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FACTORS THAT INFLUENCE FARMERS' DECISION TO UPSCALE CONSERVATION AGRICULTURE ON THEIR FARMLAND: A CASE STUDY OF MZIMBA DISTRICT, NORTHERN MALAWI

Chimwemwe Mwambungu
Department of Land Resources Conservation
Ministry of Agriculture, Irrigation and Water Development
P.O. Box 30291, Lilongwe 3, Malawi
cmwambungu@gmail.com

Supervisor
Sjöfn Vilhelmsdottir
University of Iceland
sjofn@hi.is

ABSTRACT

Almost 80% of Malawi's population depends on agriculture for their livelihood. Agriculture in Malawi is, however, facing several challenges, including persistent droughts and declining soil fertility. Several stakeholders are promoting various interventions, including conservation agriculture (CA) to curb these challenges. Despite several efforts to promote CA, the current rate of upscaling CA is very low, with most farmers practicing it in small demonstration plots. This study, conducted in Mzimba, Malawi, was designed to identify individual level factors that influenced farmers' decision to upscale CA, focusing on the famers' socio-economic characteristics, and their access to input incentives and extension services. Quantitative data collected through semi-structured questionnaires, administered to 50 farmers, was used in the study. The results revealed that farmers' gender and education level, as well as the farmers' farmland sizes were associated with CA upscaling. Thus, male farmers were more likely to upscale CA than their female counterparts. Farmers with a higher education level upscaled CA more compared to those with a lower education level. Also, farmers with a larger farmland upscaled CA more than those with smaller farmland. The study's findings suggest that farmer's gender, education level and farmland size influence their decision to upscale CA while farmers' access to input incentives and frequency of extension-farmer contacts did not influence farmers' decision to upscale CA. The implication of these findings calls for stakeholders involved in CA promotion to consider the above social-economic factors when designing CA promotion strategies. Along with other recommendations, it is proposed that CA promoting agencies should address the gender gap in Malawian agriculture by ensuring that women are more engaged and prominent in CA upscaling, which would in turn enhance successful CA promotion.

Key words: conservation agriculture, CA upscaling, farmland, socio-economic characteristics

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1. INTRODUCTION

1.1 The role of agriculture in Malawi

Malawi's economy is predominantly dependent on agriculture. About 80% of its 17.5 million people are directly or indirectly relying on agriculture to meet their livelihood demands and earn a living (World Bank 2019). Agriculture contributes nearly a third of the country's GDP and employs the greatest percentage of the labour force (Malawi Government 2017). Crop farming is the main sub-sector of agriculture in the country, with maize being the dominant and staple crop, apart from other crops such as rice, cotton, etc. (Malawi Government 2011). Agriculture in Malawi is dominated by smallholder resource-poor farmers. They cultivate fragmented customary lands and a great deal of these farmers do not have the capacity to invest in land improvements and other technologies related to enhancement of their land productivity (Phiri et al. 2012).

1.2 Main agricultural production challenges and how they are addressed in Malawi

Although most Malawians depend on crop production for survival, the industry is facing several challenges. These challenges include: recurrent droughts due to climate change, land degradation especially in the form of depletion of soil fertility, poor soil management practices, technology adoption barriers, and poverty (Phiri et al. 2012). According to the Malawi growth and development strategy (MGDS) III, the role of agriculture in Malawi's economy is negatively affected by its continued dependency on rain fed agriculture. Malawi's dependence on rain fed agriculture is mostly associated with several challenges which include poor water management, land degradation and the most recent and overwhelming: climate change (Malawi Government 2017).

In order to address the adverse effects of climate change and depletion in soil fertility for crop production in the country, the Malawian government has proposed strategies that focus on adaptation and mitigation of climate change impacts (Malawi Government 2017). The government of Malawi, through the Ministry of Agriculture, Irrigation and Water Development (Department of Land Resources Conservation) and its development partners, is promoting sustainable land management (SLM) practices among the farmers in order to lessen the negative impacts of land degradation and climate change on agriculture production. One of the most effective scientifically proven SLM technology is conservation agriculture (CA) (Thangata & Alavalapati 2003). CA was originally derived from the concept called no-till farming (Kassam et al. 2014). No-till farming, which originated from the United States of America, is a cropping system in which seeds are directly placed on undisturbed/untilled soil by either using machines or hand tools (Kassam et al. 2018).

1.3 Why promote CA upscaling

According to FAO (2016), CA is a farming system in which a farmer ensures permanent soil cover in order to protect the soil, minimises soil tillage and cultivates a variety of plant species for improvement of soil conditions. CA is also a useful method for reducing land degradation and increasing nutrient and water use efficiency (Hobbs 2007). CA technology encompasses promotion of three main principles (permanent minimum soil disturbance, continuous soil cover with organic mulch and plant species diversity) practiced concurrently on a piece of land (Kassam et al. 2014). CA enhances the soil's potential in soil water recharge and soil water conservation during rainy seasons that are characterised by low precipitation due to droughts

(Sosola et al. 2011). Continuous decline in crop productivity due to soil organic matter loss, soil erosion, destruction of soil structure, high crop production costs, persistent dry spells and droughts have been some of the primary drivers for the spread of CA (Kassam et al. 2014). Furthermore, TerAvest et al. (2015) reported that government agencies and international non-governmental organizations are promoting CA in order to overcome agriculture production constraints, including reversing soil degradation and mitigating the climate change impacts in southern and eastern Africa.

1.4 CA upscaling challenges

Despite several efforts made by the Malawi government and its development partners to promote CA technology among farmers, the hectarage under the technology in most areas is not expanding (Dougill et al. 2016). The rate of CA upscaling in Malawi is very low. Most of the farmers continue to practice the CA technology in small demonstration plots instead of expanding the area under the technology in successive years (Sosola et al. 2011). On a larger scale, there has been limited adoption of CA among smallholder farmers in Africa (TerAvest et al. 2015).

Although some few adaptive research studies on CA have been done in Malawi, there is still an information gap in CA research, especially related to CA adoption which is closely related to CA upscaling. Therefore, there is need for strengthened adaptive research on promotion of area specific CA practices suitable for various agro-ecological conditions in order to facilitate the upscaling of the technology (Sosola et al. 2011).

1.5 Previous studies on factors related to CA upscaling in Malawi and globally

According to the World Bank (2003), one of the aims of upscaling any technology is to efficiently spread its socio-economic impact to large-scale coverage. Upscaling a technology such as CA is usually associated with changes in farmers' behaviours, attitudes, transaction costs and objectives. These changes, therefore, directly or indirectly depend on the prevailing socio-economic characteristics of the farmers who need to upscale the technology. Also, people may only adopt a technology if they have the knowledge on how to do it, have adequate inputs, have tried it and are able to weigh the benefits (Rodgers 2003).

In their study assessing the determinants of the decision of smallholder farmers to adopt integrated soil fertility management practices in the central highlands of Kenya, Mugwe et al. (2008) reported that adoption was higher among the younger farmers and lower among the older farmers. Similarly, adoption of CA among vulnerable households in Zimbabwe was found to be low among the old farmers (Mazvimavi & Twomlow 2009).

According to Asfaw and Neka (2017), there was a positive correlation between farmers' education levels and their adoption of soil and water conservation practices. However, Chisenga (2015) in his study on factors associated with CA adoption of female farmers in Balaka, Malawi, found no correlation between education levels and CA adoption. Also, Mlamba (2012) failed to establish a relationship between the farmer's education level and CA adoption.

Most smallholder farmers are unlikely to adopt most of the introduced technologies because they are generally not suitable to the prevailing small farm systems conditions (Asfaw & Neka 2017). Furthermore, a study by Chisenga (2015) found that most female farmers experienced

problems in adopting CA in Malawi due to its complexity and compounded by the fact that women have limited access to land and limited technical knowledge on CA technology.

There is also need for initial government support to CA farmers in the form of incentives. The focus of the incentives should be to ensure that relevant farm tools and equipment are more available, and on the reduction of risks associated with crop productivity loss especially in the first years of CA in order to improve its adoption (Kassam et al. 2014). In his study investigating factors affecting adoption of CA in Salima, Malawi, Mlamba (2012) found that farmers that bought their own CA inputs were more likely to adopt CA compared to those that received input incentives.

According to Asfaw and Neka (2017), farmers' extension access was found to have an important effect on adoption of soil and water conservation practices in the Wereillu Woreda district, Kenya. Also, Mazvimavi and Twomlow (2009) reported that extension services access had an influence on adoption of CA among vulnerable households in Zimbabwe. Furthermore, Mlamba (2018) reported that frequency of extension worker-farmer contacts was found to influence survival rate of agroforestry trees and related to adoption. Additionally, Liu et al. (2018) found that acquisition of relevant information on specific environmental conservation initiatives, besides frequent person-to-person contacts between conservation agents and farmers, can help improve awareness on the conservation initiatives and has a significant effect on their adoption.

Currently there has been limited adoption of CA among smallholder farmers in Africa (TerAvest et al. 2015). CA adoption faces some challenges. These challenges include scarcity of relevant tools and equipment, implementation in the initial years is quite challenging, competition for mulch between CA and livestock, need for more technical-know-how as well as environmental and landscape-specific application approaches. (Kassam et al. 2014).

1.6 The need for this study

It is against this background that the present study was carried out to identify factors that influence the farmers' decisions to expand their area of land under CA in Mzimba district in Northern Malawi. There have been studies done in Malawi addressing the issue of CA, but they have been concentrating more on lessons learned and challenges related to CA development in general (see e.g. Mloza-Banda et al., 2011). The present study could help policymakers, institutions and other stakeholders with information on crucial parameters and issues needed to effectively strategize, plan and implement CA interventions and to enhance the upscaling of the technology among farmers. Thus, the study findings are intended to contribute to improved knowledge on CA in the Mzimba district, Malawi, and globally. The study's findings will also contribute to the researcher's successful promotion of CA upscaling among the farmers that he serves in the study area. This will aid the farmers to achieve increased agricultural yields, thereby contributing to improved household and national food security and livelihood standards in the district and on a larger scale.

1.7 Project goal

The study was conducted in order to achieve the following research project goal:

To identify factors that influence farmers' decision to expand the area for practising CA on their farmland.

1.8 Project objectives

Specifically, the proposed research project was designed in order to achieve the following objectives:

1. To identify socio-economic factors that influence farmers' decision to increase the area under CA in the successive years.
2. To examine if access to farm inputs has an effect on farmers' decision to increase the area of land allocated to CA.
3. To examine if the frequency of extension services has an effect on farmers' decision to increase the area of land allocated to CA.

1.9 Research questions

The study's research questions were:

- ☞ Do farmers' socio-economic characteristics influence their decision to upscale CA on their farmlands?
- ☞ Does farmers' access to CA input incentives influence their decision to upscale CA?
- ☞ Does farmers' access to extension services influence their decision to upscale CA?

1.10 Relevance of this study to Malawi

In order to achieve its long-term development aspirations, the Malawian government is currently implementing its development policy agenda following the five-year strategies summarised in the Malawi Growth and Development Strategy (MGDS) (Malawi Government 2017).The government is currently implementing the third phase of the strategy (MGDS III), which runs from 2017 to 2022 (Malawi Government 2017). The MGDS III is aligned to the country's international obligations, including the 2030 Agenda on Sustainable Development Goals (SDGs) to which Malawi is a signatory. The MGDS III puts more emphasis on investing concurrently in areas that enhance economic growth through the linkages of various sectors. The strategy identifies five key priority areas with agriculture, water development and climate change management being the core priority area. The desired outcome to the above priority area is inclusive agriculture transformation adaptive to climate change. Other intermediate result areas include: (i) increased agriculture productivity, (ii) improved food safety diversification, (iii) increased agriculture diversification, (iv) enhanced agriculture risk management, (v) enhanced integrated water resources, (vi) enhanced community resilience to climate change impacts, and (vii) enhanced climate change research and technology development, among others (Malawi Government 2017).

This study was designed with the purpose that its findings will support an effective CA promotion and upscaling among farmers, and as such contribute to the intermediate MGDS III outcomes as outlined above.

2. STUDY METHODOLOGY

2.1 Study area

The study was conducted in the Mzimba district in the northern part of Malawi (Fig 1.). According to the latest census conducted in Malawi, the Mzimba district has a population of

about 936,250 people, of which the percentage of women is slightly higher than men (NSO 2018). The district has about 195,459 households with an average household size of about 4.8 persons (NSO 2018). The number of households for the Mzimba district represents about 4.9% of the total households in Malawi. The study area was chosen because it is one of the districts in the country where upscaling of CA among farmers is very low, despite the effort of the Malawian government and various development partners to promote CA in the area. Another reason for selecting Mzimba as the study area, was that the researcher has been directly involved in interacting with the extension workers and the farmers in promoting CA. The researcher has, therefore, a good understanding of the problems associated with upscaling of CA in the study area. The map of Malawi (Fig. 1) shows the Mzimba district in red.

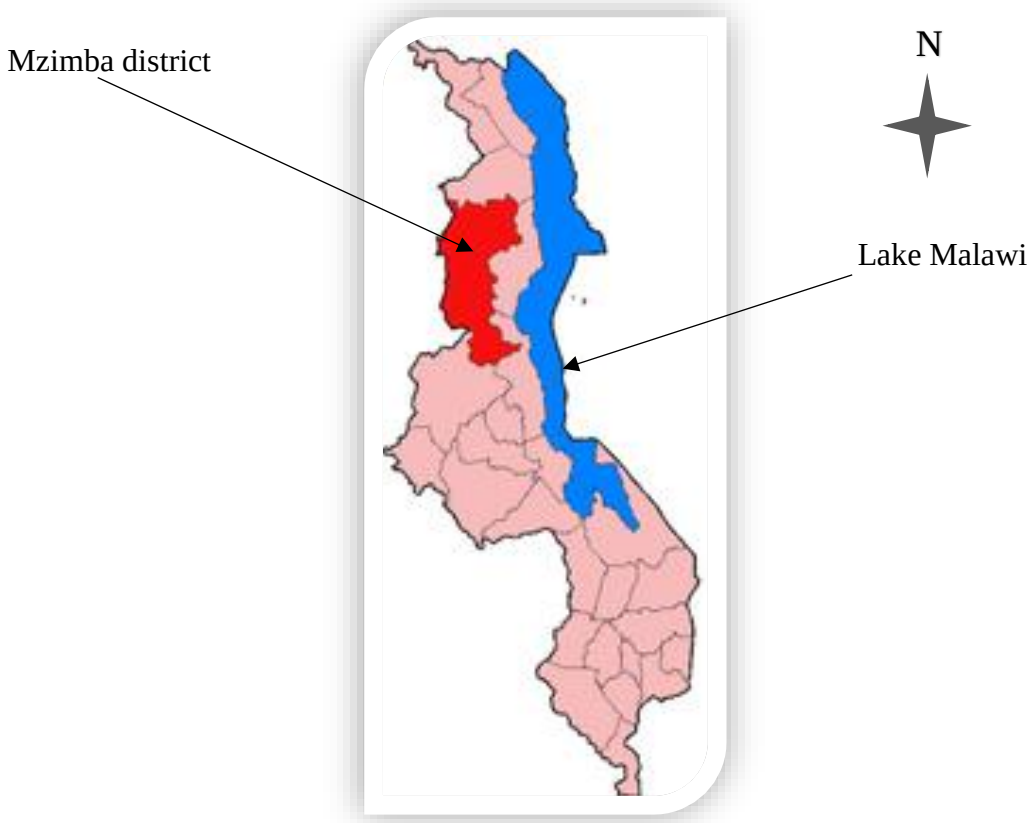

Figure 1**.** Map of Malawi showing the location of the Mzimba district, the study area, in red. (Source: https//www.google.com.mzimbadistrictmap).

2.2 Data collection

Data was collected using a semi-structured questionnaire, which was administered through a door-to-door survey to the sampled households (refer to the questionnaire in appendix 1). A team of four people were involved in the data collection and organisation process. The data collection process took four days. The four-day period included briefing of the data collection team on the data collection tool and a field pre-testing survey on using the tool. The whole data collection exercise, which included planning and making necessary arrangements with the sampled farmers, was carried out from 1st to 4th July 2019.

2.3 The sample

The study's sample consisted of 50 farmers. They were sampled using proportionate stratified sampling in order to ensure representativeness of the sample for the population in the study area. In this study, the population consisted of all farming households in the Mzimba district. The parameters considered in the stratification of the population sample included: farmer gender and whether the farmers had benefited from CA inputs incentives before. The sampling unit was the head of the household. The head of the household was defined as the individual who makes most of the economic decisions in the household, including decisions on how to use and manage their farmland (NSO 2011). The farmers were sampled from two extension plan areas (EPAs) of the Mzimba district. EPAs are administrative arrangements through which the Ministry of Agriculture provides services to the farmers in Malawi. The two EPAs were sampled using purposeful sampling method based on two main considerations: (1) population of farmers practicing CA in order to obtain a more representative sample; (2) closeness of the EPAs to the district agriculture office, to make the data collection exercise easier, due to limited time and financial resources. The EPA offices had information on all farming households in their area including information that categorised CA and non-CA farm households. Two lists consisting of 50 CA practicing farmers each, were generated from the two EPAs, considering proportionate stratification. From each list a sample of 25 farmers was obtained using a systematic random sampling method, ending with a sample of 50 farmers who participated in the study.

2.4 Data analysis

The study's data was coded and manually entered in Excel and then cleaned in order to run a preliminary analysis. One of the objectives of the preliminary analysis was to categorise the 50 farmers into two groups. The first group consisted of 25 households which had relatively smaller CA plots on their farmland. They were categorised as "low CA upscaling farmers". The second group also consisted of 25 households but these farmers had relatively larger CA plots on their farmland and were categorised as "high CA upscaling farmers". The data was then re-coded and fed into the Statistical Package for Social Scientists (SPSS) to run further analysis.

Descriptive statistics in the form of frequencies and cross tabulations of percentages were used for interpretation and presentation of findings. The Pearson Chi-square test was applied to determine the significance of the relationships between variables that were assumed to affect the farmers' decision to upscale CA on their farmlands. The Chi-square test was preferred because it is described by Rana and Singhai (2015) as a good tool for analysing categorical data, hence suitable in this study. The Chi-square test indicates whether there is a significant difference between the expected frequencies of that population and the observed frequencies of each independent category of the sample (Rana & Singhai 2015). In this study, a set Chi-square significance of 0.05 was applied to test the results. This means that for all the statistical test results in this study with a corresponding p-value > 0.05, it was concluded that there was no adequate evidence to suggest an association between the variables that were being tested.

2.5 Research ethics

According to de Jong et al. (2016), all researchers have an obligation to comply with research management ethical norms and standards. Also, participants must be safeguarded from the risks

related to participating in surveys to ensure that the researchers conduct research that meets the required scientific standards.

In order to ensure ethical research conduct in this study, the sampled farmers participating in the interviews were asked for their consent. This was done after explaining to them the purpose of the information that was collected from them. The respondents were assured of the confidentiality and privacy of the information that they provided to the research team, and they were told that collected data would only be used for analysis in relation to this study. Furthermore, those farmers that were not willing to participate in the questionnaire interview were replaced by other farmers from a replacement sample that was generated.

3. RESULTS

3.1 Socio-economic and demographic characteristics of the farmers

The results presented in this section mainly focus on cross tabulations and comparative analysis between the 25 interviewed farmers who had "low CA upscaling on their farmlands" and the other category of 25 interviewed farmers who had "high CA upscaling on their farmlands". The results highlighted the association between various independent variables and the rate of CA upscaling.

To evaluate if socio-economic characteristics had an impact on the famers' CA upscaling rate, the following socio-economic and demographic indicators were assessed: the farmers' age, gender, household size, education level, landholding size, farmland size, access to credit facilities, and livestock ownership. The farmers participating in this study were also the household heads, so the term "farmer" is used interchangeably with "household head" in the presentation of results.

3.1.1 Age of household head

Table 1 shows farmers' age and their rate of CA upscaling on their farmland. The farmers' age was categorised into three age groups as indicated in the table. Regarding the rate of CA upscaling among the youthful farmers (35 years and below), 70% of the interviewed youthful farmers had high CA upscaling on their farmlands compared to low upscaling farmers in the same age category. Of the interviewed farmers between the ages of 36 to 59 years, 42.9% had high CA upscaling. The rate of CA upscaling was evenly distributed among the interviewed farmers from 60 years and above with 50% of the farmers in each CA upscaling category. The Chi-square test of independence was also performed to examine the relationship between the farmer's age and farmer's CA upscaling rate. The Chi-square test revealed that the farmer's age was not associated with farmer's rate of CA upscaling ($\chi 2(3) > = 2.743$, $p = 0.338$). Thus, the results suggest that the farmers' age had no influence on farmers' decision to upscale CA on their farmland.

Table 1. The household head's age and rate of CA upscaling (n = 50).

Farmer's age category	Low CA upscaling frequencies (%)	High CA upscaling frequencies (%)	Total	% of the of the total	p-value
35 and below	3 (30%)	7 (70%)	10 (100%)	20%	0.338
36 to 59	16 (57.1%)	12 (42.9%)	28 (100%)	56%	
60 and above	6 (50%)	6 (50%)	12 (100%)	24%	
Total	**25 (50%)**	**25 (50%)**	**50 (100%)**	100%	

3.1.2 Gender of household head

Table 2 shows the results for farmers' gender and farmers' rate of CA upscaling on their farmlands. Of the 25 male interviewed farmers, a greater percentage (64%) comprised high CA upscaling farmers as compared to 36% of the farmers who consisted of low CA upscaling farmers. On the other hand, of the 25 female farmers interviewed, only 36% of them had a high CA upscaling rate. The findings also showed that a greater percentage (64%) of low CA upscaling farmers interviewed were female as opposed to the high CA upscaling farmers interviewed who comprised a greater percentage of the male farmers (64%). From these results, CA upscaling was therefore high among the interviewed male farmers and was low among the interviewed female farmers. The Chi-square test analysis results showed that there was a significant association between farmer's gender and farmer's rate of CA upscaling ($\chi2(1) <= 3.92$, $p = 0.048$.

Table 2. The household head's gender and rate of CA upscaling (n = 50).

Household head's gender	Low CA upscaling frequencies & %	High CA upscaling frequencies & %	Total	% of the of the total	p-value
Male	9 (36%)	16 (64%)	25 (100%)	50%	0.048
Female	16 (64%)	9 (36%)	25 (100%)	50%	
Total	25 (50%)	25 (50%)	50 (100%)	100%	

3.1.3 Household size

Table 3 shows results for household size and CA upscaling rate of the farmers. The results indicate that 66.7% of the farmers with small household sizes interviewed (1 to 3 persons/household) had a low CA upscaling compared to 33.3% of the same category who had a high CA upscaling. In contrast, a majority (85.7%) of the interviewed farmers with larger households (7 persons and more/household) had a higher CA upscaling compared to low CA upscaling farmers in the same category. There was even distribution of the rate of CA upscaling among the middle household size (4 to 6 persons/household). These results show that household size has some effect on the farmers' rate of CA upscaling on their farmland since the rate of CA upscaling increased with household size and vice versa. However, the results of the Chi-square test showed that there was no significant association between farmer's household size and farmer's rate of CA upscaling ($\chi2(2)> = 5.238$, $p = 0.073$.

Table 3. Farmer's household size and rate of CA upscaling (n = 50).

Household size	Low CA upscaling frequencies & %	High CA upscaling & frequencies	Total	% of the of the total	p-value
1 to 3 people	10 (66.7%)	5 (33.3%)	15 (100%)	30%	0.073
4 to 6 people	14 (50%)	14 (50%)	28 (100%)	56%	
7 people and above	1 (14.3%)	6 (85.7%)	7 (100%)	14%	
Total	25 (50%)	25 (50%)	50 (100%)	100%	

3.1.4 Education level of household head

Table 4 shows the results for the farmers' level of education and their CA upscaling rate on their farmland. Some 61.3% of the interviewed farmers who had attended eight years or less of formal education had low CA upscaling while 38.7% of the farmers in the same category had a high rate of CA upscaling. A majority (68.4%) of the interviewed farmers who had attended 9 years or more of formal education had a high rate of CA upscaling compared to low CA upscaling farmers of the same category. The descriptive statistics results showed that farmers who attained more years of formal education had a higher rate of CA upscaling. The Chi-square test of independence confirmed that there was a significant association between the farmer's education level and the farmer's rate of CA upscaling ($\chi2(2)> = 4.353$, $p = 0.041$).

Table 4. Level of education and rate of CA upscaling (n = 50).

Household head's education level	Low CA upscaling frequencies & %	High CA upscaling frequencies & %	Total	% of the total sample	p-value
8 year and below	19 (61.3)%	12 (38.7%)	31(100%)	62%	0.041
9 years and above	6 (31.6%)	13 (68.4%)	8 (100%)	38%	
Total	25 (50%)	25 (50%)	50 (100%)	100%	

3.1.5 Household farmland size

Table 5 shows results for the farmer's farmland size and the farmer's CA upscaling rate. The results show that only 27.8% of the interviewed farmers with relatively smaller farmlands (< 2 ha) had a high CA upscaling compared to interviewed farmers within the same category who had a high CA upscaling. In contrast, a majority (81.8%) of the interviewed farmers with relatively larger farmlands (> 3 ha) had a high CA upscaling compared to the interviewed farmers of the same category who had a low CA upscaling. The results in Table 5 show that the rate of CA upscaling increased with an increase in the farmer's farmland size. Farmers with larger farmlands upscaled CA more compared to farmers with smaller farmlands. The Chi-square test revealed that there was a significant association between the farmer's farmland size and the farmer's rate of CA upscaling ($\chi2(1)< = 8.058$, $p = 0.018$.

Table 5. Farmland size (ha) and farmer's rate of CA upscaling (n = 50).

Household's farmland size (ha)	Low CA upscaling frequencies & %	High CA upscaling frequencies & %	Total	% of the total sample	p-value
< 2 ha	13 (72.2%)	5 (27.8)	18 (100%)	36%	0.018
2 to 3 ha	10 (47.6%)	11 (52.4%)	21 (100%)	42%	
> 3 ha	2 (18.2%)	9 (81.8%)	10 (100%)	20%	
Total	25 (50%)	25 (50%)	50 (100%0	100%	

3.1.6 Farmers' involvement in off-farm enterprises

Table 6 shows results for farmers' involvement in off-farm enterprises and their rate of CA upscaling. Some 50% of the interviewed farmers who were involved in off-farm enterprises had a low CA upscaling while the other 50% of the farmers in the same category had a high CA upscaling. Similarly, 50% of the interviewed farmers who were not involved in off-farm enterprises had a low CA upscaling and 50% of the farmers in the same category had a high CA upscaling. The Chi-square test of independence was performed to examine the relationship between the farmer's involvement in off-farm enterprises and the farmer's rate of CA upscaling. The results show that there was no significant relationship between these two variables ($\chi 2(1) > = 0.000$, $p = 1$.

Table 6. Household head's involvement on off-farm enterprises and rate of CA upscaling (n = 50).

Household head involvement in off-farm enterprises	Low CA upscaling frequencies & %	High CA upscaling frequencies & %	Total	% of the total sample	p-value
Yes	13 (50%)	13 (50%)	26 (100%)	52%	1
No	12 (50%)	12 (50%)	24 (100)	48%	
Total	25 (50%)	25 (50%)	50 (100%)	100%	

3.1.7 Farmer's number years of practicing CA

The study examined the effect of the number of years farmers had been practicing CA on their decision to upscale CA on their farmland. The results in Table 7 show that there was an equal (50%) rate of CA upscaling among farmers who had practiced CA for 1 to 2 years. For farmers who had practiced CA for 5 years and longer, some 52.2% of the interviewed farmers had a low CA upscaling while 47.8% of the same category had a high CA upscaling. The Chi-square test results showed that there was no significant relationship between the farmer's number of years of practicing CA and the farmer's rate of CA upscaling ($\chi 2(2) > = 0.910$, $p = 0.777$).

Table 7. The number of years practicing CA and the rate of CA upscaling (n =50).

Number of years of practicing CA	Low CA upscaling frequencies & %	High CA upscaling frequencies & %	Total	% of the total sample	p-value
1 to 4 Years	13 (48.1%)	14 (51.9%)	27 (100%)	54%	0.777
5 Years and more	12 (52.2%)	11 (47.8)	23 (100%)	46%	
Total	25 (50%)	25 (50%)	50 (100%)	100%	

3.2 Farmers access to farm input incentives and CA upscaling

The study also examined the effect of CA input incentives that farmers receive from various development agencies on the farmers' rate of CA upscaling. The CA input incentives are given to the farmers as one way of motivating these farmers to upscale CA. In order to have a clear picture of the effect of CA input incentives on farmer's rate of CA upscaling, two scenarios were created. In the first scenario, the interviewed farmers were asked whether they had ever received CA input incentives since they started practicing CA or not. In the first scenario, the aim was to assess the general long-term effect of the farmers' benefit from CA input incentives on their rate of CA upscaling. The results of the analysis for the first scenario are presented in Table 8. In the second scenario, the interviewed farmers were asked whether or not they had benefited from CA input incentives in the previous growing season (2018/2019 farming year). The purpose of the second scenario was to assess the immediate effect of farmers' benefitting on CA inputs incentives on their CA upscaling. The results of analysis for the second scenario are presented in Table 9. There is similarity in the analysis results presented in tables 8 and table 9. The results showed that there were more low CA upscaling farmers who benefited from CA input incentives (56.2% and 70% respectively) than those who did not benefit from CA input incentives (38.9% and 45% respectively). Similarly, there were more high CA upscaling farmers who did not benefit from CA input incentives (61.1% and 55% respectively) than those who benefited from CA incentives (43.8% and 30% respectively). The Chi-square test performed to examine the relationship between farmer's benefitting from CA input incentives any year before and the farmer's rate of CA upscaling showed that the relationship between the two variables was not significant ($\chi 2(1) > = 1.389$, $p = 0.239$. Furthermore, the Chi-square test performed on the relationship between the farmer benefitting from CA inputs incentives in the previous farming season and the rate of CA upscaling revealed that the two variables were not significantly related ($\chi 2(1) > = 2$, $p = 0.239$.

Table 8. The farmer's benefiting from CA input incentives during any farming season before and rate of CA upscaling (n = 50).

Benefited from CA input incentives ever	Low CA upscaling frequencies & %	High CA upscaling frequencies & %	Total	% of the total sample	p-value
Benefited	18 (56.2%)	14 (43.8%)	32 (100%)	64%	0.239
Not benefited	7 (38.9%)	11 (61.1%)	18 (100%)	36%	
Total	25 (50%)	25 (50%)	50 (100%)	100%	

Table 9. Households' benefiting from CA inputs incentives in the 2018/2019 farming season and rate of CA upscaling (n = 50)

Benefited from CA input incentives 2019 season	Low CA upscaling frequencies & %	High CA upscaling frequencies & %	Total	% of the total sample	p-value
Benefited	7 (70%)	3 (30%)	10 (100%)	20%	0.157
Not benefited	18 (45%)	22 (55%)	40 (100%)	80%	
Total	25 (50%)	25 (50%)	50 (100%)	100%	

3.3 Frequency of farmers' access to extension messages on CA upscaling

Table 10 shows the farmers' rate of CA upscaling by frequency of extension contacts between extension officers and farmers. The results showed that there were more (59.3%) low CA upscaling farmers with less extension contacts (once/month or less) compared to high CA upscaling farmers in the same category. There were more (60.9%) high upscaling CA farmers with twice/month and more contacts with extension officers compared to low CA upscaling farmers of the same category. However, the Chi-square test of independence revealed that there was no significant association between farmer's frequency of extension contacts and the farmers rate of CA upscaling ($\chi 2(2) > = 2.015$, $p = 0.156$).

Table 10. Frequency of extension worker-farmer contacts and farmer's rate of CA upscaling (n = 50).

Frequency of extension services on CA	Low CA upscaling frequencies & %	High CA upscaling frequencies & %	Total	% of the total sample	p-value
Once a month and less	16 (59.3%)	11 (40.7%)	27 (100%)	54%	0.156
Twice a month and more	9 (39.1%)	14 (60.9%)	23 (100%)	46%	
Total	25 (50%)	25 (50%)	50 (100%)	100%	

3.4 Summary of Chi-square analysis

To sum up, the results showed that the farmer's gender, farmer's education level and farmer's farmland size were significantly related to the farmer's rate of CA upscaling since their p-values were < 0.05. But there was no significant association between the other independent variables and the farmers' rate of CA upscaling.

Table 11. Summarised Chi-square analysis results for all the variables (n = 50).

	Age	**G**ender	House-Hold size	Edu-cation	Farm-land size	Off-farm activities	Years of CA practice	CA incentives any time before	CA incentives previous season	Extension services frequency
χ2 test value	2.171	3.92	5.238	4.160	8.058	0.000	0.081	1.389	2.000	2.013
df	2	1	2	1	2	1	1	1	1	1
Asymp. Sig.	0.338	0.048	0.073	0.041	0.018	1	0.777	0.239	0.157	0.156

3.5 Main challenges faced by the farmers in CA upscaling

The interviewed farmers were also asked about what they considered to be the main challenges they had faced in upscaling CA on their farmland. Table 12 shows frequencies and percentages of the farmers' responses regarding the major challenges in CA upscaling. This question was aimed at getting an overall picture regarding the main bottlenecks behind upscaling of CA among the farmers. The results showed that a greater percentage (38%) of the 50 interviewed farmers indicated that lack of CA inputs and related CA implements was their main challenge in upscaling CA. The second main CA challenge cited by 34% of the interviewed farmers was burning of CA organic mulch. According to the interviewed farmers, burning of CA mulch mostly occurred as a result of fires emanating from mice hunting, uncontrolled bush fires and in some cases was intentional by other people. However, a few farmers indicated that laying of residue mulch was a laborious task in large scale CA fields. Also, a few other farmers cited destruction of CA organic mulch by livestock, mostly cattle and goats, as a major challenge to upscale CA.

Table 12. The main challenges faced by the farmers in upscaling CA on their farmland.

Challenge	**Frequency**	**Percentage**
Lack of CA inputs and CA implements	19	38%
Burning of CA residues mulch e.g. by mice hunters, uncontrolled bush fires, etc.	17	34%
Laying organic mulch laborious	8	16%
Destruction of mulch by livestock animals	6	12%
Total	**50**	**100%**

3.6 Farmers' opinion on CA upscaling approaches

The study participants were asked about their opinion on what development agencies should do in order to successfully promote CA upscaling among the farmers. Table 13 shows the results of the farmers' opinions as regards to how CA upscaling should be promoted. The results revealed that 44% of the interviewed farmers proposed that development agencies should come up with interventions to support farmers with CA input incentives and other forms of incentives for CA practicing farmers. Of the interviewed farmers, 11% stressed the need for the development agencies to intensify CA capacity building interventions by targeting the farmers

through mounting of CA demonstrations, supporting farmer trainings and farmer exchange visits. Some 11% of the interviewed farmers had an opinion that development partners should do more on sensitisation of communities, including their local leaders and raise more awareness on CA. The farmers suggested that intensified field days was a powerful sensitisation tool on CA. Some 4% of the interviewed farmers proposed that development partners need to facilitate farmers' access to CA input loans.

Table 13. Farmers' opinions on what development partners can do in order to promote CA upscaling among the farmers.

Farmers' opinion	**Frequency**	**Percentage of the total**
Provision of CA input incentives and other incentives to CA farmers, e.g. CA trophies	22	44%
Intensifying capacity building on CA, e.g. through mounting of CA demonstrations, farmer exchange visits and farmer trainings	11	22%
Intensifying sensitization of communities and their local leadership on CA, e.g. through field days, etc.	11	22%
Provision of CA input loans to the farmers	4	8%
Intensifying extension support visits to the farmers on CA	1	2%
Strengthening institutional capacity of communities such as helping communities to formulate local by-laws on CA	1	2%
Total	**50**	**100%**

4. DISCUSSION

This section discusses the study results on what factors influence farmers' decision to upscale CA on their farmlands. The discussion in this section is based on the results from the descriptive statistics analysis and the Chi-square tests performed. The results of the analysis are based on data that was obtained through interviewing 50 sampled farmers in the study area.

The study revealed that there are some socio-economic factors that influence the farmers' decision to upscale CA on their farmland. The socio-economic factors that were found to have an influence on the farmers' decision to upscale CA were: the farmer's gender, education level and farmland size. Other socio-economic factors as well as CA input incentives given to farmers and the frequency of farmer's extension services were shown to have little influence on the farmers' decision to upscale CA. The socio-economic factors that did not have a significant influence on the farmers' decision to upscale CA included the farmer's age, household size, involvement in off-farm activities, and the number of years of experience in CA.

4.1 Farmer's age and CA upscaling

According to the descriptive statistics results, it was observed that there was a comparatively higher CA upscaling rate among the younger farmers. This discovery is a promising situation for the promotion of CA upscaling because higher CA upscaling rates among younger farmers is essential for the uptake of CA. The reason for the relatively low CA upscaling rate among the older farmers might be linked to the fact that when farmers age, they become more risk averse and less willing to adopt new technologies. Similarly, a study conducted to determine

factors influencing decisions of smallholder farmers to adopt integrated soil fertility improvement practices in Kenya by Mugwe et al. (2008) reported that adoption was higher among the younger farmers compared to the older farmers. Also, the findings of Mazvimavi and Twomlow (2009) suggested that adoption of CA among vulnerable households in Zimbabwe was low among the old farmers. However, according to the Chi-square test results in the present study, the farmer's age was not found to be significantly associated with rate of CA upscaling.

4.2 Farmer's gender and CA upscaling

The results revealed that the farmer's gender has an influence on the rate of CA upscaling among farmers. The study revealed that there was a relatively low upscaling of CA among female farmers compared to their male counterparts in the Mzimba district. Thus, female farmers are less likely to upscale CA on their farmland compared to men. The findings from this study agree with the findings of a related CA study conducted in Balaka, Malawi (Chisenga 2015). Chisenga (2015) found that CA adoption among female farmers was low because they considered CA to be a complex technology to adopt. This is compounded by the fact the women have limited technical CA knowledge (Chisenga 2015). The disparities in CA upscaling between female and male farmers revealed in this study may be as a result of the gap in agricultural productivity that currently exists between men and women. The World Bank and ONE (2014), reported that male farmers are found to be more productive than female farmers in sub-Saharan Africa. Moreover, the World Bank (2015) reported that the agricultural gender gap exists since in most cases women are less privileged when it comes to access to principal agricultural inputs such as knowledge, land, labour, improved seed, herbicides and fertilisers.

4.3 Farmer's household size and CA upscaling

The study's results showed that the farmer's household size had a minimal influence on the decision to upscale CA on their farmland. Similarly, a study conducted by Mlamba (2012) in Salima, Malawi, on factors affecting adoption of CA found that there was no statistical correlation between the farmer's household size and CA adoption. The results of the present study are in contrast with the researcher's expectation. In Malawi and other sub-Saharan countries most of the farming activities, such as land preparation, weeding and harvesting, are done with hand tools. The use of these hand tools is heavily reliant on availability of manpower. Furthermore, the household size of smallholder farmers in Malawi determines the amount of labour available to perform various farming tasks. Therefore, the researcher expected that households with large household sizes would be more likely to upscale CA than smaller households. Nevertheless, the researcher's expectations were reflected in the frequency results which showed a high rate of CA upscaling among larger households compared to smaller households. The contrasting results of the Chi-square test may be because of the relatively smaller sample size that was used in this study.

4.4 Farmer's education level and CA upscaling

People's education level generally influences their ability to make certain critical decisions in life such as how to manage their resources, including their use of land. This is the case with farmers as well. Farmers with relatively higher education levels are more likely to understand the techniques and how to apply the principles of a specific technology such as CA. In line with this school of thought, the present study tried to identify whether the farmers' education level had an influence on their decision to upscale CA. The study results revealed that the farmer's

rate of CA upscaling was related to his or her education level. According to the descriptive statistics, the farmers with more years of formal education had a higher CA upscaling rate, while farmers with fewer years of formal education had a lower CA upscaling rate. Also, the Chi-square analysis revealed that there was a significant association between education level and the farmer's rate of CA upscaling. Previous studies on the relationship between farmer's education level and adoption of a given technology, however, have shown mixed results. For example, Mlamba (2012) in his study on factors that affect farmers' adoption of CA in Salima, Malawi, found no association between the level of education and the farmers' adoption of CA. Also, Chisenga (2015) could not find a correlation between education levels and CA adoption rates in his study on factors associated with CA adoption of female farmers in Balaka, Malawi. However, the findings of the present study are supported by a study by Asfaw and Neka (2017), who found a positive correlation between farmers' education levels and their adoption of soil and water conservation practices in the Wereillu Woreda district, Kenya.

4.5 Farmer's farmland size and CA upscaling

The study results indicated that farmers' farmland size has an influence on their decision to upscale CA. This suggests that farmers who have large farmlands are more likely to upscale CA as opposed to the farmers who have smaller farmlands. Similarly, Giller et al. (2009) argued that CA upscaling will only be rapidly adopted by those farmers who have adequate inputs and related resources, such as cash, land and labour, as opposed to those farmers with related resource constraints. Furthermore, Asfaw and Neka (2017) reported that most of the introduced technologies have not been adopted by smallholder farmers because they are usually not suitable to the prevailing small farm systems conditions. The results of the present study echoed the findings of Mugwe et al. (2008), which showed that there was a high adoption of integrated soil fertility management practices among farmers who had larger farmlands in the central highlands of Kenya.

4.6 Farmer's involvement in off-farm enterprises and CA upscaling

In most sub-Saharan countries, including Malawi, farmers' engagement in off-farm activities may affect their decision to upscale CA. This mostly applies to farmers in the smallholder category, most of whom rely on family labour. For example, engagement of smallholder farmers in off-farm activities has an effect on how they distribute their available labour between the off-farm tasks and the farming activities. Also, farmers who are engaged in off-farm activities have an added advantage in terms of the status of household income, which again can affect their ability to access CA inputs. Therefore, the present study also tried to identify the effect of the farmers' engagement in off-farm activities on their decision to upscale CA. The descriptive statistics found equal CA upscaling rates among farmers belonging to both categories (those involved in off-farm enterprises and those not involved). Accordingly, the Chi-square analysis showed that the farmers' involvement in off-farm enterprises had no influence on their decision to upscale CA on their farmland. However, previous studies have reported mixed findings. For instance, a study focussing on adoption of soil conservation among smallholder farmers reported that adoption was higher among farmers who were not involved in off-farm activities (Asfaw & Neka 2017). In contrast, Enki et al.'s (2010) study to determine adoption of physical soil conservation measures in Ethiopia found that adoption was higher among farmers that were involved in off-farm enterprises.

4.7 Farmer's number of years of CA experience and its upscaling

The number of years that farmers practice a given technology may contribute to their acquisition of more knowledge, skills and experience about the technology. This may have an impact on the farmers' adoption of the technology, in this case on upscaling of CA. The results of the present study are contrary to what the researcher expected regarding the impact of more experience of using CA technology on CA upscaling rates. According to the Chi-square test results, there was a weak correlation between the farmer's number of years of CA practicing and the farmer's rate of CA upscaling. Accordingly, the study results suggest that the numbers of years a farmer had been practicing CA on their farmland had little influence on his or her decision to upscale CA.

4.8 Farmer's access to input incentives and CA upscaling

One of the major bottlenecks facing smallholder farmers in upscaling CA in Malawi, just as in other sub-Saharan countries, is CA input constraints. CA inputs range from appropriate equipment and machines, fertilisers, and improved seed to herbicides for weed control (Kassam et al. 2018). Some CA promoting agencies support selected farmers with CA inputs in order to address the CA input challenge that the farmers face. The CA input incentives are in most cases meant to support CA on-farm demonstration plots hosted by the farmers. In the present study, the researcher wanted to identify the influence of such CA input incentives on the farmers' decision to upscale CA. The interviewed farmers were asked whether or not if they had benefited from CA input incentives in the previous year. Another question in the questionnaire was if the farmers had benefited from CA input incentives in any year in the past, including the 2018/2019 farming season. The researcher expected that farmers who had benefited from CA input incentives would upscale CA more compared to those who had not benefited but the Chi-square test results in both cases revealed that there was no significant association between farmers benefitting from CA input incentives and their decision to upscale CA. Thus, the study results suggested that receiving CA input incentives has no influence on the farmers' decision to upscale CA.

Through this study it was also found that most of the farmers who benefited from CA input incentives received only small quantities of inputs in the form of start-packs. For example, the majority of the farmers who benefitted received an average of 3 kg of seeds, mostly maize, and an average of 15 kg of fertiliser. A few farmers also received an average of 1 litre of herbicides. At the same time, the average farmland size for these farmers was around 2.5 ha. Therefore, information gathered in this study revealed that the CA inputs received by the farmers were far too small (less than 10%) in relation to their total CA variable input requirements for their whole farms. The study findings suggested that the CA input incentives received by the farmers had no influence on the CA upscaling rate. The reason for this could be that the farmers who got CA input incentives were somehow restricted in terms of area of land they could allocate to CA due to the limited quantities of the inputs received. In a related study investigating factors affecting adoption of CA in Salima, Malawi, Mlamba (2012) showed that farmers that bought their own CA inputs were more likely to adopt CA compared to those that received input incentives.

4.9 Frequency of extension services and CA upscaling

In Malawi, extension services form a very important platform through which the majority of the farmers learn new farming technologies, including CA. Most of the agriculture extension

services are provided by the government through the Ministry of Agriculture, Irrigation and Water Development. But, in some cases, agriculture extension services are provided by non-governmental organisations (NGOs). Generally, the extension workers visit the farmers, who are organised in groups, and under normal circumstances the farmers are supposed to be visited at least twice a month. Although extension services play a very crucial role in the delivery of messages on new farming technologies in Malawi, the vacancy rate of field agriculture extension officers is very high. This, in turn, creates a very high farmer/extension officer ratio, and as a result some farmers are not adequately contacted by extension officers. Therefore, it was assumed that farmers who have more frequent contacts with agriculture extension officers are more likely to uptake and adopt new farming technologies. The present study worked on the same understanding, expecting that farmers who had more frequent contacts with extension officers would be more likely to upscale CA and vice versa.

In order to test this hypothesis, the researcher categorised the farmers into two groups. One category comprised farmers that were visited by an extension officer once a month or not visited at all. The other category consisted of farmers that were visited by an extension officer two times a month or more. First, a descriptive statistics analysis compared the rate of CA upscaling among the interviewed farmers belonging to the two categories. The overall picture that was observed from the descriptive statistics results was that farmers with more frequent extension officer-farmer contacts had a higher CA upscaling rate compared to those with less frequent extension officer-farmer contacts. However, after performing the Chi-square test, the results suggested that the frequency of extension officer-farmer contacts was not a significant factor influencing the farmers' decision to upscale CA. In other studies, the frequency of extension worker-farmer contacts produced results that are mostly contradictory to the present study. A study investigating factors affecting survival rate of agroforestry adoption in Malawi found that frequency of extension worker-farmer contacts was associated with the survival rate of agroforestry trees (Mlamba 2018). Also, Mazvimavi and Twomlow (2009) reported that farmers' access to extension services had an important influence on the adoption of CA among vulnerable households in Zimbabwe. Additionally, Asfaw and Neka (2017) found that there was a significant association between farmers' access to extension services and their adoption of soil and water conservation practices in the Wereillu Woreda district, Kenya. Since the descriptive results of the present study were in accordance with the findings of several studies while the result of the Chi-square test was not, it might be suggested that these disparities may have been due to the limited sample size used in the present study.

4.10 Major challenges in CA upscaling

The study sought to identify the major challenges that the farmers are facing in upscaling CA. It was observed that the lack of CA inputs and CA implements as well as the burning of organic mulch intended for CA were the major challenges faced by the farmers in upscaling CA. The participants' responses revealed that mice hunting and uncontrolled bush fires were the main causes of organic mulch burning. The current study findings were similar to what Kassam et al. (2014) reported, that CA upscaling has a number of challenges, including scarcity of relevant tools and equipment, competition for mulch between CA and livestock, requirement for more technical-know-how on its associated farm management principles, requires for environmental and landscape-specific application approaches, and that its implementation is quite challenging in the initial years.

4.11 Farmer's opinions on CA upscaling approaches

The study sought farmers' opinions on how CA upscaling could be enhanced by CA promoting agents. Some of the interviewed farmers suggested that provision of CA input incentives to farmers by promoting agents was a viable strategy to enhance CA upscaling. Others suggested that intensified capacity building on CA, e.g. through CA demonstrations, farmer exchange visits and farmer trainings, could be an effective approach in promoting CA upscaling. Furthermore, there were farmers who had the view that intensified sensitization of communities and their local leaders on CA, e.g. through field days, could be an effective method to promote CA upscaling. The findings of the current study are supported by the findings of a similar study by Kassam et al. (2014), who stressed the need for initial government support to CA farmers in the form of incentives. Kassam et al. (2014) further reported that the support should focus on enabling availability of relevant farm equipment and the reduction of risks associated with crop productivity loss, especially in the first years of CA.

5. CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

This study was conducted in order to identify socio-economic and demographic factors influencing farmers' decisions to upscale CA on their farmlands. The study was also aimed at examining if the farmers' access to CA input incentives and frequency of extension services to the farmers had an influence on their decisions to upscale CA. The main socio-economic and demographic factors that were investigated included: the farmer's age, gender, marital status, education level, household size, farmland size, number of years of CA practicing, and the farmer's involvement in off-farm enterprises. It was established that the farmer's gender, education level and farmland size were significantly associated with the farmer's rate of CA upscaling on their farmland while there was no significant association between the other socio-economic and demographic variables investigated and CA upscaling. It is therefore concluded that farmer's gender, farmer's education level and the farmer's farmland size play an important role in farmers' decisions to upscale CA on their farmland.

The study also established that farmers' access to CA input incentives and frequency of extension worker-farmer contacts were not significantly associated to the rate of CA upscaling. It is therefore concluded that the farmers' access to input incentives was not found to influence their decisions to upscale CA on their farmland. The study findings also suggested that frequency of extension services had no significant influence on the farmers' decision to upscale CA on their farmland. In addition, it was observed that there were some challenges affecting CA upscaling. These challenges included lack of CA inputs and implements among the farmers, burning of organic mulch intended for CA, laying of organic mulch being laborious, and destruction of organic mulch by livestock. The findings also suggest that the CA upscaling rate can be improved by the following interventions: provision of adequate CA input and other forms of incentives to farmers, intensified farmer capacity building on CA, provision of CA input loans to the farmers and intensified community sensitisation meetings on CA.

The overall implications of the study findings are that CA upscaling can be enhanced if CA promotion agencies can bridge the gender gap between men and women by strategizing on how to motivate female farmers to upscale CA. This is because the women constitute the gender category mostly involved in farming activities in the study area and many parts of sub-Saharan

Africa. Furthermore, if CA upscaling promotion interventions can be designed to target more young farmers, quick positive and sustainable results in upscaling of CA may be achieved. Another implication of these findings calls for the need for CA promoting agents to support CA farmers with adequate CA inputs and implements other than supporting them in bits, which has a negative impact on promotion of CA upscaling.

5.2 Recommendations

The following are the main recommendations proposed based on the findings of this study:

1. Since this study found that CA upscaling was low among the female farmers, there is a need to develop policy and institutional support that focuses on encouraging female farmers to upscale CA. Thus, various stakeholders involved in promotion of CA need to address the gap between men and women in order to ensure successful upscaling of the technology. This would include developing strategies that should be implemented to address this gender gap a long with the core CA promotion interventions. Furthermore, the strategies should put a deliberate emphasis on ensuring that women are more engaged and prominent in CA upscaling.

2. More gains in CA upscaling could be made if CA promoting agents could engage the youth more because the younger farmers were found to be more likely to upscale CA than the older farmers in this study. Strategies that engage the youthful farmers more in the upscaling of CA are needed. The reason for this suggestion is that usually the youthful farmers find it difficult to integrate with the older farmers in most activities, such as CA awareness meetings and capacity building. Thus, the need for formulation of special programmes to target younger farmers' engagement in CA upscaling.

3. The data used in this study were collected by interviewing 50 farmers in the Mzimba district, in northern Malawi. Due to social, cultural and ecological diversity in Malawi and globally, the findings from this study might not necessarily reflect the situation of the population of all districts in Malawi nor on a global scale. Therefore, I propose further research on this topic to be carried out, with bigger sample sizes and covering more districts in Malawi since this study was limited in terms of sample size and coverage area due to time and resources constraints.

4. In this study, it was observed that CA promoting agencies generally give some farmers CA input incentives such as fertilizers, seed and herbicides but in very small quantities. The CA input incentives are in most cases not proportionate to the farmland size. They are generally below 10% of the total inputs required by the farmers. Development agencies involved in promoting the upscaling of CA should revisit the farmers' motivation strategy such that the use of CA input incentives should correspond to the farmer's CA input demands and needs.

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APPENDIX

Appendix 1: Household Survey Questionnaire

UNITED NATIONS UNIVERSITY
UNU-LRT

Government of Malawi

Questionnaire No.

HOUSEHOLD SURVEY QUESTIONNAIRE ON FACTORS THAT INFUENCE FARMERS' DECISION TO UPSCALE CONSERVATION AGRICULTURE ON THEIR FARMLAND

Inroductory Remarks

Hello, my name is …… . I am a research assistant involved in a study by a Senior Land Resources Conservation Officer, under the Ministry of Agriculture (Mzuzu ADD) on upscaling of conservation agriculture (CA) in this district. Please take note that the information collected in this household survey is strictly confidential and is only for the purpose of the researcher`s analysis regarding the research study. All the data will be detsroyed after the final analysis. The interview will take a maximum of 1 hour 20 min. You are most welcome to ask me any question related to the exercise at the end of the interview. Are you willing to take part in the interview?

Date of Interview…….

SECTION A: GENERAL INFORMATION & HOUSEHOLD CHARACTERISTICS

1 Name of Household Head (HH) (***If respondent is not HH***) ……

2 Age of HH…….

3 What is the gender of HH. ☐ Fill the box with 1. (Male) 2. (Female)

4 What is the maritual status of the HH? ☐ 1. (Married) 2. (Never married) 3. (divorced) 4 (Widow/widower)

5 Number of people that can provide labour in the household (***above the age of 5 years***)..

6 Name of Village for the household..……

7 Name of EPA for the household.…….

SECTION B: HOUSEHOLD HEAD EDUCATION AND LAND OWNERSHIP CHARATERISTICS

1 How many years of formal education did the HH head attend, (***dont include repeated years***)? ☐ 1. Primary (1-4 Years) 2. Primary (5-8 Years) 3. Secondary (9-10) 4. Secondary (11-12) 5. Tertially (13 years and above) 6. Never attended

2 How much farmland **in acres** did the HH use for rainfed crop production in the previous growing season? ***Use June 2018 to May 2019 as reference period previous season*****.....**

3 How much of the land used for rainfed crop production is allocated to CA technology?**.....*Please enumerator make sure you verify area of land allocated to CA with a GPS gugget in acres & where possible verify total farmland area***.

4 What is the estimated distance of the used farmland from the household`s house (**m**)?

5 Is the farmland owned by the household or rented? ☐ 1. (Own) 2. (Rented)

6 What is the total land (acres) owned by household including that was not cultivated in the previous season?.....**(Note: this should be sum of land units owned by household)**

7 For how many years has the household been practicing CA on the farmland? 1. (1-2 Years) 2. (3-4 years) 3. (5-6 years) 4. More than 6 years

8 What are the 3 main challenges limiting your household to upscale CA or limiting other farmers to upscale CA in this area (Rank in order of importance)?

1……2……3…….

SECTION C: HOUSEHOLD INCOMES AND OTHER SOCIO-ECONOMIC CHARACTERISTICS

1 Does the HH have any access to formal or informal loan or credit facilities for the purpose of inreasing agriculture productivity? 1. (Yes) 2. (No)

2 If yes to C1, how many times has the HH accessed credit facilities for increasing agriculture productivity since they started practicing CA on their farmland? 1. (Once) 2. (Twice) 3. (Thrice) 4. (More than three times)

3 Is the household involved in any non-farm enterprise that is a source of income apart from farming 1. (Yes) 2. (No)

4 What is the type of dwelling structure/unit for the household? 1. Permanent 2. Semi-permanent 3. Traditional (**Refer to NSO definition of type of dwelling unit)**

5 What were the two main cash crops grown by the household on ther farmland during the previous season? 1..... 2.....

6 Did the housed benefit from any social safety net programs during the previous farming season? 1. (Yes) 2. (No)

7 Does the household own any livestock animals except poultry? 1. (Yes) 2. (No)

8 If yes to **C8**, how many livestock in total does the household own?.....

SECTION D: HOUSEHOLD ACCESS TO CA FARM INPUT INCENTIVES

1 Has the household ever received input incentives related to CA since they started practicing the technology on their farmland? 1. (Yes) 2. (No)

2 If yes to **D1**, what were the inputs received? ***Please enumerator circle all received inputs by the household from the list below*** 1. (Fertilizers) 2. (Seed) 3. (Herbicides) 4. Farm implements 5. Other(Specify)……...

3 If yes to **D1**, for how many years did the HH receive the inputs since the previous growing s 1. (1-2 Years) 2. (3-4 years) 3. (5-6 years) 4. More than 6 years

4 Did the household receive any CA input incentives in the previous farming season? 1. (Yes) 2. (No)

5 If yes to **D4**, please specify the total quantities of each input received by the household during previous growing season 1.Fertilizers……Kgs 2.Seed…….Kg 3.Herbicides……Litres 4. Sprayer……No. 5. Farm implements(Specify)…….No 6. Other(Specify)……No

6 If the household received CA input incentives during previous farming season, which was the main source of CA input incentives? 1. Government 2. NGO (Name ……..) 3. Farmer organisation/Association 4 Other Specify……

SECTION E: ACCESS TO EXTENSION SERVICES ON AGRICULTURE PRODUCTION

1 Are there any extension agents who provide advisory services on agriculture production (sustainable land management issues) in this area? 1. Yes 2. No

2 If yes to **E1**, do extension officers provide advisory services on CA in this area? 1. Yes 2. No

3 If yes to **E2**, how often in a month do extension officers visit this area to provide adivisory services on sustainable land management issues, especially CA? 1. (Once a month) 2. (Twice a month) 3. (3 times a month) 4.(More than 3 times a month) 5. Takes more than a month to visit them

4 If yes to **E2**, from which agency do the extension officers that provide most of the adivisory services on CA in this area belong? 1. Government

2. NGO (Name ……..) 3. Other Specify……

5 What do you think government and its development partners should do in order to effectively promote CA upscaling in this district? ***Give 2 main suggestions maximum***

1……

2……

6 Lastly do you have any question concerning the topic we have discussed?

Note: Enumerator, please thank the respondent for their time in participating in the interview