The formula is as follows:

$$n=(t^2 \cdot p \cdot q)\ d^2$$

Where:
n = required sample size
t = Z-value corresponding to the desired confidence level (e.g., 1.96 for 95% confidence)
p = estimated proportion of the population with a particular characteristic (if unknown, use 0.5 for maximum variability)
q = 1−p
d = margin of error or precision level (e.g., 0.05)

Since there was uncertainty about the value of p, it was assumed to be 0.5, as recommended by Macfarlane in Naing et al. (2006). This assumption maximizes variability and ensures that the calculated sample size is sufficient.

Using a confidence level of 95% (t=1.96) and a margin of error (d) of 5% or 0.05, the initial sample size (n1) was calculated as follows:

n1= (1.96)2· (0.5) · (0.5) (0.05) 2 Simplifying:

n1=3.8416·0.250.0025 n1=384. Thus, the initial sample size required for this study was determined to be 384 respondents. To account for potential non-responses and incomplete data, it was necessary to adjust the initial sample size based on an assumed response rate. For this study, a response rate of 96% was assumed. The adjusted sample size (n2) was calculated using the following formula:

n2 = n1 Response Rate Substituting values:

n2=3840.96 Simplifying:

n2=400 Therefore, after adjusting for a response rate of 96%, the final required sample size for this study was determined to be 400 respondents.

In other words, using Taherdoost's formula and accounting for an assumed response rate of 96%, a total sample size of 400 respondents was established as appropriate for this study.

3.3. Ethical Considerations

Before data collection, it was essential for the researcher to communicate clearly with potential respondents regarding the purpose of the study. The assurance that all information gathered would be used solely for research purposes and would remain confidential was emphasized. Respondents were given adequate time to decide whether or not to participate, ensuring that their involvement was voluntary and informed.

3.4. Data Collection Timeline

It took place over a three-month period for data to be collected from July to September 2019. This timeframe allowed for comprehensive engagement with participants and ensured that a diverse range of perspectives could be captured.

3.5. Questionnaire Development

The questionnaire designed for this study was meticulously crafted based on specific research objectives and questions. To enhance its effectiveness, a pilot study was conducted involving seven farmers. This preliminary phase served as a critical step in testing the validity and reliability of the measuring instrument. Feedback from this pilot study led to necessary corrections and refinements of the questionnaire before it was administered in the main study.

3.6. Data Collection Methods

The study aims to explore these multifaceted factors affecting the adoption of conservation agriculture in Livingstone District. By examining both qualitative and quantitative data from local farmers and stakeholders, this study sought to provide insights into how these elements interact to promote sustainability and resilience in farm production.

3.6.1. Quantitative Data Collection was done through

- Surveys: Designed a semi-structured questionnaire (Bargali et al, 2007 & 2009; Pandey et al, 2011) targeting farmers in Livingstone District. The survey should include questions on demographics, farming practices, and perceptions regarding CA.
- Sampling Method: Used stratified random sampling to ensure representation across different farming communities within the district.

3.6.2. Qualitative Data Collection was done through

- Interviews: Conducted semi-structured interviews with key informants such as agricultural extension officers and local leaders to gather insights on barriers and facilitators to CA adoption.
- Focus Groups: Organized focus group discussions with farmers who have adopted CA and those who have not to explore their experiences and perceptions.

3.7. Data Analysis Methods

3.7.1. Quantitative

Descriptive Statistics through the use of frequency distributions for categorical variables (e.g., education level) and through the use of Inferential Statistics using the logistic regression analysis to identify significant predictors of CA adoption while controlling for confounding variables. The findings were presented in tables and graphs for clarity

3.7.2. Qualitative

Triangulation through comparing findings from quantitative data with qualitative insights to validate results and provide a comprehensive understanding of factors affecting CA adoption.

4. Results and Discussion

4.1. Demographic and socioeconomic status of respondents

4.1.1. Age Distribution and Its Impact

The data indicates that the age category with the highest frequency of respondents was 46 – 60 years, accounting for 50.4% of the surveyed population. This finding suggests that middle-aged farmers are more likely to engage in traditional farming practices compared to their younger counterparts and aligns with the study of Bargali et al (2009) and Pandey et al (2011). The implications of this trend are profound for agricultural policy and practice.

4.1.2. Age as a Determinant of Farming Practices

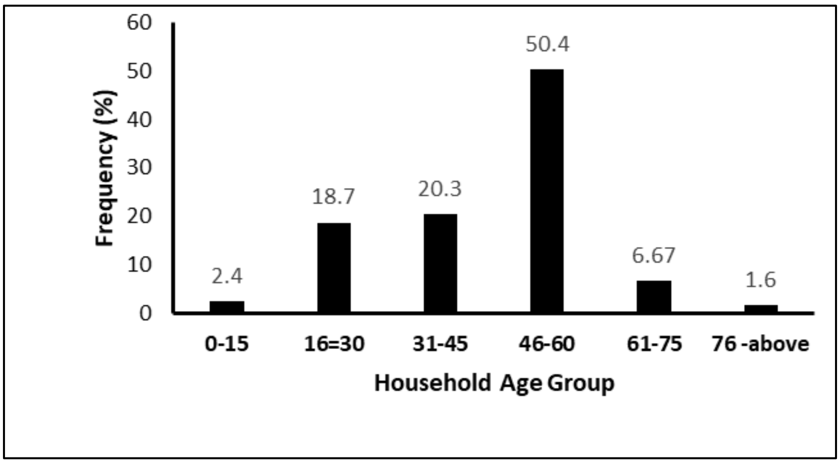
Research has shown that age significantly influences the type of farming approaches adopted by individuals. For instance, Njeru (2017) noted that younger men often show less interest in agricultural activities, opting instead for careers in sectors such as information technology, tendering, and mining. This shift away from agriculture among youth can be attributed to various factors, including perceived economic opportunities outside farming and a lack of engagement with modern agricultural practices.

4.1.3. Implications for Conservation Agriculture Adoption

Given that older farmers dominate the demographic landscape in the Livingstone District, strategies aimed at promoting conservation agriculture must consider this age distribution. According to Doss et al. (2018), age influences not only the willingness to adopt new technologies but also access to resources necessary for implementing such changes.

The gap between older and younger farmers indicates a need for targeted outreach programs that specifically engage younger individuals. Similarly, Kiptot & Franzel (2015) highlighted that older farmers tend to have more experience but may resist change due to established routines, while younger farmers might lack both experience and motivation if they perceive better opportunities elsewhere. Such programs could include workshops and training sessions tailored to younger audiences that can help bridge knowledge gaps regarding conservation agriculture practices. Providing financial incentives or subsidies for young farmers who adopt CA techniques could stimulate interest and participation as well. Furthermore, Manda et al. (2020) found that targeted interventions focusing on youth engagement are essential for fostering innovation within agricultural sectors.

Leveraging technology to make conservation agriculture more appealing to younger generations may enhance adoption rates.



(Source: Author compilation, July –September, 2019)

Figure 2 Distribution of the respondents by age group

Most households sampled for the study were made up of more males than females. Though this imbalance could have been due to sampling, generally male-headed households tend to have higher chances of adopting conservation agriculture (Kristjanson et al. 2017; Makate et al. 2017; Ng'ombe et al. 2017). Women tend to have challenges in carrying out some of the activities on the farm, such as ploughing and spraying. Given this, they wait for men to perform these tasks, which in the long run result in the loss of the farm produce (Njeru 2017). The analysis above reveals that the participation of women in smallholder farming still remains a challenge in the Southern province, Livingstone district.

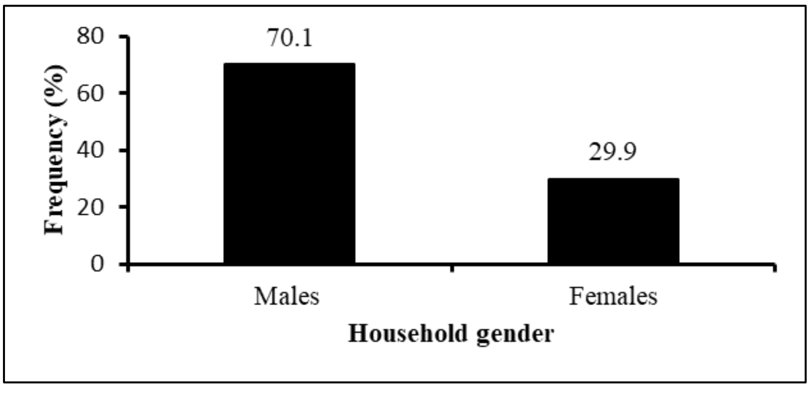


Figure 3 Household gender

The summary of the descriptive statistics was indicative as shown below.

Table 1 Descriptive statistics of sample households (n=375)

Variable	**Percentage (%)**	**Frequency**	**Mean**	**std. dev**	**Variance**
Level of education			2.49	0.62	0.39
No education	3.20	12			
Primary	50.10	188			
Secondary	42.40	159			
Tertiary	4.30	16			
Number of years (farming experience)			2.35	1.03	1.05
0-5	21.90	82			
6-10	40.80	153			
11-15	18.10	68			
16-20	19.20	72			
20 –above	4.80	18			
Household decisions			2.58	1.53	2.34
Women	40.30	151			
Men	59.70	224			
Marital status			2.2	0.95	0.90
Single	12.30	46			
Married	73.90	277			
Separated	2.10	8			
Widowed	5.30	20			
Divorced	6.40	24			
Own equipment for CA			1.7	0.46	0.21
Yes	29.60	111			
No	70.40	264			
Do you own cattle or donkeys?			1.35	0.48	0.23
Yes	65.30	246			
No	34.70	130			
Number of cattle pairs owned			1	0.94	0.89
0	34.70	130			
1	39.50	148			
2	18.40	69			
3	6.40	24			
4	1.10	4			
Number of dependents			2.23	2.66	7.09
0-2	62.40	234			

3-4	16.00	60			
5-6	11.00	41			
7-8	9.60	36			
9-10	1.10	4			
Extension services given			1.05	0.26	0.07
Yes	93.30	350			
No	6.90	25			
How often are extension services given?			2.29	0.81	0.66
Regularly	18.10	68			
Occasionally	39.50	148			
Rarely	38.10	143			
Never	4.30	16			
Have you ever attended any CA / CFU meeting?			1.55	0.50	0.25
Yes	44.80	168			
No	55.20	207			
Do you have access to credit facilities?			1.94	0.24	0.06
Yes	5.90	22			
No	94.10	353			

(Source: Author compilation, July –September, 2019)

Results in Table 1 show that most decisions in smallholder farmers' households were made by men, who were 59.7% (224), compared to women, 40.3% (151), who may have made decisions for the adoption of conservation agriculture. From the results obtained in this study in Table 1, it was clear that at least most farmers had cattle or donkeys to help them with field work. The majority (65.3%) of smallholder farmers owned cattle. In terms of the number of cattle owned, the majority of farmers, 39.5% (148), had only one pair (male and female) of animals. Only 18.4% (69) had two pairs, 6.4% (24) had three pairs, and 1.1% (4) had above four pairs of cattle (Table 1).

Table 1 shows that 93.3% (350) of the smallholder farmers agreed that they received extension services. However, 39.5% (148) of the respondents agreed that these extension services were only done occasionally. Results indicate that 44.8% (168) of smallholder farmers had attended conservation agriculture meetings or conservation farming unit meetings. However, 55.2% (207) of the farmers had never attended any training sessions at all. This shows that rural livelihood is threatened as a result of inaccessibility to credit facilities. This, therefore, is a threat to smallholder farmers as they may not easily access the capital required to purchase essential inputs for conservation agricultural practices to be carried out effectively.

4.2. Smallholder farmers' likelihood to adopt conservation agriculture

Table two indicates that only six covariates were significant in the regression, namely: decision making, number of households, number of dependents, access to extension services, how often they receive the extension services, and number of trainings received through attending meetings such as the conservation farming units (CFU) meetings.

Table 2 Probit estimates for adoption of conservation agriculture

Variable	**Coefficient**	**Odd ratio**	**Std. Error**	**P >Z**
Age	-.0.25	1.61	0.11	.823
Who makes most of the decisions in the household?	-0.14***	3.11	0.06	.026
Household Gender	0.58***	6.26	0.24	.014

Marital Status	-0.116	2.651	0.1275	.364
Education Level	-0.30	2.45	0.18	.09
Number of Dependents	0.12***	3.27	0.06	.04
Hectares	-0.10	2.14	0.14	.46
Do you own cattle?	0.50	0.00	0.31	.11
Pairs of cattle owned	0.19	1.37	0.16	.23
Extension	1.30***	13.94	0.42	.00
Times of extension visits	0.44***	4.95	0.12	.00
Farming Experience	0.03	0.57	0.10	.73
Have you ever attended Conservation Farming Unit (CFU) meetings?	-0.43***	2.06	0.21	.04
Number of meetings attended	0.10	6.04	0.07	.12
Credit facilities	-0.16	0.25	0.37	.66

(Source: Author compilation, July –September, 2019) ***; statistically significant at 5%

4.2.1. Decision-making by males as household heads

According to probit analysis, this indication was statistically significant with a negative correlation coefficient of -0.14 at the 5% level of significance. This negative correlation indicates that decisions, though made by males, tend to negatively influence the decision to adopt conservation agriculture. In other words, though men tend to make most of these decisions (odds ratio of 3.11) for conservation agriculture, as was the result of this study, they tend not to be very receptive to the adoption of conservation agriculture. This may also be due to the traditional beliefs or resistance to change.

Some household heads do not adopt conservation agriculture as an adaptive measure to climate change, but instead they take it that it was all the design of God, and it was normal to have such climatic changes in the environment (Arslan et al. 2017).

4.2.2. Household head gender

The results in Table 2 reveal that the variable gender was statistically significant with a correlation coefficient of 0.58 at the 5% level of significance. This means that there was an increased likelihood (odds ratio of 6.26) that the gender of the household head affects the adoption of conservation agriculture. The results in this study were consistent with findings of studies done in Zambia and Zimbabwe, where male-headed households had higher chances of adopting conservation agriculture than female-headed households. The males had better access to finances, land, and other farming inputs compared to females (Mazvimavi and Twomlow 2009; Kristjanson et al. 2017; Makate et al. 2017; Ng'ombe et al. 2017). Greater access to resources increases the likelihood of adopting conservation agriculture.

4.2.3. Household size

The results in Table 2 show that dependents were positively correlated ($r = 0.12$, $p < 0.05$) with the adoption of conservation agriculture. This shows that the number of dependents in a household was most likely (odds ratio of 3.27) to affect the adoption of conservation agriculture. The results obtained in this study were consistent with findings by Ngoma (2021). In Zambia, where farm mechanization is far from being attained, which creates a big productivity gap, the only way to fill the gap is by intensifying labor use of the number of dependents in a family. Larger households are more likely to adopt conservation agriculture, potentially because of increased labor availability. Therefore, for adoption, this gap must be filled.

4.2.4. Extension services

Table 2 shows that the provision of extension services was significantly ($P<0.002$) correlated with the decision to adopt conservation agriculture. It had a correlation coefficient of 1.30 with an odds ratio value of 13.94. This is the most impactful factor. Farmers receiving extension support are much more likely to adopt conservation agriculture. These results are consistent with the findings of Nkoma et al. (2017). Extension services also play a critical role for extension officers as they allow them to learn beneficiaries of the technology. Extension officers can learn or evaluate the effects of the technology when they look at how the beneficiaries are responding to it at the grassroots level, whether for the better or the worse, to get better results thereafter.

4.2.5. Frequency of extension services

How often extension services were given was also significantly correlated with the decision to adopt conservation agriculture in this study. At the probability level of 5% level of significance, it was correlated at 0.44 and had an odds ratio value of 4.95. Although this may have been significant but it may not always give the desired results. Extension services are important in the acquisition of relevant information that promotes technology adoption, which in turn reduces uncertainty about a technology's performance (Razzaghi Borkhani, and Mohammadi 2018). More frequent engagement of the farmers improves adoption rates.

4.2.6. Attendance of conservation farming unit or conservation agriculture meetings

The training received through attending meetings, such as the conservation farming units (CFU) meetings, was negatively correlated (0.26 at a 5% level of significance) with the adoption of conservation agriculture technology, the odds ratio still shows a positive impact from this study.

4.3. Constrains of the study

Some of the respondents constituted a barrier during the data gathering process for this study since they lacked valid records and information, such that they had no choice but to rely on recalling, which was prone to errors. The gender variable on the adoption of conservation agriculture was not adequately addressed in this study. This requires further research and more study to be able to establish more information about it.

5. Conclusions

Six covariates were significant in the regression model, with access to extension services playing a pivotal role and contributing an odds ratio of 13.94. followed by gender (odds ratio of 6.26), frequency of extension services (odds ratio of 4.95), number of dependents (odds ratio of 3.27), decision maker in a household (odds ratio of 3.11), and number of trainings received through conservation farming unit meetings attended (odds ratio of 2.06).

Recommendations

Increased government support for Extension officers in terms of resources to enable them to reach a wide number of smallholder farmers for increased adoption of conservation agriculture is needed by the Ministry of Agriculture. Policy documents need to be developed for active engagement of farmers, which is important if the adoption of conservation agriculture is to be made effective in the country. Furthermore, the Ministry of Agriculture must promote increased participation of women in smallholder conservation agriculture through policy developments and by ensuring sustainable extension services. It is necessary to empower women through training to promote their involvement through the provision of access to farming technologies that will be more effective and productive.

Compliance with ethical standards

Acknowledgments

The authors wish to thank the journal's anonymous reviewers for comments and suggestions that have led to the successful publication of this study.

Disclosure of conflict of interest

No conflict of interest to be disclosed

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