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Factors Affecting Adoption of Conservation Agriculture Practices in Mpatsa Extension Planning Area, Nsanje, Southern Malawi

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Abstract

Conservation agriculture (CA) emerged as an alternative innovation to conventional agriculture due to losses in soil productivity as a result of soil degradation. This study investigated factors affecting the adoption of Conservation Agriculture in the Mpatsa Extension Planning Area in a southern district of Malawi, Nsanje. A quantitative method approach was followed where were collected from a sample of 110 targeted smallholder farmers in the study area using a semi-structured questionnaire where the majority (63.6%) were women. Focused Group Discussions (FGDs) were also done to triangulate data on questionnaires. Data were entered into a Microsoft Excel database and analyzed in SPSS version 20. Socio-economic, environmental factors and household income have a greater impact on the adoption of conservation agricultural innovations. Animals were found to cause permanent soil cover disturbance while feeding on crop residues leaving the soil bare. The study concluded that climatic factors and CA training have negatively affected the adoption of new agricultural innovations, therefore, recommending further training and extension support for CA adoption as well as more access to credit opportunities for increased households' adoption of CA.

Keywords

Conservation Agriculture, Social-Economic Factors, Environmental Factors

1. Introduction

Agriculture is one of the human activities that obtain the most direct benefits from ecosystem amenities (Chabert & Sarthou, 2020; Ruscoe et al., 2021). Conservation agriculture (CA) developed as an alternative to conventional agricul-

ture as a result of losses in soil productivity due to soil degradation (Su et al., 2021; Nyirenda & Balaka, 2021; Pooniya et al., 2021). Conservation Agriculture is a farming system that can prevent losses of arable land while regenerating degraded lands (Brown et al., 2021; Sharma & Dhaliwal, 2021; Meijaard, Sheil, & Murdiyarso, 2021). Conservation agriculture helps to hold the potential which enhances soil biological properties and could also sustain production in the long run (Akter et al., 2021; Sharma & Dhaliwal, 2021; Morales, Domínguez, Herrador et al., 2021). CA practices include zero-tillage, mulching, mixed cropping, crop rotation, and Integrated Pest Management (IPM) using botanicals rather than chemical pesticides (Brown et al., 2021; Kollah et al., 2021) and are defined as the ability to prevent soil erosion and increase soil organic matter (Sousa, et al., 2020; Polidoro et al., 2021). Studies show that CA could advance the sustainability of smallholder farm productivity and profitability (Brown et al., 2021; Byamungu, 2018) and are cost-effective in terms of labor, time and require minimum inputs unlike other types of agricultural production activities that are labor-intensive and demand more inputs (Jat et al., 2020; Selvakumar & Sivakumar, 2021). Conservation Agriculture has emerged as a popular form of climate-smart agriculture aimed at enhancing climate change resilience for smallholder farmers across Africa (Komarek et al., 2021; Hermans et al., 2020; Mupangwa et al., 2021). Some studies have shown that mainstreaming of CA systems could be hindered by knowledge gap, inadequate farm machinery and tools, smallholdings, poor infrastructures, and lack of CA-friendly policy support (Karki & Gyawaly, 2021, Sun et al., 2020). Conservation Agriculture has been widely promoted as a pathway to sustainably intensify agriculture in sub-Saharan Africa (SSA) yet its uptake in SSA remains sparse (Mvula & Dixon, 2021; Bouwman et al., 2021; Komarek et al., 2021; Nandan et al., 2021).

In Malawi, low and generally declining soil fertility, soil and water loss through erosion, and erratic and unreliable rainfall are key factors constraining crop production (Angrist et al., 2021; Zuza et al., 2021). Conventional farming practices such as burning or removing crop residue and intensive tillage often make these problems worse (Nyirenda & Balaka, 2021). Conservation Agriculture (CA) was thus, introduced in some districts like Nsanje to improve agricultural productivity (Vanclay, 2011). However, the adoption level of agricultural Conservation Agriculture technologies among smallholder farmers is very low in the area. With a population of 20,540 people in the area, the study only targeted 110 smallholders farmers (87 male-headed households and 23 female-headed households) practice Conservation Agriculture represented a 0.5% adoption rate. The study was therefore carried out to investigate factors that influence the adoption of Conservation Agriculture in Mpatsa EPA in the Nsanje district.

2. Materials and Methods

Description of Study Area

Mpatsa EPA is situated in Traditional Authority (T/A) Tengani, Nsanje with a population of 20,540 ages between 19 - 69 years (Chiunda & Kanyuka, 2019) (**Figure 1**).

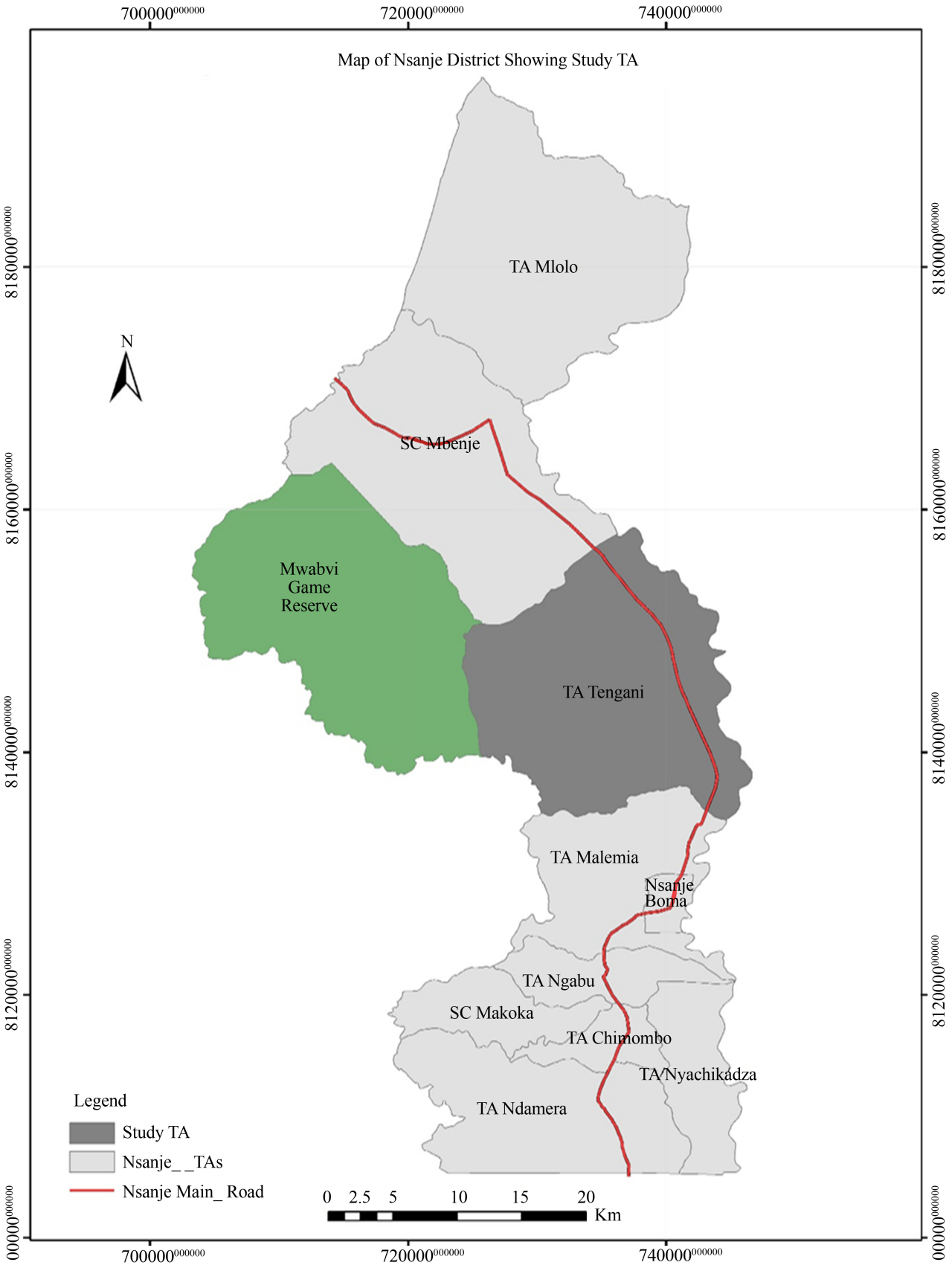

Figure 1. Shows map of Mpatsa Extension Planning Area (EPA), Nsanje district.

The EPA is located at the center of Nsanje district which has one thousand one hundred households (1100 Households) of smallholder farmers who are practicing Conservation Agriculture (**Figure 1**). The 110 households sample size is a 10% of 1100 households or smallholder farmers. Ignore percentage and leave it as a whole number (87% and 23% male and female-headed households, respectively). The commonest crops grown in this area are finger millets and sorghum during winter and grow sweet potatoes and maize in summer. Erratic rains are generally chronic in almost every growing season and the area has sandy loam soil in most parts.

The study adopted a quantitative research method approach to collect data using a semi-structured questionnaire targeting smallholder farmers who are practicing Conservation Agriculture. A sample of 110 households was chosen from various villages in five Group Village Headmen namely; Mphamba, Ntolongo, Bithi, Chikhao, and Mkango under Mpatsa Extension Planning Area (EPA) in Nsanje district. The households were selected using Systematic Sampling Procedure. Interviews were conducted with selected smallholder farmers practicing conservation agriculture. Data were coded and analyzed using SPSS software version 20 to compute frequency tables and where necessary, cross-tabulations. Graphs were produced in Microsoft Office Excel.

3. Results and Discussions

3.1. Demographic Information

Out of 110 households that were selected in the study area, 40 were male smallholder farmers representing 36.36% and 70 were female smallholder farmers representing 63.64% (Appendix). Up to 45.45% of the smallholder farmers are between the age of 35 - 59 (22.73% females and 22.73% males), 11.82% were classified as youth smallholder farmers aged between 15 - 24 years and 30.91% of the smallholder farmers were aged between 25 - 34 years (Appendix). Slightly over 10% of the farmers were over and 60 years. This finding suggests a high involvement of female farmers in Nsanje District Malawi (Appendix). The high percentage of female respondents follows the same pattern of high involvement of females in research in the country largely because female respondents are available at home while men are not at home during such exercises (data collection) (Appendix). The finding also suggests that the high percentage of female respondents means that females are highly involved in conservation agriculture than men. The results agree with the study by the Ministry of Agriculture (Ministry of Agriculture, Irrigation and Water Development, 2016) shows that women tend to carry out most of the farm work on top of doing other reproductive work such as fetching water, taking care of the children, and cooking. The age and gender distribution could also suggest low participation of youths and men in agricultural production which affects the presence of sufficient labor leading to failure to adopt some new agricultural innovations (Appendix).

The majority of smallholder farmers had completed primary school education representing 59.09% and 17.27% attained secondary school education. Up to 23.64% of smallholder farmers mentioned not attending any formal education. Most of the households are headed by males with a percentage of 81.82 and other smallholder farmers were widowed (9.09%) or were divorced (8.18%) (Appendix). Smallholder farmers heard about Conservation Agriculture but only 41.82% of farmers adopted the new agricultural innovation and 58.18% non-adopters. The results agreed with a study conducted by Chisenga (2015) shows that level of education does not have a negative impact on the adoption of new agricultural innovations but willingness. The results showed that other factors like environmental and economic play a great role in influencing individuals' choice of adopting new agricultural innovations (Chisenga, 2015).

Research findings were based on a combined percentage from all four CA techniques which found that both male and female smallholder farmers in the area adopted at least one of the Conservation Agriculture techniques (**Figure 2**). A greater number of both male and female smallholder farmers practice the mixed cropping method represented 54.5% followed by permanent soil cover at 37.7% for both males and females; zero-tillage was at 6.5% (**Figure 2**). Finally, Zero tillage and crop rotation were reported at 6.5% for both males and females and 1.3% for both males and female farmers respectively (**Figure 2**). Crop rotation was only reported among female smallholders (**Figure 2**). This means that the adoption of new agricultural innovation is partially determined by the method of CA techniques. The results agree with the study conducted by Brown et al. (2021) in the United Kingdom, the aim of the study was to compare the impact of reduced and zero tillage on soil carbon storage across 4 - 10 years of field experiments. This shows that if more women are trained in crop rotation it can help to conserve the environment compared to men. Smallholder farmers benefited much from mixed cropping (54.5%) and permanent soil cover techniques (37.7%) than the rest of the techniques (**Figure 3**). Smallholder farmers use the profits from farm produce to pay school fees for their children as well as other family needs such as clothes.

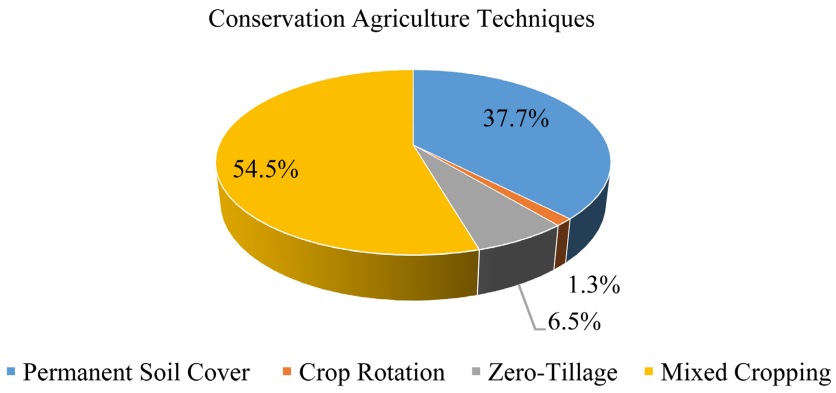

Figure 2. Proportion of respondents practicing conservation agriculture by techniques.

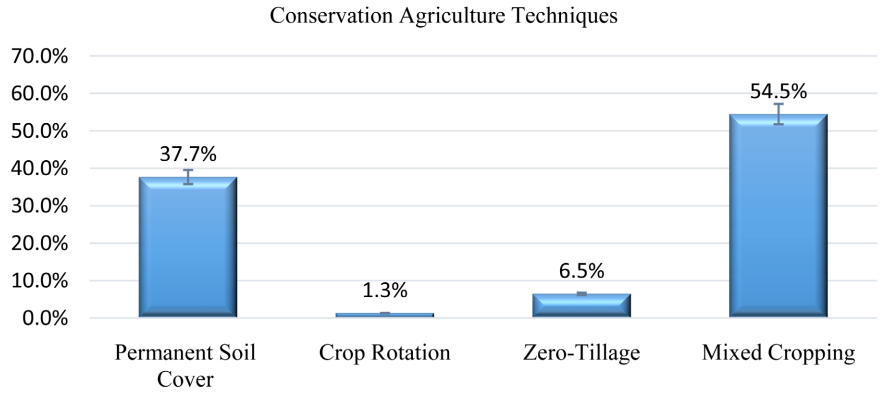

Figure 3. Proportion of respondents reporting benefits from conservation agriculture.

3.2. Social Network Factor

The percentage of the findings was separately based on the type of agriculture techniques which found that smallholder farmers in the study area get information about weather and agricultural messages from the radio since farmers cannot afford to buy smartphones to access information on the internet and other social networks. The research found that 7.79% reported that social networks had negatively affected the adoption of Conservation Agriculture while 92.21% reported that social network does not affect the adoption of new agricultural innovation (**Figure 4**). Finally, 87.01% of the male farmers denied that social network has any negative impact on the adoption of new agricultural innovation while 12.99% of male farmers reported that social networks have negatively affected the adoption of new agricultural innovation in the study area (**Figure 4**). However, smallholder farmers claimed the information which farmers get from radio does not have any impact on individuals' choice of choosing new agricultural innovation (**Figure 4**). The results suggest that most smallholder farmers get information on Conservation Agriculture from Extension Workers (EWs) which is not adequately accessible due to insufficient extension staff. This agrees with the study conducted by Chisenga (2015) in Balaka district, Malawi where the aim of the study was to analyze the socio-economic factors that affect the adoption of Conservation Agriculture, especially in women in the area of study.

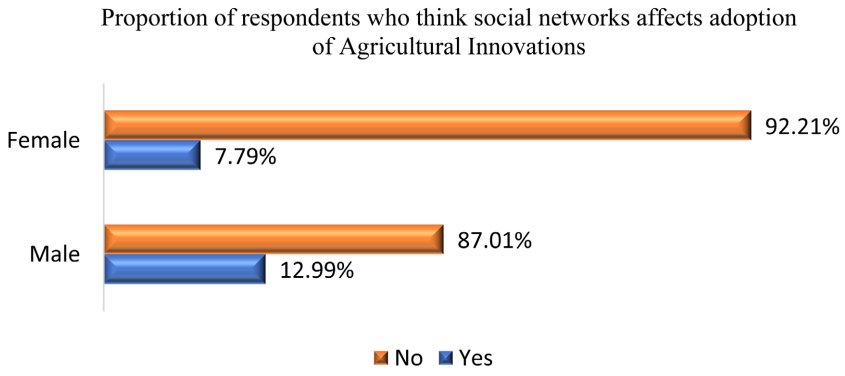

Figure 4. Proportion of respondents who think social networks affects adoption of CA.

3.3. Training in Conservation Agriculture

The findings were based on a combined percentage based on both sexes where males and females were included. Results show that a slight significant number of female smallholder farmers (40%) did not receive training in Conservation Agriculture as compared to male farmers (13.64%) (**Figure 5**). Those trained in CA were 23.63% females and 22.73% men of smallholder farmers (**Figure 5**). The results show that only a small proportion of men and youths had access to CA training since the majority of people in the study area think that women are responsible for all agricultural activities. Men have huge responsibilities such as providing day-to-day foods, money for school fees and buying clothes while women spend much of their time doing farming and other household chores. The results agree with the study conducted by Njeru (2016) in Kenya who found that Conservation Agriculture training has a greater impact on individual's choice of choosing new agricultural innovation since it equips farmers with basic knowledge on how farmers can manage to practice the whole four techniques of Conservation Agriculture.

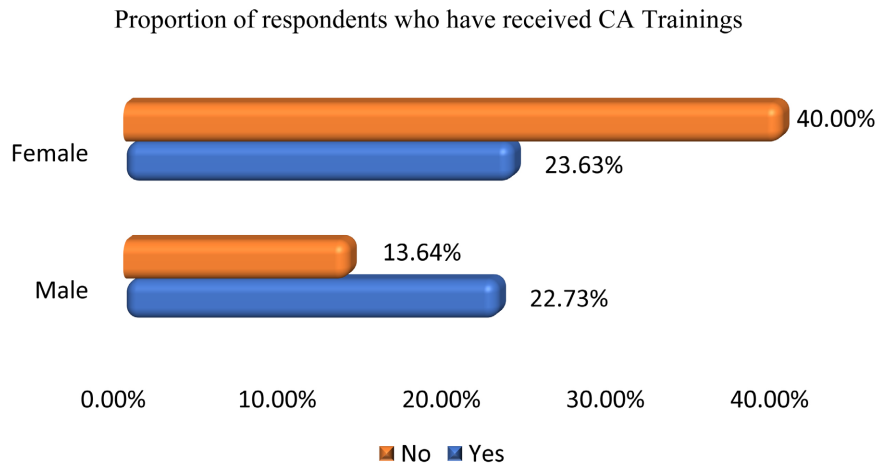

Figure 5. Proportion of respondents who received training in conservation agriculture.

3.4. Economic Factor

3.4.1. Source of Income

Almost every smallholder farmer in Mpatsa EPA reported multiple sources of income but the majority relies much on agriculture as a main source of income. The proportion of both males and female smallholder farmers was separated from all four main sources of income based on sex to give the percentage of the respondents. The proportion of female farmers who reported agriculture as their main source of income was at 68.57%, 21.43% relied on business as a source of income, 7.14% got their incomes from Village Savings Loans (VSLs) while 2.86% got from family members (100%) (**Figure 6**). The majority of male farmers who rely on agriculture represented 70.0%, 27.5% got their income from doing businesses and 2.5% got their income from family members (**Figure 6**).

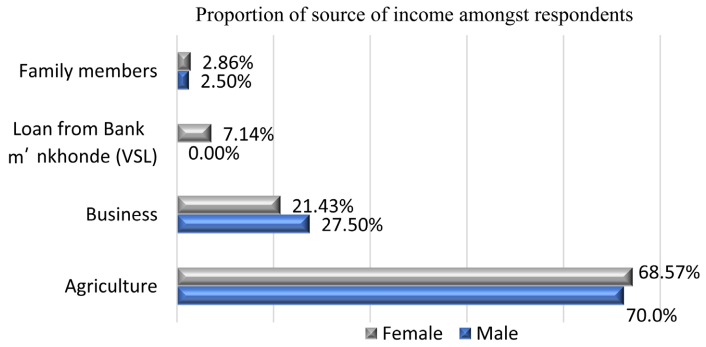

Figure 6. Source of income amongst respondents by Gender (Multiple responses).

However, none of the male smallholder farmers got their incomes from Village Savings Loans (VSL) as compared to female farmers (**Figure 6**). The study findings suggest that agriculture is the main sustainable source of income in respondents' households among other sources assessed such as family members (2.86% for female farmers and 2.50% for male farmers) (**Figure 6**). The gender disparity in participation in local financial services such as bank "M'nkhonde" was revealed in the finding that only female farmers indicated that they sometimes get money from such local initiatives; reported at 7.14% (**Figure 6**). The results agree with the study conducted by Chisenga (2015) in Malawi, which found that the source of income has negatively affected the adoption of conservation agriculture in the Balaka district. Women smallholder farmers have limited or no access to loans that can be used to purchase farm inputs and also pay for any agricultural labor as a result affected farmers' perception of adopting conservation agriculture.

Respondents reported that relying on agriculture as a source of income has a great negative impact on the livelihood of most smallholder farmers since the study area has been experiencing a dry spell for almost every growing season. The incomes most of these smallholder farmers get by end of each growing season are not sufficient to support agricultural activities, purchase farm inputs, and also support their families which affects farmers' decision to accept new farming technologies.

Research conducted in Kenya by Esther Njeru revealed that Income plays an important role in financing the uptake of new innovations (Njeru, 2016). The Researcher further explained that high family income enhances the ability to embrace technology due to the presence of fundamental capital to begin the innovation and pointed out that inadequate access to loans and other means of generating income impacts the small scale farmer which has a negative effect on the adoption of technology (Njeru, 2016).

3.4.2. Source of Farm Inputs

The majority of the male smallholder farmers got their farm inputs through multiple sources which rely much on purchasing from Agro-dealers. The percentage was found separately based on the sex of the respondents when all sources of farm inputs were combined. Percentages for buying from Agro-dealer

were reported at 60% males, 7.5% got farm inputs from the Affordable Input Program and 32.5% got their farm inputs from agriculture (100%) (Figure 7). The majority of female smallholder farmers got their farm inputs by purchasing from agro-dealers represented 70.0%, followed by farm produce at 22.86% and Affordable Input Program at 7.14% (100%) (Figure 7). By looking at the trend of how smallholder farmers get their farm inputs where farmers rely much on purchasing farm inputs from Agro-dealers adoption of new technologies may be greatly affected as farmers cannot afford to buy farm inputs every growing season (Figure 7).

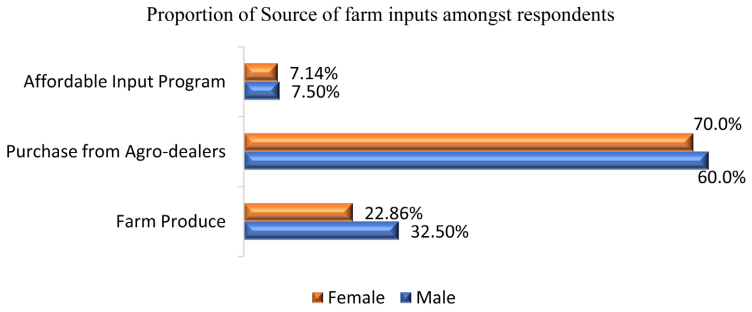

Figure 7. Source of farm inputs amongst respondents by Gender.

Respondents reported that all of the mentioned multiple main sources of farm inputs are not fully sustainable ways of getting farm inputs with a proportion of 58.57% for females and 60% for males respectively and the percentage was found separately based on the sex of the respondents (Figure 8). Only 41.43% for males and 40.00% for females reported that the main source of farm input is a sustainable way of accessing farm inputs yearly (Figure 8). The results agreed with the research which was conducted in other districts (Dowa, Nkhotakota, and Salima). Findings showed that the source of farm inputs has a negative impact on individuals' choice of adopting new agriculture innovation since smallholder farmers cannot afford to purchase farm inputs yearly due to financial crisis (Ngwira, 2014). Results also revealed that the source of farm inputs has a negative impact on individuals' choice of adopting new agriculture innovation since smallholder farmers cannot afford to purchase farm inputs yearly due to financial crisis (Ngwira, 2014).

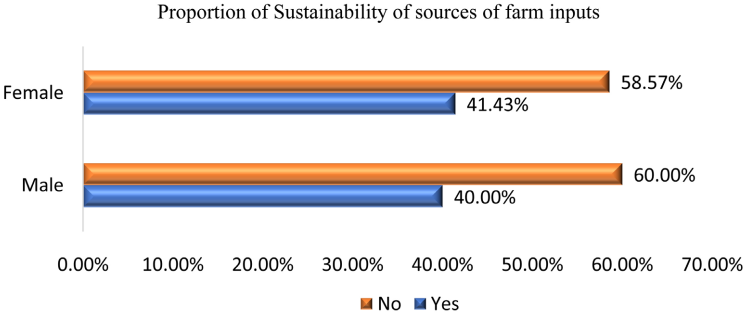

Figure 8. Sustainability of sources of farm inputs by gender.

3.5. Environmental Factors

Type of Weather (Temperature)

Responses from the respondents indicated that the area experiences very hot weather yearly with a percentage of 63.64% for females and 36.36% for males who reported to be the main factor that affects adoption of new agriculture technologies (Figure 9). Both sexes were combined to get a percentage on the proportion of the respondents that reported experiencing very hot weather. Very hot weather associated with unpredictable weather patterns has been affecting yields in the study area since crops are usually scorched by dry spells in almost every growing season.

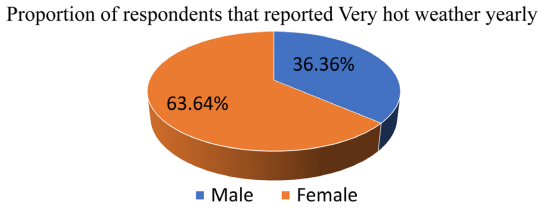

Figure 9. Proportion of respondents that reported experiencing hot weather yearly.

The researcher found the percentage by combining all responses from the respondents regardless of their sex. Research findings show that 42.73% of females and 25.45% think that very hot weather contributes to failure by the farmers to adopt new agricultural innovations whereas 20.91% of females and 10.91% of male farmers declined that very hot weather has a negative impact on the acceptance of new agriculture innovations (Figure 10). Results indicated that the greater proportion lies under those who reported that very hot weather has negatively affected the adoption of new agricultural innovation than those who declined (Figure 10). The type of weather of an area plays a great in changing individuals' choice of adopting new agricultural innovation since some Conservation Agriculture techniques require resources such as crop residues which can locally be found after harvest (Dougill et al., 2017). The results agree with the study conducted by Iris Aid, (2015) in Malawi which aimed at comparing variation of annual temperatures in all 28 districts in the past years.

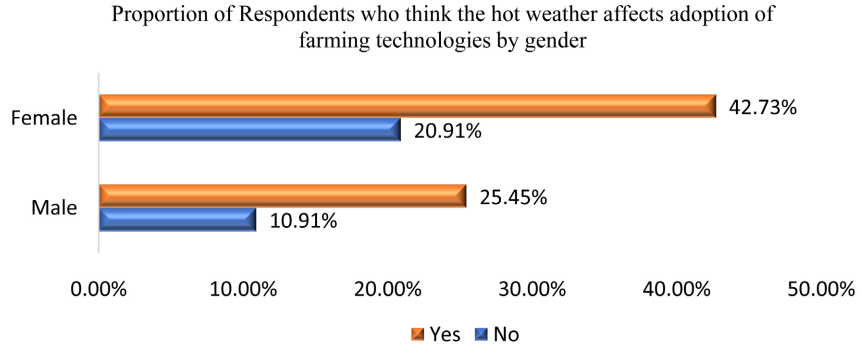

Figure 10. Proportion of respondents who think that hot weather affect adoption of farming technologies.

4. Conclusion and Recommendations

The results of the study have indicated that only two factors namely; socio-economic and environmental have a negative impact on an individual's choice of choosing new agriculture innovation in the study area. Environmental factor has been shown to be the main factor influencing community adoption among the three factors. Some other variables such as level of education, social networks, labor have no impact on individuals' choice of choosing or adopting new agriculture innovation.

Smallholder farmers reported that permanent soil cover is being disturbed by animals and termites which destroy crop residues leading to scarcity of grasses to cover the soil. Only a few farmers adopted Conservation Agriculture as a result of climatic factors and are not trained in Conservation Agriculture despite that they heard about the innovation. Some of them are discouraged to adopt the new innovation since benefits are not being met as a result of climatic and economic constraints to purchase improved farm inputs.

There is a need for the Ministry of Agriculture to recruit more extension officers in the study area as one extension officer is assigned to almost two sections which have eight blocks in each section. This is greatly affecting agriculture extension services since not all farmers have access to extension services. The study results show that the majority of the farmers owned farmland, the researcher, therefore, recommends further training and extension support for CA adoption to be targeted towards farmers who own their own land. Furthermore, the study findings have shown that household income has the greatest influence on CA adoption, the researcher also recommends more opportunities for access to credit to enhance CA adoption among households. This could be achieved by arrangements through NGOs, the Ministry of Agriculture, and the National Government financial assistance to farmers willing to adopt CA practices. Finally, there is a need to conduct follow-ups on the training provided by the NGOs and extension services to establish whether farmers understand what they were taught or trained.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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Appendix

Table A1. Demographic information.

	All RESPONDENTS					
	Female		Male		Total Respondents	
	n = 70	% of total respondents	n = 40	% of total respondents	n = 110	% of total respondents
Sex						
Female	70	63.64%	-	-	70	63.64%
Male	-	-	40	36.36%	40	36.36%
Age						
15 - 24	11	10.00%	2	1.82%	13	11.82%
25 - 34	24	21.82%	10	9.09%	34	30.91%
35 - 59	25	22.73%	25	22.73%	50	45..45%
60 or older	10	9.09%	3	2.73%	13	11.82%
Highest education completed						
Preschool	0	0%	0	0%	0	0%
Primary	37	33.64%	28	25.45%	65	59.09%
Secondary	8	7.27%	11	10%	19	17.27%
College	0	0%	0	0%	0	0%
University	0	0	0	0%	0	0%
Others	25	22.73%	1	0.91%	26	23.64%
Marital status						
Single (never married)	1	0.91%	0	0%	1	0.91%
Married	50	45.45%	40	36.36%	90	81.82%
Separated or divorced	9	8.18%	0	0%	9	8.18%
Widowed	10	9.09%	0	0%	10	9.09%
Have you ever heard of Conservation Agriculture						
Yes	70	63.64%	40	36.36%	110	100%
No	0	0%	0	0%	0	0%
Do you practice Conservation agriculture?						
Yes	23	20.91%	23	20.91%	46	41.82%
No	47	42.73%	17	15.45%	64	58.18%