

**ASSESSING SMALLHOLDER FARMERS' ADOPTION OF CLIMATE SMART
AGRICULTURAL PRACTICES IN ZOMBA DISTRICT IN MALAWI**

MASTER OF SCIENCE(GEOGRAPHY AND EARTH SCIENCES) THESIS

FESTON KEN SHANI

UNIVERSITY OF MALAWI

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AGRICULTURAL PRACTICES IN ZOMBA DISTRICT IN MALAWI**

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FESTON KEN SHANI

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DECLARATION

I, the undersigned, hereby declare that this thesis is my own original work, which has not been submitted to any other institution for similar purposes. Where other people's work has been used, acknowledgements have been made.

FESTON KEN SHANI

Full Legal Name

Signature

Date

CERTIFICATE OF APPROVAL

We, the undersigned certify that this research represents the student's own work and effort and has been submitted with our approval.

Signature: _____

Date: _____

Miriam Joshua, PhD (Associate Professor)

Main Supervisor

Signature: _____

Date: _____

Cosmo Ngongondo, PhD (Professor)

Co-Supervisor

DEDICATION

To my family.

We are more than conquerors.

We shall always win!

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ABSTRACT

This study has assessed smallholder farmers' adoption of climate smart agricultural practices in Malosa Extension Planning Area, Zomba District, within the framework of Diffusion of Innovations theory. The study used a convergent mixed research design, which purposively selected Group Village Nthiko and three key informants, and randomly selected 70 smallholder farmers. Questionnaires, interview, and observation guides were used to collect data. Thematic analysis was used to analyse qualitative data while descriptive analysis was used to analyse quantitative data. Results indicate that a few (26%) smallholder farmers have adopted the promoted climate smart agricultural practices. Compatibility is the chief determinant of climate smart agricultural practices' adoption. Complexity is the main barrier to climate smart agricultural practices' adoption as most of the practices are labour and input intensive. Most smallholder farmers fall under the late majority since their likelihood of adopting climate smart agricultural practices awaits observable benefits from early adopters. One insight from this is that many of the non-adopters of climate smart agricultural practices seem to be at the innovation decision process of Diffusion of Innovations theory where they are considering the advantages and disadvantages of Agriculture Sector Wide Approach Support Project II climate smart agricultural practices. A major implication of this study is that labour and capital intensive climate smart agricultural practices are less likely to be adopted by smallholder farmers. A major recommendation of this study is that implementing agencies should employ a bottom-up approach in implementing interventions in the area. This can best be done by first consulting the concerned farmers to see the farming practices that are already being practised and effectively working before introducing the new ones. This will ensure that climate smart agricultural practices, which are appropriate to the climatic realities and conditions of the targeted areas, are promoted.

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ABBREVIATIONS

ADD	Agriculture Development Division
AEDO	Agricultural Extension Development Officer
AEPS	Agriculture Extension Planning Area Supervisor
ASWAp	Agriculture Sector Wide Approach
ASWAp SP	Agriculture Sector Wide Approach Support Project
CCAFS	Climate Change, Agriculture and Food Security
CCARDESA	Centre for Coordination of Agricultural Research and Development for Southern Africa
CGIAR	Consultative Group on International Agricultural Research
CIAT	International Centre for Tropical Agriculture
COVID 19	Corona Virus Disease of 2019
CRA	Climate Resilient Agriculture
CSA	Climate Smart Agriculture
DADO	District Agriculture Development Officer(s)
DoA	Director of Agriculture
DoANRM	Director of Agriculture and Natural Resources Mangement
DoI	Diffusion of Innovations
EPA	Extension Planning Area
ESA	Eastern and Southern Africa
FANRPAN	Food, Agriculture and Natural Resources Policy Analysis Network
FAO	Food and Agriculture Organisation (of the United Nations)
GDP	Gross Domestic Product
GHG	Green House Gases
GoM	Government of Malawi
GVH	Group Village Head
HH	Household(s)
ICT	Information and Communication Technology
IFPRI	International Food Policy Research Institute
IPCC	Intergovernmental Panel on Climate Change
LUANAR	Lilongwe University of Agriculture and Natural Resources
MCSAA	Malawi Climate Smart Agriculture Alliance
MoA	Ministry of Agriculture

MoAIWD	Ministry of Agriculture, Irrigation and Water Development
NSO	National Statistical Office
PPE	Personal Protective Equipment
SA	Smart Agriculture
SMART	Specific, Measurable, Achievable, Reliable, and Timely
SPSS	Statistical Package for Social Scientists
SSA	Sub Saharan Africa
T/A	Traditional Authority
VH	Village Head

CHAPTER ONE

INTRODUCTION

1.1 Chapter overview

This chapter introduces the study assessing smallholder farmers' adoption of climate smart agricultural (CSA) practices. It is covering background to the study, statement of the problem, research objectives, significance of the study, and thesis outline. In this study, smallholder farmers refer to subsistence farmers who practice agriculture on a small scale. The term adoption refers to the acceptance and uptake of CSA practices by smallholder farmers. CSA adopters are farming households that implemented at least one of the CSA practices learnt from any training offered by the agriculture sector wide approach support project (ASWAp-SP) II. Climate smart agriculture refers to the type of farming that delivers sustainable increases in food production (availability and productivity), increases in resilience to climate change and/or adaptive capacity of farms, and accumulates carbon in soils or biomass or reduces emissions of greenhouse gases (GHG) when possible (Lipper et al., 2014; Neufeldt et al., 2013). On the other hand, climate smart agricultural practices are the means to achieve resilience in combating effects of climate change while at the same time reducing environmental degradation in agricultural production (Food and Agriculture Organisation [FAO], 2010). Zomba is one of the districts located in the southern region of Malawi. It is one of the five districts that are prone to effects of climate change in Malawi (World Bank, 2010).

1.2 Background to the study

Agriculture remains the spine of Malawi's economy. It accounts for one third of the gross domestic product (GDP) and 90% of foreign exchange earnings (Government of Malawi [GoM] 2011; Msowoya et al., 2016). The agricultural sector in Malawi employs 85% of the labour force (Msowoya et al., 2016; Mwanakatwe & Kebedew, 2015; Ngwira et al., 2012). Smallholder farmers contribute about 75% of agricultural production with cropping systems. Malawi's agriculture is dominated by maize farming, which covers 92% of the land. This is largely because maize is the staple food

crop in Malawi and contributes about 54% of national caloric intake (GoM, 2011; Msowoya et al., 2016; World Bank, 2015). Out of the 3 million hectares of cultivatable agricultural land, more than 99% of agricultural land in Malawi remains under rain-fed cultivation (Hongo, 2010; Msowoya et al., 2016) with over 92% dominated by a maize (GoM, 2011). This means that Malawi heavily depends on precipitation for its agricultural production.

In addition to that, most farmers in Malawi practice agriculture on small-scale basis with land sizes ranging from 0.2 hectares to 3 hectares. The rain-fed dependent smallholder farming makes agricultural production in Malawi prone to various adverse weather conditions (GoM, 2010). Again, this over-dependence on rain fed agriculture makes the country vulnerable to climate-related shocks leading to low agricultural production and productivity. For example, Malawi has been experiencing low agricultural production due to unreliable rainfall patterns, erratic rains, dry spells, pest and diseases, droughts, and floods. This has depressed economic growth and development in the country. Since the good performance of the economy is directly linked to performance of the agriculture sector, the national development strategies in Malawi have emphasise d the importance of the growth of the agricultural sector in the fight against poverty. This is also because most of the smallholder farmers are poor and engaged in the subsistence agricultural sector (Mariyono, 2019).

Nonetheless, several factors affect Malawi's agriculture. For instance, use of poor farming practices, such as poor land and water management practices have led to loss of soil fertility and reduction of productive capacity of once fertile lands (Hunga & Mussa, 2016). Further, Thierfelder et al. (2012) argue that in Malawi maize yields have declined over the years because of continuous cultivation, which has led to soil degradation. It can be argued, therefore, that most of these effects are due to absence of effective conservation practices by smallholder farmers. On the other hand, Msowoya et al. (2016), assert that Malawi's rainfed maize production may decrease by 14% by the mid-century due to climate change. Evidence shows that Malawi has already been seriously affected by the impacts of climate change such as rainfall variability, frequency occurrence of floods, strong winds (GoM, 2011). According to the Intergovernmental Panel on Climate Change [IPCC] (2014), climate change is already happening as evidenced by impacts such as rising temperatures and changes in rainfall

patterns worldwide including Malawi. As such, it is believed that climate change will continue to increase the frequency, intensity, and magnitude of various weather-related events thereby affecting agricultural productivity and causing food shortages, hunger, and malnutrition even in Malawi (Environmental Affairs Department, 2006). Although the above statements entail that several factors affect agriculture in Malawi, this study singles out climate change and its related impacts as chief culprits. This is because agriculture is more vulnerable to the increasing effects of climate change than any other economic sector and it uses almost 80% of the world's fresh water (World Bank, 2012). In fact, climate change is said to be among other challenges that have emerged to be significant to agricultural production (Mwase et al., 2013).

In Malawi, although agriculture faces many challenges in achieving its intended outcomes, climate change intensifies and worsens these challenges (Hunga & Mussa, 2016; Khamis, 2006; Trocaire, 2018; United States Agency for International Development [USAID], 2012). This means that in absence of climate change, some of the challenges facing smallholder farming in Malawi could have been solved. It can be argued, therefore, that some challenges facing Malawi's agricultural sector are inevitable. This is because climate change is a global challenge, which requires global solutions. As such, Malawi needs the cooperation of all other countries in the fight against climate change.

Despite climate change posing a major threat to agricultural production and food security in developing countries, climate-smart agriculture is crucial in addressing such potential impacts. Climate-smart agriculture refers to the practices that help farmers achieve climate change adaptation, GHG mitigation and food security (Aggarwal et al., 2013). For instance, use of stress-tolerant seed varieties, minimum tillage, laser land levelling, site-specific nutrient management, and crop diversification. In principle, a CSA practice must simultaneously achieve all the three aims (Aryal et al., 2018). In view of the above effects of climate change and its related effects on agriculture, this study emphasises that it is critical for smallholder farmers to combat climate change in its totality. One of the many ways of achieving this is the implementation of climate smart agricultural practices. This is because the CSA practices help to address the interlinked challenges of sustainable agriculture, food security, and climate change (FAO, 2010, 2013; Lipper et al., 2014). The CSA practices employ several agricultural

practices that sustainably increase productivity, improve resource-use-efficiency, reduce exposure, sensitivity or vulnerability to climate variability or change, and reduce GHG emissions from agriculture (Neufeldt et al., 2013). As such, the CSA practices help farmers adapt to climate change effects and use sustainable land and water management principles to foster improved agricultural production (Hunga & Mussa, 2016; Thierfelder et al., 2012). This is responsive to what Branca et al. (2011) contend that there is need to transform agricultural systems to increase the productive capacity and stability of smallholder agricultural production in the wake of climate change. It is said that CSA practices are the means to achieve climate change resilience and reduce environmental degradation (FAO, 2010). These practices are tailored to improve the integration of agricultural development and climate responsiveness. This is because they are aimed at achieving food security, enhance resilience, and reduce or remove greenhouse gases (Food, Agriculture and Natural Resources Policy Analysis Network [FANRPAN], 2014; 2017; FAO, 2010; Knegtel, 2014; Malawi Climate Smart Agriculture Alliance [MCSAA], 2016; Mensah, et al., 2020). In other words, CSA practices sustainably increase productivity, improve resource-use-efficiency, reduce exposure, sensitivity or vulnerability to climate variability or change, and remove GHG emissions from agriculture (Neufeldt et al., 2013). In view of this, the Government of Malawi, and other non-governmental organisations (NGOs) have been promoting the sustainable land and water management practices in order to reverse this situation. One of the main ways is the introduction of climate smart agricultural practices (Hunga & Mussa, 2016). In its efforts, the Government of Malawi has put in place ways of solving the effects of climate change on agriculture through ASWAp-SP II (Hunga & Mussa, 2016). Under ASWAp-SP II, several climate smart agricultural practices are being promoted to smallholder farmers.

Although various CSA practices exist, research (Lipper et al., 2014; MCSAA, 2016; Murray et al., 2016; Mwandira, 2016; Sosola et al., 2011) indicate that many smallholder farmers are yet to implement CSA practices in their farming. Reasons are varied suggesting that the factors are largely contextual. Gaps remain in the understanding of adoption status and associated factors especially in Zomba District. The district has several extension planning areas (EPAs) with diversity in social cultural and environmental factors. This study, therefore, contends that adoption situation may be varied. According to the World Bank (2010), Zomba is one of the districts worst hit

by effects of climate change. It was, therefore, critical to assess smallholder farmers' adoption of the CSA practices in Zomba in order to help avert and mitigate the effects of climate change in the district. This study, therefore, has assessed smallholder farmers' adoption of CSA practices in Malosa EPA, Zomba District.

1.3 Statement of the problem

Malawi heavily depends on agriculture as the keystone of its economy (Chinsinga, 2013; Gairhe & Adhikari, 2018; IPCC, 2007; MCSAA, 2016; Ngongondo et al., 2014). Majority of farmers in Malawi are smallholders who largely depend on rain. This dependency on rain highly exposes agriculture in Malawi to the impacts of climate change (Joshua et al., 2016; Makate, 2019; Murray et al., 2016; Ngongondo et al., 2014). Although smallholder agriculture is a victim of the effects of climate change (Abegunde et al., 2020; Makate, 2019), smallholder farmers are responsible for producing most of the food consumed in sub-Saharan Africa (SSA) (FAO, 2017; Giller et al., 2021). Like many countries in sub-Saharan Africa, Malawi is experiencing increasing climate change, which results into poor crop yields or total crop failure due to drought and floods (Joshua et al., 2016; Ngongondo et al., 2014). World Bank (2010) ranks Malawi as the twelfth most exposed country to effects of climate change. Although the effects of climate change have worsened food insecurity for most smallholder farmers in Malawi (Hunga & Mussa, 2016), several measures have been put in place to overcome such effects. One of them is the introduction of climate smart agriculture (Arslan et al., 2015; FAO, 2010; Jellason et al., 2020; MCSAA, 2016; Sarker et al., 2019; Totin et al., 2018). Climate smart agricultural practices have been promoted to smallholder farmers in sub-Saharan Africa since 2011 (Bell et al., 2018). In Malawi, the government is implementing the same through ASWAp (Hunga & Mussa, 2016). Despite the potential of CSA practices in combating effects of climate change on agriculture, smallholder farmers' adoption of the same is very low (Amadu et al., 2019; Brown et al., 2018; Lipper et al., 2014; Makoka et al., 2015; MCSAA, 2019; Meijer et al., 2014; Onyeneke et al., 2017; Simtowe et al., 2016; Sova et al., 2018; Teklewold et al., 2013; Westermann et al., 2018) yet adoption of CSA practices could greatly improve household food security (Shahzad & Abdulai, 2020). Studies conducted elsewhere (Amadu et al., 2019; Jellason et al., 2020; Pagliacci et al., 2020; Sardar et al., 2020; Zakaria et al., 2020) and in Malawi - Phalombe, Dowa, Nkhotakota, Kasungu, Lilongwe, Chikwawa, Chiradzulu, Thyolo, and Mangochi - (FANRPAN,

2014; Hunga & Mussa, 2016; Joshua et al., 2016; Katengeza, 2018; Kitsao, 2016; MCSAA, 2016; 2017) found that different factors influence smallholder farmers' adoption of CSA. It was not known how farmers in Zomba were adopting the CSA practices. There was a gap in literature on smallholder farmers' adoption of CSA in Zomba yet Zomba is one of the districts vulnerable to the effects of climate change in Malawi (World Bank, 2010). This study, therefore, has bridged this gap by assessing smallholder farmers' adoption of CSA practices in Malosa EPA, Zomba. Malosa EPA is one of the areas where Malawi Government through the Ministry of Agriculture is promoting CSA practices under ASWAp-SP II since 2017. It was envisaged that lack and scarcity of resources such as land, labour, finances, unfamiliar practices, and lack of knowledge of the practices hampered smallholder farmers' adoption of CSA practices in Zomba.

1.4 Research objectives

The main objective of this study was to assess the adoption of climate smart agricultural practices by smallholder farmers in Zomba District. The following were the specific objectives of the study:

1. to ascertain the level of climate smart agricultural practices' adoption by smallholder farmers;
2. to explore the determinants of climate smart agricultural practices' adoption by smallholder farmers; and
3. to evaluate the impacts of climate smart agricultural practices on agricultural production of smallholder farmers.

1.5 Significance of the study

This study has filled the gap in literature on smallholder farmers' adoption of climate smart agricultural practices in Zomba District. In so doing, this study has contributed towards the current discussions on adoption of CSA practices by smallholder farmers. Likewise, this study has revealed the level of CSA practices' adoption, determinants of CSA practices' adoption, and the impacts of CSA practices on smallholder agricultural production in Nthiko. These findings will assist in finding the best CSA practices for smallholder farmers in Malawi in order to save resources that could have been spent on non-popular CSA practices.

1.6 Thesis outline

This thesis has five chapters. Chapter one has introduced this study. Chapter two has discussed literature related to this study as well as the theoretical framework guiding the study. Chapter three has described and justified the design and methodology of this study. Chapter four has presented and discussed results and findings of this study. Finally, chapter five has presented the conclusions and recommendations of this study.

1.7 Chapter summary

This chapter has introduced the study assessing smallholder farmers' adoption of climate smart agricultural practices in Zomba District in Malawi. The focus has been on background to the study, statement of the problem, research objectives, and significance of the study. It has been observed that there is a gap in literature on smallholder farmers' adoption of climate smart agricultural practices in Zomba District. In the following chapter, literature related to this study has been reviewed.

CHAPTER TWO

LITERATURE REVIEW

2.1 Chapter overview

This chapter discusses literature related to smallholder farmers' adoption of climate smart agricultural practices. The focus is on climate change and smallholder agriculture, smallholder farmers' perceptions of climate change, combatting the effects of climate change on agriculture, the concept of climate smart agriculture, benefits of climate smart agricultural practices to smallholder farmers, smallholder farmers' adoption of climate smart agricultural practices, factors influencing the adoption of climate smart agricultural practices, the Malawi agriculture sector wide approach support project, and the theoretical framework guiding this study.

2.2 Climate change and smallholder agriculture

Climate change refers to any change in climate over time in response to natural or human activities (IPCC, 2007). According to Tompkins and Adger (2004), climate changes are likely to manifest in four main ways. Firstly, there are observable slow changes in the average conditions of the climate. Secondly, there is an increased interannual and seasonal variability. Thirdly, there is an increased frequency of extreme events in a climate. Finally, there are rapid climate changes, which result in catastrophic shifts in ecosystems. This implies that a place might be affected by climate change in any or all the four ways. Again, this might also mean that climate change can manifest in various other minor ways than the above four main ones. This, therefore, means that climate change is multi-faceted.

Evidence shows that smallholder farmers in developing countries are the most vulnerable to effects of climate change (Abegunde et al., 2020; Barbier & Hochard, 2018; Hunga & Mussa, 2016; Makate, 2019; Murray et al., 2016; Ngongondo et al., 2014; Tol, 2018). For instance, Abegunde et al. (2020) argue that in agriculture, small-scale farmers are victims of the effects of climate change. Again, many studies focusing

on impacts of climate change on agriculture indicate that rural population in developing countries are the most vulnerable to the effects of climate change (Barbier & Hochard, 2018). This is mainly due to their reliance on rainfed agriculture for meeting their needs (Tol, 2018). Further, Makate (2019) contends that climate change is a major risk to small-scale farmers in Africa. One of the key issues supporting this claim is lack of food resulting from several challenges brought by climate change. This is evident in what Hunga and Mussa (2016) discovered that effects of climate change exacerbated food insecurity at smallholder farm level in Malawi. In their separate studies, Murray et al. (2016) and Ngongondo et al. (2014) agree that in Malawi the agro-based economy, which heavily depends on rainfed agriculture, has crippled the country's economy due to its susceptibility to the effects of climate change. From the above statements, it is apparent that climate change is a crucial topic in agriculture. This position is also supported by Gairhe and Adhikari (2018) who posit that climate change has been a critical issue in the agricultural sector. Again, its effects on agriculture are severe, and one of the most significant emerging challenges to households' livelihoods in Africa (FANRPAN, 2017) including Malawi. Further, IPCC (2014) agrees that climate change is emerging as a major threat on agriculture, food security, and livelihood of millions of people in many places of the world. It is said that if climate change continues, food production will decline thereby leading to an increase in poverty levels and a rise in food prices (Pound et al., 2018).

Several studies indicate that agriculture production could be significantly impacted due to the increase in temperature (Aggarwal et al., 2009; Lobell et al., 2012), changes in rainfall patterns (Mall et al., 2006; Prasanna, 2014) and variations in frequency and intensity of extreme climatic events such as floods and droughts (Brida & Owiyo, 2013; Singh et al., 2013). Climatic change especially through increased temperatures, dynamic rainfall patterns, and variations in intensity and frequency of extreme events such as droughts and floods, significantly limits agricultural production to varying degrees in different regions of the world (Aggarwal et al., 2009; Brida & Owiyo, 2013; IPCC, 2014; Lobell et al., 2012; Zselezky & Yosef, 2014). According to Porter et al. (2014), estimated negative impacts of climate change on cereal crop yields in different regions indicate up to 60% reduction in maize yield, 50% yield reduction for sorghum, 35% yield reduction for rice, 20% reduction for wheat and 13% reduction for barley. For sub-Saharan Africa (SSA), climate variability and change are predicted to continue

decreasing production of major cereal crops in the region including maize, sorghum, and millet. Maize, sorghum, and millet yields are estimated to fall by 22%, 17%, and 17% respectively by 2050 (IPCC, 2007; 2014). In addition, rain-fed crop yields are projected to decrease by almost 50% due to climate variability and change. This could be a serious problem in Malawi considering that most smallholder farmers are already poor and living in the rural areas, where their main source of livelihood is agriculture itself. This is because effects of climate change greatly affect agriculture in developing countries, since such countries do not have advanced technological implements and resources to compliment production (Jacob, 2015). This is in line with what Ubisi et al. (2017) contend that climate change poses a major challenge to agricultural production and rural livelihoods of smallholder farmers. In Malosa EPA, all farmers practice agriculture on small scale. It was, therefore, important to appreciate the challenges smallholder farmers were facing in Malosa EPA in the wake of climate change. This could significantly help understanding why ASWAp-SP II intervention was implemented in the area.

However, apart from climate change, several factors affect agriculture in Malawi. One of them is the use of poor farming practices, such as poor land and water management practices. These factors have led to loss of soil fertility and reduction of productive capacity of once fertile lands (Hunga & Mussa, 2016). Further, Thierfelder et al. (2012) argue that in Malawi maize yields have declined over the years due to continuous cultivation, which has led to soil degradation due to lack of effective conservation practices. On the other hand, Msowoya et al. (2016), assert that Malawi's rainfed maize production may decrease by 14% by the mid-century due to climate change. It is said that Malawi has already been seriously affected by the impacts of climate change such as rainfall variability, frequency occurrence of floods, strong winds (GoM, 2011). According to IPCC (2014), climate change is already happening as evidenced by impacts such as rising temperatures and changes in rainfall patterns worldwide. As such, it is believed that climate change will continue increasing the frequency, intensity, and magnitude of various weather-related events thereby affecting agricultural productivity and causing food shortages, hunger, and malnutrition even in Malawi (Environmental Affairs Department, 2006). Although the above statements entail that there are several factors that have and are affecting agriculture in Malawi, this study has singled out climate change and its related impacts as the main culprit. This is

because agriculture is more vulnerable to the increasing effects of climate change than any other economic sector and it uses almost 80% of the world's fresh water (World Bank, 2012). This entails that climate change is among the chief causes of low agricultural production. This resonates with what Mwase et al. (2013) indicate that climate change is among other challenges that have emerged to be of great importance to agricultural production.

In agriculture, climate change mainly affects the four dimensions of food security namely availability of food, access to food, stability of food, and utilisation of food. According to Jacob (2015), FAO defines food security as a situation that exists when all people, always have the physical, social, and economic access to enough, safe, and nutritious food that meets their dietary needs and food preferences for an active and healthy life. It is also argued that availability of food may be reduced by a drop in production caused by extreme events, changes in the suitability or availability of arable land and water and unavailability or lack of access to suitable crops and livestock. Again, access to food may be worsened by climate change-intensified events that lead to damaged infrastructure and losses of livelihood assets and income. Stability of food supply could be influenced by food price fluctuations and higher dependency on imports and food aid while utilisation of food can be affected indirectly by food safety hazards associated with pests and animal diseases (Jacob, 2015; Pound et al., 2018). In this study, smallholder farmers in Malosa EPA were engaged to assess their understanding of effects of climate change in their area as well as their adoption of CSA practices.

2.3 Smallholder farmers' perceptions of climate change

Perceptions are ways in which people think and become aware of something being experienced. In this study, therefore, the term perception refers to the way smallholder farmers see, understand, and interpret changes in climate of their area. Several studies have assessed smallholder farmers' perceptions of climate change (Amadou et al., 2021; Apata, 2011; Munthali et al., 2016; Nyang'a et al., 2021; Olabanji et al., 2021; Pickson & He, 2021; Redda et al., 2022; Saguye, 2017; Teshome et al., 2021; Zeleke et al., 2022). In their study of smallholder farmers in Ethiopia, Teshome et al. (2021) found that the majority of smallholder farmers perceived changes in climate evidenced by the increase in temperatures and the decrease in rainfall. Similarly, Pickson and He

(2021) found that the smallholder farmers were aware of the occurrence climate change as evidenced by unpredictable rainfall patterns, rising temperatures, and declining precipitation. Likewise, Zeleke et al. (2022) found that a higher percentage of smallholder farmers perceived climate changes with regard to temperature and rainfall. In the same way, a study by Amadou et al. (2021) found that many smallholder farmers perceived climate change as manifested in the increase in temperature, decrease in rainfall, shortening of growing season, early cessation of rainfall, and increase in the frequency of dry spells at the beginning of the growing season.

Further, a study by Saguye (2017), found that majority of smallholder farmers were aware that climate was changing as manifested in different ways. For instance, the increase in temperature, extended periods of temperature, a decrease in precipitation, changes in the onset of rains and an increase in the frequency of droughts. This study found that the smallholder farmers' awareness about the changing temperature, rainfall amount, distribution, onset and offset, increased frequency and intensity of weather and climatic extreme events was very high. In South Africa, a study by Olabanji et al. (2021) found that, in essence, most smallholder farmers indicated that they are generally aware of the changes happening in the area. This was corroborated by Redda et al. (2022) who also found that majority (91.2%) of smallholder farmers perceived climate change as indicated by erratic rainfall, rising temperatures, and increased frequency of drought.

In Kenya, a study by Nyang'a et al. (2021) revealed that most smallholder farmers perceived climate changes. This was evidenced by a decrease in rainfall, poor rainfall distribution, late onset of rainfall, and an increase in temperature. In Malawi, a study on smallholder farmers' perception on climate change in Rumphi District (Munthali et al., 2016) found that there was an increased awareness by smallholder farmers on climate change. For example, with regard to temperature, the results showed that over half of the respondents reported that they had experienced increased temperatures for the past 10 years. On rainfall, most of the smallholder farmers indicated that there has been a decrease in rainfall in the past 10 years. It can be argued, therefore, that almost all the smallholder farmers are cognisant of the changes in climate in their areas. This is crucial in assisting the farmers to adapt to the same. According to Franklin et al. (2012), adaptation to climate change in agricultural production refers to the modifications in farming activities that reduce the possible harmful effect of climate

change. It is necessary for smallholder farmers to first perceive climate change before adapting to it. This is in tandem with what several studies (Apata, 2011; Franklin et al., 2012; Jha & Gupta, 2021; Zeleke et al., 2022) agree that prior to responding to climate change, farmers must perceive climate change and that those farmers' perceptions of climate change have positive and significant impacts on adaptation measures. This entails that smallholder farmers' perceptions of climate change are a determinant and first step required to implement adaptation measures. This study, therefore, emphasises that it was pivotal to find out how smallholder farmers in Nthiko perceived climate change prior to assessing their uptake of adaptation measures, in this case, ASWAp-SP II CSA practices.

2.4 Combatting the effects of climate change on agriculture

Although climate change has severe effects on agriculture, several measures have been designed to reverse this situation. According to Pound et al. (2018), there are, basically, three interacting ways of addressing climate change. These measures are mitigation, adaptation, and resilience (Abegunde et al., 2020; Andrieu et al., 2017; Arslan et al., 2015; Barbier & Hochard, 2018; Bell et al., 2018; Chandra, 2017; FANRPAN, 2017; Gairhe & Adhikari, 2018; Ghosh, 2019; Hassan et al., 2018; IPCC, 2014; Jellason et al., 2020; Joshua et al., 2016; Lipper et al., 2014; Makate, 2019; Makoka et al., 2015; MCSAA, 2016; Meijer et al., 2014; Murray et al., 2016; Ngongondo et al., 2014; Pound et al., 2018; Sarker et al., 2019; Simtowe et al., 2016; Totin et al., 2018; World Bank 2010). Mitigation refers to all interventions aimed at reducing the sources, or enhancing the sinks, for greenhouse gases (Pound et al., 2018). Adaptation is the process of deliberate adjustment to actual or expected climate and its effects (IPCC, 2014). In other words, it is a way of reducing or completely warding off harm or exploitation of beneficial opportunities regarding climate change. Resilience refers to the capacity of social, economic, and environmental systems to cope with a hazardous event or trend or disturbance [in this case climate change], responding or reorganizing in ways that maintain their essential function, identity, and structure, while also maintaining the capacity for adaptation, learning, and transformation (IPCC, 2014).

Research indicate that Malawi has been experiencing different climatic hazards (Arndt et al., 2014; Coulibaly et al., 2015; Joshua et al., 2016; Kambauwa et al., 2015; Knegtel, 2014; GoM, 2015; Mailosi, 2019; Murray et al., 2016; Mwanakatwe & Kebedew, 2015;

Ngongondo et al., 2011; 2015; World Bank, 2010) For instance, the country has been experiencing seasonal droughts, cold spells, dry spells, intense rainfall, strong winds, thunderstorms, landslides, hailstorms, mudslides, floods, heat waves (Kambauwa et al., 2015; Knegtel, 2014; Murray et al., 2016; Ngongondo et al., 2014), and late arrival of rains (Coulibaly et al., 2015; Mwanakatwe & Kebedew, 2015; Ngongondo et al., 2011).

On the other hand, rainfall in Malawi is projected to decline with an annual precipitation of over 25% upper end and nearly 13% by the year 2050 (Arndt et al., 2014). Likewise, in a separate study, Ngongondo et al., (2015) found that the temperature trends for Malawi were increasing. Again, a recent study (Mailosi, 2019) found that the effects of climate change affected 60% of Malawi's smallholder farmers, who mostly depend on rainfed agriculture. No wonder some researchers who studied spatial and temporal characteristics of rainfall for the period 1961 to 2006 found that there was no any obvious rainfall trend pattern (Ngongondo et al., 2011). Another study in Nkhotakota, a district in Malawi, agreed that climate change was happening in Malawi; therefore, recommended proper adaptation measures to be implemented to reduce the exposure to the effects of climate change in Nkhotakota (Mailosi, 2019). Similarly, the 2007 United Nations Human Development Report rated Malawi as one of the countries most vulnerable to harmful impacts of climate change (GoM, 2015). Likewise, the World Bank (2010) reports that the whole country of Malawi is vulnerable to droughts with five districts that are hit hard. The five districts are Zomba, Chikwawa, Karonga, Salima, and Nsanje. This is one of the reasons why this study was conducted in Zomba.

Although climate change is prevalent in Malawi, various efforts are being made to arrest the situation. The main aim is to ensure that people can handle, recover from, and thrive in the wake of climate change and its associated impacts and shocks (Nyasimi et al., 2017). For instance, people should be capable of responding to effects of climate change by transforming and re-orienting their agricultural systems and practices in a manner that successfully supports sustainable agricultural production and food security in the face of climate change (Arslan et al., 2015; Lipper et al., 2014). One of the ways of achieving mitigation, adaptation, and resilience to climate change is embracing or implementing climate smart agricultural (CSA) practices. In Malawi, the Ministry of Agriculture is implementing CSA practices in various EPAs including Malosa in Zomba. Despite such interventions, studies (Lipper et al., 2014; MCSAA, 2016; Murray

et al., 2016; Mwandira, 2016; Sosola et al., 2011) indicate that many smallholder farmers are hardly implementing CSA practices in their farming. There were still gaps in literature on smallholder farmers' adoption status and associated factors especially in Malosa EPA-Zomba. Yet the Zomba is among the five districts worst hit by effects of climate change in Malawi (World Bank, 2010). This study, therefore, has filled this gap by assessing smallholder farmers' adoption of CSA practices in Malosa EPA, Zomba District.

2.5 The concept of climate smart agriculture

CSA is an umbrella term for the technique that refers to the practice of growing crops and rearing animals that sustainably increases farm productivity (income, food security and income), resilience of farming systems to adapt to effects of climate change (at farm or national level), develops opportunities for increasing carbon sinks and reducing greenhouse gas emissions, and enhance achievement of national and household food and nutrition security and development goals (Arslan et al., 2014; Brown & Funk, 2008; Campbell et al., 2014; FAO, 2011; 2013; IPCC, 2014; Lipper et al., 2014; Neufeldt et al., 2013). On the other hand, the term smart is derived from the acronym SMART, in which S stands for specific, M for measurable, A for achievable, R for reliable, and T for timely (McCarthy et al., 2012). Specific means that each CSA practice must be unique or particular. Measurable entails that effectiveness of each CSA must be assessable. Achievable means that each CSA practice must attain its purpose. Reliable means that each CSA practice must be dependable. Finally, timely entails that each CSA practice must be implementable within a given period.

According to FAO (2013), agriculture becomes climate-smart when it contributes to a set of achievements regarding sustainable development by integrating the three dimensions of sustainable development (economic, social, and environmental) and jointly addressing food security and climate challenges, with these three main pillars as the central goals. From the above definition, it is clear that CSA aims at achieving three main things namely productivity, adaptation, and mitigation. These three outcomes are referred to as pillars of CSA. Under productivity, CSA strives to develop practices of agriculture for increasing productivity and earning from crops, livestock, and fisheries without any adverse effect on the environment as well as helping to improve food and nutritional security (Branca et al., 2011). On adaptation, CSA aims at minimising

farmers to short-term risks, while at the same time developing their resilience by enhancing their capacity to adapt in the perspective of longer-term stresses (Zougmore et al., 2014). CSA practices are essential in increasing capability for climate change adaptation, increasing productivity, and ensuring flexibility of the system for adaptation and recovery from shocks (Basche, 2015). Under mitigation, CSA aims at minimising or controlling GHG emissions from food, fibre, and fuel. It manages soils and trees in ways that can help to play a role as carbon layer and absorb carbon dioxide from the environment. Mitigation is the capability of systems, society, group, or individuals to protect, prevent, minimise, alleviate, or cope with risk and recover from stresses (FAO, 2013) of climate change. It is argued that adaptive capacity is essential for an agricultural system, which is vulnerable to climate change, to be resilient over time (Sarker et al., 2019).

However, it is interesting to note that CSA is not a new set of practices but rather an integrated approach to the implementation of agricultural development programming policies (FAO, 2013; MCSAA, 2016). This is because CSA practices have been in existence even before the term was coined. This is in tandem with what Makoka et al. (2015) posit that many practices that comprise CSA already exist worldwide and are used by farmers to cope with various kinds of agricultural production risks. A unique feature is that CSA aims to address food security and climate change goals simultaneously (Bell et al., 2018). It is also important to note that most CSA practices continue to focus on the development and diffusion of technological packages to increase the productivity of smallholder farmers (Totin et al., 2018). Further, it is recommended that CSA practices must have at their heart smallholder farmers in developing countries since such farmers are key to change across the entire agricultural system (Aryal et al., 2018; FAO, 2013). Partey et al., (2018) contend that CSA is a suitable approach to address the challenges of building synergies among climate change mitigation, adaptation, and food security, which are closely related within agriculture, and minimizing their potential negative trade-offs (Partey et al., 2018). This is the more reason the three objectives (i.e., food security, adaptation, and mitigation) are designated as the three pillars (criteria) of CSA within the agricultural science and development communities. CSA lies at the interface between science and policy-making and strives to foster action on the ground and mobilise financing (FAO, 2013; Lipper et al., 2014; Saj et al., 2017). In this study, the focus was mainly on the two

pillars namely adaptation and resilience. Pound et al. (2018) argue that adaptation and resilient refer to climate-resilient agriculture (CRA), whose aim is to enhance the resilience of agricultural systems and the social systems depending on them. In short, CRA is CSA excluding interventions to mitigate GHGs. Even though only two pillars have been considered, this study remains focused on climate smart agricultural practices. This is so because a practice is considered climate-smart if it is conducive to achieve at least one of the three objectives of CSA (Khatri-Chhetri et al., 2017). In this study, the practices aiming at achieving the two objectives of CSA were considered. This, therefore, justifies the above claim.

Generally, CSA integrates climate change into the planning and implementation of sustainable agricultural strategies and focusses on developing resilient food production systems that can lead to food and livelihood security of farming communities under climate change and variability (Lipper et al., 2014; Vermeulen et al., 2012). According to Lipper et al. (2014), CSA identifies synergies and trade-offs among food security, adaptation, and mitigation as a basis for reorienting policy in response to climate change. As such, it is designed to identify and operationalise sustainable agricultural development by clearly integrating climate change as a major parameter. However, for CSA to become a reality FAO (2013) states that an integrated approach receptive to specific local conditions is necessary. This is in line with what the International Centre for Tropical Agriculture (CIAT) advocates that CSA interventions integrate location-specific traditional and innovative technologies, practices, and services for adaptation of agriculture to climate change and variability. As such, the CSA approach does seven things. Firstly, it addresses adaptation and builds resilience to climatic shocks. Secondly, it considers climate change mitigation as a potential co-benefit. Further, it is location specific and knowledge-intensive. In addition to that, it identifies integrated options that create synergies and reduce trade-offs. Likewise, it identifies barriers to adoption and provides appropriate solutions. Similarly, it strengthens livelihoods by increasing access to services, knowledge, and resources. Finally, it integrates climate financing with traditional sources of agricultural investment (FAO, 2013).

According to Khatri-Chhetri et al. (2016), CSA practices are of six types namely water smart, energy smart, nutrient smart, carbon smart, weather smart, and knowledge smart. Water smart are those practices that improve water use efficiency such as rainwater

harvesting, drip irrigation, and cover crops method. Energy smart are those practices that improve energy use efficiency such as zero tillage or minimum tillage. Nutrient smart are those practices that improve nutrient use efficiency such as green manuring. Carbon smart practices are those practices that reduce GHG emissions such as agroforestry, and integrated pest management. Weather smart practices are those interventions that provide services related to income security and weather advisories to farmers such as crop insurance and weather-based crop agro-advisory. Knowledge smart practices are those CSA interventions that use a combination of science and local knowledge such as improved crop varieties. This entails that there are numerous examples of CSA practices that smallholder farmers use. The literature (Ajayi et al., 2018; Altieri & Nicholls, 2017; Branca et al., 2011; Bernier et al., 2015; FANRPAN, 2017; FAO, 2013; Gairhe & Adhikari, 2018; Ghosh, 2019; Jacob, 2015; Jat et al., 2014; Khatri-Chhetri et al., 2016; Makate, 2017; Makate et al., 2018; Mittal, 2012; Partey et al., 2018; Sapkota et al., 2015; Teklewold et al., 2013; FAO, 2010; World Bank, 2011; 2012) indicate several practices as examples of CSA practices. For instance, agricultural and livestock waste management, agroforestry, aquaculture, better weather forecasting, composting, conservation agriculture, minimum tillage, ground cover, efficient use of herbicides, cover cropping, crop diversification, crop rotation, cultivation of drought-resistant crops, destocking, efficient use of fertiliser, genetically modified crops, improved feed management, improved water management, improved high-yielding varieties, integrated crop-livestock management, integrated farming and fishing systems, integrated pest and disease management, integrated soil fertility management, irrigation, legume intercropping, livestock manure management, minimum soil disturbance practices, crop residue mulching, no till or minimum tillage, pasture management, rotational grazing, pest resistant crop varieties and seeds, pit planting, rain water harvesting, stress tolerant varieties, drought tolerant species or breeds of livestock, terrace and bunds making, use of improved seed, and use of organic fertilisers.

As already alluded to, research on climate change adaptation and mitigation in agriculture has identified CSA as a suitable strategy, which can ensure that smallholder farmers withstand the harmful effects of climate change (MCSAA, 2016). In other words, CSA practices are a pathway to improvement of agriculture in a changing climate. This is because the CSA practices address the issues of food security, climate

change, and agricultural productivity (Hasan et al., 2018; Makate, 2019; Murray et al., 2016). It is also important to note that CSA practices have the potential to alleviate food insecurity among smallholder farmers if used in combinations and to a larger extent (Aryal et al., 2018). No wonder agricultural experts, policy makers and other actors highly concerned with rural livelihoods, poverty alleviation and food security recommend adoption of CSA practices as a means of reducing the effects of climate change and variability in smallholder farming. This, therefore, prompted this study to assess smallholder farmers' adoption of CSA practices as a means of reducing the effects of climate change on smallholder farming in Malosa EPA in Zomba.

2.6 Benefits of climate smart agricultural practices to smallholder farmers

Literature has outlined several benefits of implementing CSA practices that smallholder farmers enjoy (Altieri & Nicholls, 2017; Branca et al., 2011; Business Innovation Facility, 2012; Gairhe & Adhikari, 2018; Ghosh, 2019; Hunga & Mussa, 2016; Jat et al., 2014; Kassam et al., 2009; Mittal, 2012; Ouya et al., 2020; Quinion et al., 2010; Sapkota et al., 2015; Shahzad & Abdulai, 2020; Vernoooy et al., 2018). To begin with, Shahzad and Abdulai (2020) in their study found that adoption of CSA practices significantly reduced household food insecurity for the smallholder farmers in Pakistan. In another study, Ghosh (2019) found that farmers who adopted CSA practices in India achieved higher output, yield, and economic returns than those farmers who did not implement CSA practices in their fields. Further, Vernoooy et al. (2018) in their study found that farmers in Vietnam achieved three outcomes from implementation of CSA practices. The outcomes were improved animal health, improved productivity, cost savings (labour and inputs), and improved environmental health (reduction of bad smells and pollution by animal waste). According to a study by Business Innovation Facility (2012), intercropping of maize with legumes and other crops made farmers in Malawi to realise yields of up to 1215 kg maize and 545 kg of soya beans per hectare. Again, when intercropped with groundnuts with maize, the farmers realised yields of up to 5330 kg per hectare and 1203 kg per hectare. In the same area, they found that agroforestry helped farmers to increase their yields by 280% in the zone under canopy of *Faidherbia* trees. These studies agreed with the position of Ouya et al. (2020) that agroforestry and conservation agriculture contribute to increasing food security and raise climate adaptation and mitigation in a sustainable way.

In addition to that, Kassam et al. (2009) argue that the benefits of adopting conservation agriculture and agroforestry systems include enhanced soil fertility, increases in yield, heightened resilience to environmental change, and improvements of livelihood. In Malawi, similar benefits were found by various studies. For instance, Quinion et al. (2010) in their study found that agroforestry adopters in Kasungu and Machinga districts of Malawi achieved an increase in their incomes as well as yields. As a result, their incomes were diversified due to opportunities to harvest wood for construction materials and firewood, in addition to improved yields.

From the above, it can be argued that CSA practices help to increase the chances of farmers achieving more benefits from agriculture regardless of the effects of climate change. This is also argued by Gairhe and Adhikari (2018) that the initiative to promote climate smart agriculture practices among smallholders certainly add value in achieving global food security. For instance, Branca et al. (2011), Jat et al. (2014), and Sapkota et al. (2015) argue that CSA practices such as minimum tillage, different methods of crop planting, irrigation and nutrient management, and incorporation of crop residue can improve crop yields, water and nutrient-use efficiency and reduce GHG emissions from agricultural activities. Similarly, Altieri and Nicholls (2017) and Mittal (2012) argued that use of improved seeds, information and communication technology (ICT)-based agro-advisories, crop or livestock insurances and rainwater harvesting could help farmers to reduce the negative impacts of climate change and variability on agricultural activities.

In Nepal, a significant impact of intervention was observed in yield and yield attributes in the trial with climate smart agriculture practices than in conventional practices of farmers (Gairhe & Adhikari, 2018). The study found that plant density, ear number, filled grains per cob and grain yield was substantially higher in fields that used some CSA practices than those fields which did not implement CSA practices. In India, results revealed that farmers who implemented single to a full package of CSA practices achieved satisfactory yields and farm income in the less favoured agroecological areas of Punjab (Sardar et al., 2020). In Pakistan, research results indicated that adopting CSA practices significantly reduces poverty level and poverty severity and improves food and nutrition security of farm households (Shahzad & Abdulai, 2020). Likewise, some studies have shown that where labour is limiting, conservation agriculture offers

opportunities for greater gains by reducing or spreading the labour to avoid bottlenecks (Hunga & Mussa, 2016). Again, where inputs are limiting, conservation agriculture ensures efficient utilisation through precision placement; where land is limiting, conservation agriculture offers maximum possible yields through rotations and combinations; where soils are depleted, conservation agriculture encourages restoration of structure and fertility, and in dry lands, conservation agriculture brings the extra drop of water the crop needs through in-situ water harvesting (Hunga & Mussa 2016).

Since there are such numerous benefits of CSA practices to agriculture, farmers worldwide have been encouraged to utilise the same. In Malawi, the government and other non-governmental organisations are in the forefront encouraging smallholder farmers to implement CSA practices in their fields. This is because, worldwide, CSA practices are suggested as a strategy to ensure smallholder farmers withstand the effects of climate change (Abegunde et al., 2020; Chandra, 2017; FAO, 2010; 2011; 2013; Jellason et al., 2020; Joshua et al., 2016; MCSAA, 2016; Ngongondo et al., 2014), increase agricultural production (Hassan et al., 2018; Lipper et al., 2014; Makate et al., 2018; Sarker et al., 2019), and feed the growing global population (Totin et al., 2018). As such, the Government of Malawi has put in place mechanisms to achieve this through an agricultural sector wide approach (ASWAp), which promotes CSA practices among smallholder farmers (Hunga & Mussa, 2016). Under ASWAp, CSA practices are aimed at making smallholder farmers resilient to effects of climate change emanating from erratic and changing rainfall patterns, long and frequent dry spells, and improve soil fertility and structure over time in order to achieve sustainable agricultural production (Hunga & Mussa, 2016). It was, therefore, the purpose of this study to assess the uptake of CSA practices by smallholder farmers' in Malosa EPA (Zomba), which is one of the places where ASWAp-SP II interventions are being implemented. The findings of this study have determined whether the CSA interventions, though beneficial, are being adopted by farmers or just a waste of time and resources. Eventually, this will help find the best practices for Malawi, save resources for non-popular CSA practices, encourage popular ones, and yield better results in agricultural production.

2.7 Smallholder farmers' adoption of climate smart agricultural practices

Several studies have been conducted to find out the adoption of CSA practices by smallholder farmers in various areas such as Asia (Aryal et al., 2018; Gairhe & Adhikari, 2018; Sardar et al., 2020), Europe (Long et al., 2015), Africa (Arslan et al., 2014; 2015; Campbell et al., 2014; Kurgat et al., 2020; Makate et al., 2017; Makate, 2019; Meijer et al., 2014; Mensah et al., 2020; Ringler & Nkonya, 2012; Ouédraogo et al., 2019; Partey et al., 2018; Teklewold et al., 2013; Thornton & Herrero, 2010; Westermann et al., 2015; Zakaria et al., 2020), and also Malawi (Mailosi, 2019; Makoka et al., 2015). The studies have mainly found two major results. On one hand, some smallholder farmers have adopted the CSA practices. On the other hand, other smallholder farmers have not yet adopted the CSA practices. According to Gairhe and Adhikari (2018), the CSA practices have been adapted in Nepal for cultivation and crop management in the wake of climate change without compromising yield and productivity. Likewise, in India, findings by Sardar et al. (2020) indicate that, in general, about 50% of the farmers adopted one or more combinations of CSA practices in the Punjab region. The most adopted CSA practices included changing cropping dates, zero or minimum tillage, water management measures, improved crop varieties, and nutrient management options. The results depict the variations in the adoption of CSA practices across the study districts.

In addition to that, a study by Long et al. (2015) found that some farmers in the Netherlands, France, Switzerland, and Italy adopted several CSA practices. Again, in West Africa, results show significant differences in the adoption rates of the CSA practices such as drought tolerant crop varieties, micro-dosing, organic manure, intercropping, contour farming, farmer managed natural regeneration, agroforestry, and climate information service. According to Ouédraogo et al. (2019) and Partey et al. (2018), the most adopted practice was the organic manure (89%) while the least adopted was the intercropping (21%). In Mali, the results indicated that a certain number of smallholder farmers adopted the CSA practices such as agroforestry (Ouédraogo et al., 2019). In Ghana, certain research (Mensah et al., 2020) found that farmers adopted cover cropping to control weeds and reduce the cost of weeding the farms. Cover cropping had some multiple benefits to the farmers as it also added nutrients to the soil and optimised the use of land (Mensah et al., 2020). It is also reported that most farmers adopted more than one CSA practice in Ghana (Zakaria et al., 2020). In Malawi, a study

on sugarcane smallholder farmers (Mailosi, 2019) found that some of the farmers adopted the CSA practices such as irrigation, which provided them with an increase in sugarcane production as compared to those who did not. No wonder governments and donors have been funding various projects and initiatives to support various interventions on CSA practices (Amadu et al., 2019).

However, despite the efforts and potential of CSA practices in promoting agricultural productivity in the face of climate change, the uptake of the same by smallholder farmers, worldwide, is reported to be very low (Abegunde et al., 2020; Amadu et al., 2019; Arslan et al., 2015; Aryal et al., 2018; Kurgat et al., 2020; Lipper et al. 2014; Long et al., 2015; Makate, 2019; Makoka et al., 2015; MCSAA, 2016; Meijer et al., 2014; Ouédraogo et al., 2019; Sardar et al., 2020; Teklewold et al., 2013; Zakaria et al., 2020). For instance, some studies found that the uptake of CSA practices, among smallholder farmers, is low in low-income regions such as sub-Saharan Africa (Arslan et al., 2014; Campbell et al., 2014; Makate, 2019; Makate et al., 2017; Meijer et al., 2014; Ringler & Nkonya, 2012; Teklewold et al., 2013; Thornton & Herrero, 2010; Westermann et al., 2015). Further, similar results were found in Netherlands, France, Switzerland, and Italy (Long et al., 2015), India (Aryal et al., 2018; Sardar et al., 2020), Ghana (Zakaria et al., 2020), (Ouédraogo et al., 2019), South Africa (Abegunde et al., 2020), Nigeria (Arslan et al., 2015), and Tanzania (Kurgat et al., 2020). Likewise, other studies done in some parts of Malawi (Makoka et al., 2015; MCSAA, 2016) indicate similar trends in the uptake of CSA practices among smallholder farmers. The fact that some smallholder farmers did not adopt CSA practices entails that there is something that either prevent or discourage them from embracing the same. It was still unknown how smallholder farmers were adopting the CSA practices in Malosa EPA, Zomba where the Ministry of Agriculture, under ASWAp-SP II, is promoting the CSA practices. This study, therefore, aimed at assessing the smallholder farmers' adoption of such CSA practices in Malosa EPA in Zomba District.

2.8 Factors influencing the adoption of climate smart agricultural practices

A number of factors influence smallholder farmers' adoption of climate smart agricultural practices worldwide (Amadu et al., 2019; Chandra, 2017; FAO, 2016; GoM, 2015; Jellason et al., 2020; Katengeza, 2018; Knegtel, 2014; Makate et al., 2018; Makate, 2017; Makate, 2019; MCSAA, 2016; Meijer et al., 2014; Murray et al., 2016;

Ouédraogo et al., 2019; Pagliacci et al., 2020; Partey et al., 2018; Sardar et al., 2020; Shahzad & Abdulai, 2020; Terdoo & Adekola, 2014; Tiarniyu et al., 2018; Zakaria et al., 2020). One of the determinants is access to information, which includes access to extension institutions, weather forecasting information, and knowledge and/or capacity of extension workers (Chandra, 2017; Knegetel, 2014; Pagliacci et al., 2020; Partey et al., 2018; Tiarniyu et al., 2018). According to Chandra (2017), adoption of CSA practices in South East Asia was hampered by lack of awareness of the impacts of climate change, and inaccessibility of weather information. Likewise, Knegetel's (2014) study found that lack of understanding of climate change and its effects affected CSA adoption by farmers. Again, in separate studies, inaccessibility to climate change information (Pagliacci et al., 2020) and CSA information (Partey et al., 2018; Tiarniyu et al., 2018) were found to play a positive role in hampering innovation adoption. As a result, adoption of CSA practices by smallholder farmers was limited.

Secondly, adoption of CSA practices by smallholder farmers is hindered by lack and scarcity of resources such as land, labour, finances, competition for the use of biomass, water, income, and farm inputs (Amadu et al., 2019; Chandra, 2017; FANRPAN, 2014; FAO, 2013; 2016; GoM, 2015; Murray et al., 2016; Ouédraogo et al., 2019; Pagliacci et al., 2020; Partey et al., 2018; Sardar et al., 2020; Tiarniyu et al., 2018). In their study, Amadu et al. (2019) found that the adoption of CSA practices thrives in contexts where most of the farming population is not constrained by essential land, labour, and financial resources. This finding is consistent with what GoM (2015) found that inadequate financing and limited human or financial resources impeded the uptake of CSA practices by smallholder farmers. On the other hand, FANRPAN (2014) and FAO (2013; 2016), found that competition for the use of biomass as fuel, fodder, mulch, and compost at the household level was a common barrier to the adoption of CSA practices in Malawi. Likewise, Tiarniyu et al. (2018) found that loss of stalks during dry season make many farmers fail to adopt CSA practices, which require the same resources. Further, land tenure and size have been cited as barriers to adoption of CSA practices in Malawi and elsewhere (FANRPAN, 2014; FAO, 2013; Sardar et al., 2020). In addition, Murray et al. (2016) found that women smallholder farmers in Nkhamenya and Kabudula areas of Malawi had problems in adopting CSA practices due to extremely limited access to agricultural inputs, resources, and credit. This agrees with

what Ouédraogo et al. (2019) found that farmers with access to subsidy and credit are more likely to adopt CSA practices.

Other studies found that access to markets (MCSAA, 2016; Tihamiyu et al., 2018), and market information (Sardar et al., 2020) are necessary for smallholder farmers to adopt CSA practices. These determinants positively and significantly correlate with the adoption of different sets of CSA practices. Again, some smallholder farmers' adoption of CSA practices got affected by the anticipated benefits of CSA practices. According to Mwandira (2016), farmers tend to accept and adopt practices, technologies, and innovations when they see the benefits themselves. In the same vein, some smallholder farmers' adoption of CSA practices was found to be determined by exposure to previous harsh weather conditions. These factors helped smallholder farmers build weather expectations and influence use of CSA practices as adaptive mechanisms (Katengeza, 2018). For instance, the study found that smallholder farmers who were previously exposed to early-season and late-season dry spells were more likely to use CSA practices. One implication from this is that immediate weather shocks prompt smallholder farmers to adopt CSA practices that can offset them. It can be argued, therefore, that most smallholder farmers are not ready to adopt a CSA practice for the climatic hazard they have never experienced before.

In addition to that, farm size (Knegtel, 2014; Pagliacci et al., 2020; Sardar et al., 2020), distance between farmers' home and farm location (Zakaria et al., 2020), farming experience (Makate et al., 2018; Sardar et al., 2020), and farmers' education levels (Makate, 2017; Sardar et al., 2020) affect adoption of CSA practices by smallholder farmers. Land size has a positive association with the adoption of different sets of CSA practices (Sardar et al., 2020). It is argued that if farmers have a larger land area, the likelihood of intensifying CSA practices would be very high due to economies of scale. A study by Zakaria et al. (2020) found that the distance between the farmer's home and farm location negatively influenced farmers' adoption intensity of CSA practices. On farming experience, a study by Makate et al. (2018) found that farming experiences can be associated with adoption and use of CSA practices in smallholder farming. In addition to that, smallholder farmers' adoption of CSA practices is influenced by household sizes, age of farmers, marital status, gender, and single female-headed households (Makate, 2017; Makate et al., 2018). In a study on adoption of CSA

practices in smallholder farming systems of southern Africa, Makate et al. (2018) found that gender and marital status influence the adoption and use of CSA practices in smallholder farming. Similarly, in Malawi, it was found that household sizes, age of farmers, and single female-headed households are among the factors that influence smallholder farmers' adoption of CSA practices (Makate, 2017).

Other studies found location of farmers (Zakaria et al., (2020), farmers' dependency syndrome, and laziness (Tiamiyu et al., 2018) as critical factors in influencing the decision of farmers to adopt CSA practices. For instance, a study on rice farmers in Ghana (Zakaria et al., 2020) found that location of smallholder farmers negatively influenced farmers' adoption of CSA practices. Likewise, a study by Tiamiyu et al. (2018) found that most smallholder farmers had not adopted CSA practices in Nigeria due to laziness. This is so because some of these practices are labour-intensive. For instance, mulching, which requires time of the farmer to collect the maize stalks or grass. This implies that labour intensive CSA practices are less likely to be adopted by smallholder farmers. Further, some smallholder farmers failed to adopt CSA practices due to reliance on donations. For instance, a study by Kitsao (2016) found that some smallholder farmers in Malawi did not adopt the CSA practices because, in times of poor harvest, some charity organisations supply them with food. It can be argued, therefore, that dependency syndrome prevents some smallholder farmers from adopting essential CSA practices. This calls for implementing agencies to civic educate such farmers understand that once the good Samaritans are gone, they would suffer. This study, therefore, stresses the need for smallholder farmers to emulate good practices from colleagues even if they have never met such challenges as the saying goes "forewarned is forearmed."

It is critical to note that in some cases, novel or unfamiliar CSA practices (Murray et al., 2016), knowledge of CSA (Terdoo & Adekola, 2014), lack of training (Ouédraogo et al., 2019; Pagliacci et al., 2020; Tiamiyu et al., 2018), limited understanding of CSA concept and framework (Centre for Coordination of Agricultural Research and Development for Southern Africa [CCARDESA], 2019; FAO, 2013; Partey et al., 2018) influence smallholder farmers' adoption of CSA practices. CSA is not just a simple set of practices and technologies that can be easily replicated in every context since farming systems are complex systems that must be understood in connection with

climate, weather, soil, the farmers' own socio-economic context, gender dynamics, markets, and regulatory environments (CCARDESA, 2019). It is envisaged that this understanding is required to move from the often-unsuccessful promotion of best bet practices to best fit practices, that meet female and male farmers' individual priorities while simultaneously increasing production, building resilience to climate change and where possible, reducing GHG emissions. This entails that not every CSA practice may be implemented anywhere. In its study, FAO (2013) found that CSAs are knowledge intensive hence need for smallholder farmers to comprehensively understand them. In a study of women smallholder farmers, Murray et al. (2016) found that it was difficult for women smallholder farmers to consider adopting unfamiliar CSA practices unless the knowledge gaps are filled. In a similar study, Terdoo and Adekola (2014) and Partey et al. (2018), in their separate studies, found that little or no knowledge of some CSA practices, even by agricultural extension officers, and limited understanding of CSA concept and framework made it difficult for smallholder farmers in Nigeria to adopt the CSA practices in question. Finally, lack of training inhibited the uptake of CSA practices by some smallholder farmers in West Africa (Pagliacci et al., 2020), Mali (Ouédraogo et al., 2019), and Nkhotakota in Malawi (Kitsao, 2016). It can be argued, therefore, that comprehensive sensitisation and civic education campaigns are vital tools in training smallholder farmers on CSA practices prior to promotion of their adoption.

The last factor determining adoption of CSA practices regards policy issues. These include fitting CSA practices into the existing policy frameworks (Partey et al., 2018), lack of clear guidelines for specific CSA practices (GoM, 2015), weak coordination, implementation, targeting, and monitoring (MCSSA, 2016), and political commitment (Terdoo & Adekola, 2014). Partey et al. (2018) posit that existing national and regional level policies, programmes, plans, and strategies on agriculture ought to mainstream CSA for effective climate change adaptation. For instance, lack of clear guidelines for specific CSA practices negatively affected the adoption of the same by some smallholder farmers in Malawi (GoM, 2015). In addition to that, weak coordination, targeting, implementation, and monitoring of CSA practices were found to be among the common barriers to smallholder farmers' adoption of CSA practices (FANRPAN, 2014; FAO, 2013). Again, lack of political commitment was found to be another factor influencing adoption of CSA practices by smallholder farmers in Nigeria (Terdoo &

Adekola, 2014). Political commitment is crucial in giving CSA the necessary backing and integration into current agricultural and environmental policies. This study calls on politicians to commit themselves in serving their followers by among others ensuring food security through provision of environment conducive for the promotion of CSA practices adoption. It is also critical to note that determinants and barriers to the adoption of CSA practices in Malosa EPA were still unknown. It is this study that has unearthed the determinants and barriers to adoption of CSA practices by smallholder farmers in Malosa EPA, Zomba. This was done by finding out the CSA practices that have been adopted by smallholder farmers or not, and the barriers or determinants of adopting the same. This was crucial as the study has identified the popular and best CSA practices for Malawi. As a result, the findings of this study may help to save resources wasted on non-popular ones, while at the same time encouraging or promoting the popular one in order to help farmers achieve better results out of them.

2.9 The Malawi agriculture sector wide approach support project

The Government of Malawi adopted the agriculture sector wide approach support project through the Ministry of Agriculture. The programme is currently in its second phase referred to as ASWAp-SP II (Ministry of Agriculture, Irrigation and Water Development [MoAIWD], 2017). As a project, ASWAp-SP II aims at improving food security and nutrition, increasing agricultural incomes, achieving more than 6% agricultural growth annually, and ensuring sustainable use of natural resources (FANRPAN, 2014). It is argued that although the Food Security Policy does not directly mention Climate-Smart Agriculture, one of its policy objectives is relevant to CSA. This is because the policy aims at ensuring that the ways in which food is produced and distributed is environmentally friendly and sustainable. Again, the policy recognises the importance of and advocates the participation of all stakeholders in conservation and utilisation of natural resources to achieve increased but sustainable agricultural productivity. By linking agricultural productivity with conservation and utilisation of natural resources and the environment, the policy acknowledges the link between agriculture and CSA. This is so because CSA is agriculture that sustainably increases productivity, resilience (adaptation), reduces or removes greenhouse gases (mitigation), and enhances achievement of national food security and development goals (FAO, 2013).

Following the above, an institution was identified to spearhead and coordinate the scale up of CSA in Malawi. As a result, the Malawi Climate Smart Agriculture Alliance was born under ASWAp. Its aims are to develop and manage a communication strategy to promote widespread adoption of CSA, coordinate and lead on CSA advocacy, and monitoring roll out of CSA (MCSAA, 2016). The project, therefore, seeks to address the gap that has been created by over emphasis on improving maize productivity and production. It is important to note that ASWAp SP I was implemented in all the districts of Malawi while ASWAp-SP II is being implemented in 12 selected districts (figure 1). The districts are Chitipa and Mzimba (in the northern region), Kasungu, Ntchisi, Mchinji, Lilongwe, Dedza, and Ntcheu (in the central region), Zomba, Phalombe, Mulanje, and Thyolo (in the southern region).

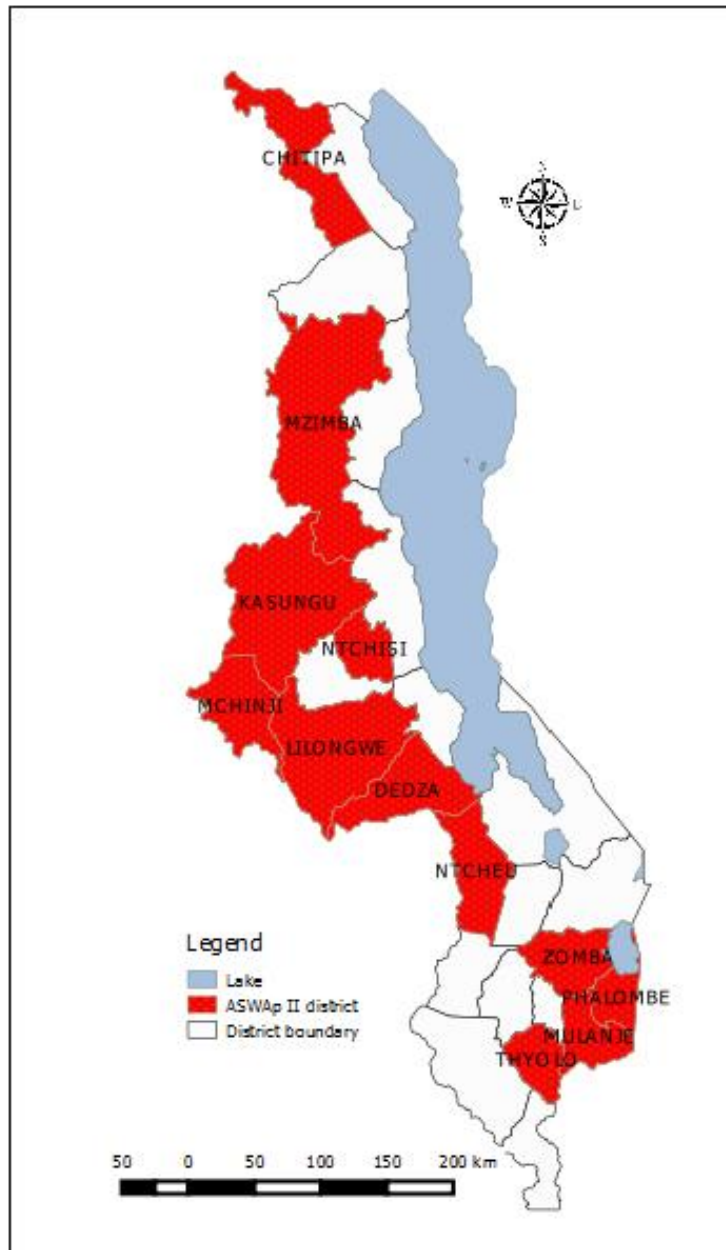


Figure 1: ASWAp-SP II districts

(Source: MoAIWD, 2017)

ASWAp-SP II is aimed at filling the gap created by over emphasis on improving maize productivity and production. It intends to improve production and productivity of other agricultural commodities in the intervention areas thereby promoting diversification of the agriculture sector in project impact sites through among others up-scaling successful interventions under the first ASWAp-SP. The project has four components. One of which emphasises sustainable agricultural productivity and diversification (MoAIWD,

2017). Under this component, the project addresses constraints related to limited agricultural productivity and diversification, which has been adversely affected by climate change thereby limiting agricultural growth and food security. Under one of its sub-components, Integrated Soil Fertility Management, the project is expected to support the scaling up of CSA practices among the smallholder farmers in order to enhance the resilience of agricultural production systems to climatic change shocks. Some of the CSA practices include conservation agriculture, agroforestry and other integrated sustainable land, and water management practices.

In Malawi, the Ministry of Agriculture (MoA) is the lead institution in supporting agricultural development. The MoA is divided into 28 district agriculture development offices (DADOs). The DADOs are the focal points for planning, providing information including technical advice, training, and supervision of extension planning area staff and farmers. The DADOs are further divided into 154 EPAs. The EPAs are responsible for developing farmers' groups, facilitating farmers' access to credit institutions, and farmers' training. The EPAs are further divided into sections, which are the lowest level of the MoA structure. In most cases, a section covers one village (MoAIWD, 2017). This study was conducted in one village of one section of Malosa EPA, Zomba District in Malawi. It was still unknown how smallholder farmers were adopting these CSA practices in Malosa EPA. There was need for a study to evaluate the uptake of CSA practices. This study, therefore, has assessed the adoption of CSA practices by smallholder farmers in Malosa EPA.

2.10 Theoretical framework

This study was guided by the Diffusion of Innovations (DoI) theory propounded by Rogers (2003). The framework was used to collect data, and interpret the results of this study. The term diffusion refers to a social process that takes place among people in response to learning about an innovation, for instance, CSA practices. Put differently, diffusion is the process by which an innovation is communicated through certain channels over time among the members of a social system (Rogers, 2003; Wejnert, 2002). On the other hand, an innovation is an idea, practice, service, product, or object that is perceived as new by an individual or other unit of adoption. As a theory, Diffusion of Innovations seeks to explain how people adopt innovations in a given area. The theory explains how, why, and at what rate new ideas and technology spread

(Vishwanath & Barnett, 2011). The theory states that the characteristics of an innovation will shape its rate of adoption (Rogers, 2003). In other words, this theory emphasises that it is not people who change rather the innovations themselves. For instance, DoI answers the two main questions, that is, why certain innovations spread more quickly than others, and why other innovations fail. Further, the theory contends that during the process of diffusion, an innovation is communicated through communication channels among the members of a social system. This concept was used to find out how smallholder farmers in the study area were communicated about the CSA practices promoted by ASWAp-SP II. This study has focused on four main issues of the theory namely elements, the innovation-decision process, factors determining adoption of innovation, and adopter categories.

2.10.1 Elements of the theory

Rogers (2003) uses a measure of “innovativeness” to distinguish different categories of adopters. Using the average time of adoption for a population and an individual’s time of adoption, the individual can be associated with one of the following five adopter categories - innovators, early adopters, early majority, late majority, and laggards (Wejnert, 2002). The boundaries between the categories are based on standard deviations from the average time of adoption. There are four main elements of the DoI theory namely innovation, communication channels, time, and social system (Vishwanath & Barnett, 2011).

2.10.1.1 Innovation

According to Rogers (2003), an innovation may have been invented a long time ago, but if individuals perceive it as new, then it may still be an innovation for them. On the other hand, uncertainty is an important obstacle to the adoption of innovations (Vishwanath & Barnett, 2011). An innovation’s consequences may create uncertainty. She argues that consequences are the changes that take place in a person or a social system because of the adoption or rejection of an innovation (Rogers, 2003). In order to reduce the uncertainty of adopting the innovation, individuals ought to be informed about its advantages and disadvantages to make them aware of all its consequences (Wejnert, 2002).

2.10.1.2 Communication channels

The second element of the Diffusion of Innovations process is communication channels. Communication is “a process in which participants create and share information with one another in order to reach a mutual understanding” (Rogers, 2003, p. 5). Communication channels are the ways through which information about an innovation is disseminated (FasterCapital, 2024). Examples of communication channels include face to face, radio, television, the print as well as social media (Wejnert, 2002).

2.10.1.3 Time

According to Rogers (2003), the time aspect is ignored in most behavioural research while including the time dimension in diffusion research illustrates one of its strengths. The innovation-diffusion process, adopter categorisation, and rate of adoptions all include a time dimension.

2.10.1.4 Social system

Social system is the last element in the diffusion process. Rogers (2003) describes the social system as “a set of interrelated units engaged in joint problem solving to accomplish a common goal” (p. 23). Since Diffusion of Innovations takes place in the social system, it is influenced by the social structure of the social system. Structure is “the patterned arrangements of the units in a system” (Rogers, 2003, p. 24). The nature of the social system affects individuals’ innovativeness, which is the main criterion for categorising adopters (Wejnert, 2002). This section helped in assessing the level of promotion of CSA practices in the study area, Nthiko Village, Malosa EPA.

2.10.2 The innovation-decision process

The innovation-decision process is “an information-seeking and information-processing activity, where an individual is motivated to reduce uncertainty about the advantages and disadvantages of an innovation” (Rogers 2003, p. 172). The innovation decision process has five main stages (figure 2) namely knowledge, persuasion, decision, implementation, and confirmation stages (Vishwanath & Barnett, 2011; Wejnert, 2002).

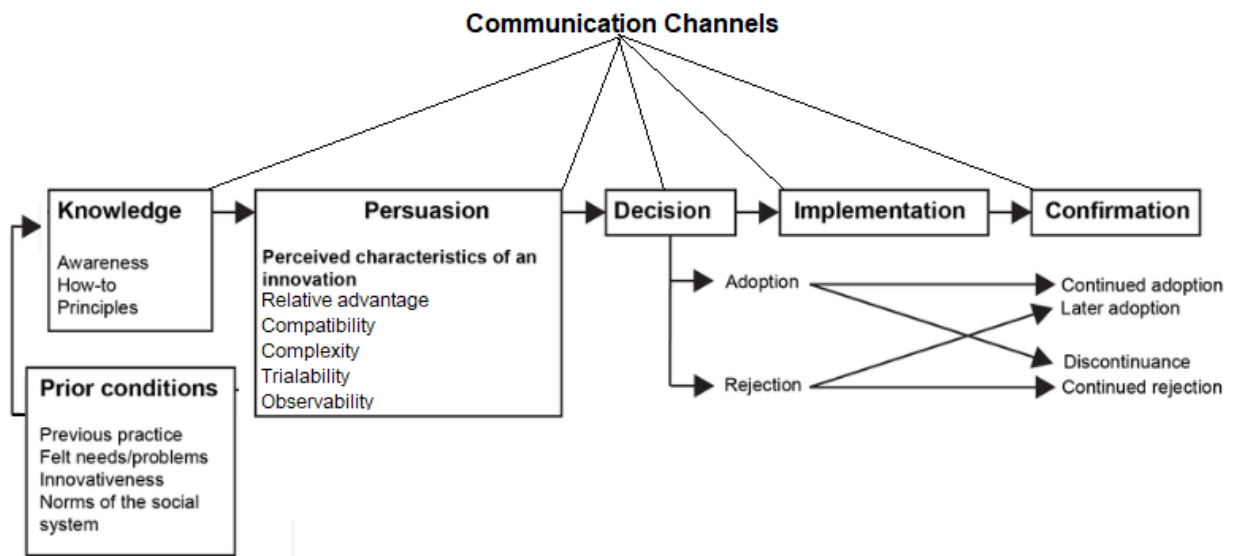


Figure 2: A model of five stages in the innovation-decision process

(Source: Henderson, 2005)

2.10.2.1 The knowledge stage

The innovation-decision process starts with the knowledge stage (Vishwanath & Barnett, 2011). In this step, an individual learns about the existence of innovation and seeks information about the innovation. “What?,” “how?,” and “why?” are the critical questions in the knowledge phase. During this phase, the individual attempts to determine “what the innovation is and how and why it works” (Rogers, 2003, p. 21).

2.10.2.2 The persuasion stage

The persuasion step occurs when the individual develops an attitude towards an innovation (Vishwanath & Barnett, 2011). The attitude can be either negative or positive. However, “the formation of a favourable or unfavourable attitude toward an innovation does not always lead directly or indirectly to an adoption or rejection” (Rogers, 2003, p. 176).

2.10.2.3 The decision stage

At this stage, an individual who is aware of an innovation and has formed an attitude towards it will at some point choose whether to adopt the innovation or not (Vishwanath & Barnett, 2011). This often involves a trial phase by the individual themselves or a peer (Rogers, 2003).

2.10.2.4 The implementation stage

At the implementation stage, an innovation is put into practice. The individual starts using the adopted innovation. However, an innovation brings the newness in which “some degree of uncertainty is involved in diffusion” (Rogers 2003, p. 6). The individual continues learning about the innovation and overcomes problems, further reducing the innovation’s uncertainty (Vishwanath & Barnett, 2011).

2.10.2.5 The confirmation stage

In this stage, an individual looks for support for the adopted innovation. According to Rogers (2003), this decision can be reversed if the individual is “exposed to conflicting messages about the innovation” (p. 189). However, the individual tends to stay away from these messages and seeks supportive messages that confirm his or her decision. Thus, attitudes become more crucial at the confirmation stage. In this study, this section helped to determine the stage at which the smallholder farmers (adopters or non-adopters) are in Nthiko Village, Malosa EPA, Zomba District.

2.10.3 Factors that influence adoption of an innovation

There are five factors that influence adoption of an innovation namely relative advantage, compatibility, complexity, trialability, and observability (Vishwanath & Barnett, 2011).

2.10.3.1 Relative advantage

Relative advantage is the extent to which an innovation is perceived as being better than the idea it replaces (Rogers, 2003). To increase the rate of adopting innovations and to make relative advantage more effective, direct, or indirect financial payment incentives may be used to support the individuals of a social system in adopting an innovation. The key question here could be ‘in what ways are the CSA practices promoted by ASWAp-SP II better than what smallholder farmers are already practising in Nthiko Village?’

2.10.3.2 Compatibility

Compatibility is “the degree to which an innovation is perceived as consistent with the existing values, past experiences, and needs of potential adopters” (Rogers, 2003, p. 15), in this case, smallholder farmers. If an innovation is compatible with an

individual's needs, then uncertainty will decrease and the rate of adoption of the innovation will increase (Vishwanath & Barnett, 2011). The key question here could be 'how well do the CSA practices fit with the existing values, patterns of behaviour, or tools of smallholder farmers in Nthiko Village?'

2.10.3.3 Complexity

On the other hand, complexity is the extent to which an innovation is perceived as relatively difficult to understand and use (Rogers, 2003). In other words, this is how difficult the innovation is to understand and/or use. Rogers states that complexity is negatively correlated with the rate of adoption. For instance, excessive complexity of an innovation is an important obstacle to its adoption. The key question here could be 'are the CSA practices being promoted by ASWAp-SP II in Nthiko Village too difficult for smallholder farmers to understand or use?'

2.10.3.4 Trialability

According to Rogers (2003), "trialability is the degree to which an innovation may be experimented with on a limited basis" (p. 16). It is the extent to which the innovation can be tested or experimented with before a commitment to adopt is made. Again, trialability is positively correlated with the rate of adoption, that is, the more an innovation is tried, the faster its adoption is (Vishwanath & Barnett, 2011). The key question here could be 'can smallholder farmers in Nthiko Village try the CSA practices promoted by ASWAp-SP II before adopting them?'

2.10.3.5 Observability

Observability is the last characteristic of innovations is observability. It refers to the extent to which the results of an innovation are visible to others (Rogers, 2003). In other words, this is the extent to which the innovation provides tangible results. It is one of the key determinants to adoption of innovations (Vishwanath & Barnett, 2011; Wejnert, 2002). Ideas in this segment helped this study in explaining the determinants or barriers to CSA adoption by smallholder farmers in Malosa EPA. The key questions here could be 'are the benefits of the CSA practices promoted by ASWAp-SP II noticeable to other smallholder farmers in Nthiko Village?'

2.10.4 Adopter categories

Rogers (2003) uses a measure of “innovativeness” to distinguish different categories of adopters. Using the average time of adoption for a population and an individual’s time of adoption, the individual can be associated with one of the following five adopter categories namely innovators, early adopters, early majority, late majority, and laggards (figure 3) (Vishwanath & Barnett, 2011; Wejnert, 2002). “Innovativeness is the degree to which an individual or other unit of adoption is relatively earlier in adopting new ideas than other members of a system” (Rogers, 2003, p. 22). This section helped in rating or assessing the smallholder farmers in the study area with regard to their respective categories of adoption.

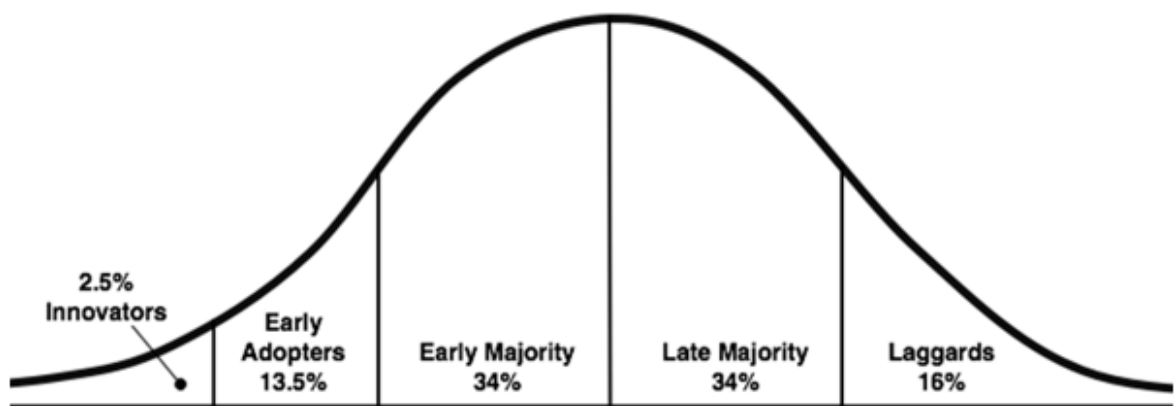


Figure 3: Adopter categories

(Source: Rogers, 2003).

2.10.4.1 Innovators

These are the people who want to be the first to try the innovation. They are venturesome and interested in new ideas. According to Rogers (2003), innovators were willing to experience new ideas. Thus, they should be prepared to cope with unprofitable and unsuccessful innovations, and a certain level of uncertainty about the innovation. The innovators are the gatekeepers bringing the innovation in from outside of the system. They may not be respected by other members of the social system because of their venturesomeness and close relationships outside the social system. Their venturesomeness requires innovators to have complex technical knowledge (Vishwanath & Barnett, 2011; Wejnert, 2002).

2.10.4.2 Early adopters

These are people who represent opinion leaders (Rogers, 2003). They enjoy leadership roles, and embrace change opportunities. They are already aware of the need to change and so are very comfortable (Vishwanath & Barnett, 2011; Wejnert, 2002). They do not need information to convince them to change. Compared to innovators, early adopters are more limited with the boundaries of the social system. Finally, “early adopters put their stamp of approval on a new idea by adopting it” (Rogers, 2003, p. 23).

2.10.4.3 Early majority

These people are rarely leaders, but they do adopt new ideas before the average person. Rogers (2003) claimed that although the early majority have a good interaction with other members of the social system, they do not have the leadership role that early adopters have. As Rogers stated, they are deliberate in adopting an innovation and they are neither the first nor the last to adopt it. Thus, their innovation decision usually takes more time than it takes innovators and early adopters (Vishwanath & Barnett, 2011).

2.10.4.4 Late majority

These people are sceptical of change, and will only adopt an innovation after the majority have tried it (Vishwanath & Barnett, 2011). The late majority includes one-third of all members of the social system who wait until most of their peers adopt the innovation. They are sceptical about the innovation and its outcomes, but economic necessity and peer pressure may lead them to the adoption of the innovation (Wejnert, 2002). To reduce the uncertainty of the innovation, interpersonal networks of close peers should persuade the late majority to adopt it. Then, “the late majority feel that it is safe to adopt” (Rogers, 2003, p. 284).

2.10.4.5 Laggards

These people are bound by tradition and very conservative. They are very sceptical of change and are the hardest group to bring on board. As Rogers (2003) stated, laggards have the traditional view and they are more sceptical about innovations and change agents than the late majority. Because of the limited resources and the lack of awareness-knowledge of innovations, they first want to make sure that an innovation works before they adopt (Wejnert, 2002). Thus, laggards tend to decide after looking at

whether the innovation is successfully adopted by other members of the social system in the past. Due to all these characteristics, laggards' innovation-decision period is relatively long.

2.11 Chapter summary

This chapter has reviewed existing literature related to the study assessing smallholder farmers' adoption of climate smart agricultural practices. The focus was on climate change and smallholder agriculture, smallholder farmers' perceptions of climate change, combatting the effects of climate change on agriculture, the concept of climate smart agriculture, benefits of climate smart agricultural practices to smallholder farmers, smallholder farmers' adoption of climate smart agricultural practices, factors influencing the adoption of climate smart agricultural practices, the Malawi agriculture sector wide approach support project, and the theoretical framework guiding this study. It has been established that there was a gap in literature on smallholder farmers' adoption of CSA practices in Malosa EPA in Zomba District. This study has filled the gap. The last part of this chapter discussed the theoretical framework guiding this study. The theoretical framework was used to collect data and interpret the results and findings of this study. In the following chapter, research design and methodology has been described.

CHAPTER THREE

RESEARCH DESIGN AND METHODOLOGY

3.1 Chapter overview

This chapter describes and justifies the design and methodology that was used to assess smallholder farmers' adoption of climate smart agricultural practices in Malosa EPA in Zomba District. It begins with research design, study area and population, data collection, data management, data analysis, ethical considerations, pilot study, research dissemination strategy, and study risks and offsetting strategies.

3.2 Research design

This study adopted a mixed research design. A mixed research design is a research technique for collecting, analysing, and mixing both quantitative and qualitative methods in a single study to understand a research problem (Creswell & Plano Clark, 2018). In this study, a convergent parallel design, also called triangulation mixed methods, was used. This was because the study simultaneously collected both qualitative and quantitative data, merged the data, and used the results to clearly understand the research problem (Creswell, 2012). The purpose of using the convergent parallel design was to collect different but complementary data (Morse, 1991) on the adoption of CSA practices by smallholder farmers. Using this design is advantageous as one data collection form provides strengths to offset the weaknesses of the other form. Again, a more complete understanding of a research problem results from collecting both quantitative and qualitative data. For instance, the quantitative data from many smallholder farmers offered strengths to cancel the weaknesses of qualitative data from a few smallholder farmers. Similarly, some in-depth qualitative data from a few smallholder farmers provided strengths to quantitative data that did not adequately provide detailed information about the context in which smallholder farmers gave information. As such, using either qualitative or quantitative method alone could not have sufficiently dealt with the research problem or adequately respond to the research questions. This agrees with what Walliman (2011) recommends that a study engages a

mixed methods design when one type of research design is not enough to address the research problem or answer the research questions.

In this study, the comparison of two methods was achieved by merging the quantitative and qualitative data in a single table. To achieve this, for each major topic in the study, the researcher displayed the quantitative results and the qualitative themes in columns that match each topic. This is because the mixed methods researcher compares the results from quantitative and qualitative analyses to determine if the two databases yield similar or dissimilar results (Creswell, 2012). In this study, the two methods complemented each other to achieve the same goal. This is in tandem with what Lee and Greene (2007) advance that a mixed research design is a complementarity mixed methods study. The rationale of this mixed design was to provide a more complete understanding than either quantitative or qualitative could alone do (Creswell, 2012). Furthermore, this study was a one-phase design in which the two types of data got collected in the same period, but quantitative data were given more weight. After collection, the datasets were analysed separately, the results from the analysis of both datasets were compared, and the interpretations were made as to whether the results support or contradict each other. This direct comparison of the two datasets by the researcher provided a convergence of the data sources (Creswell, 2012). This enabled the researcher to compare the results from different data sources to get a more inclusive understanding of the research problem and validate the same (Creswell, 2018).

In addition to that, this study employed a case study approach. This case study was powered by a survey. The survey design was chosen because it makes it possible for a study to numerically describe trends, attitudes, and opinions of a population by studying a sample of the given population (Creswell, 2014). The case study was exploratory in nature because it was assessing smallholder farmers' adoption of CSA practices. This is in line with what Punch (2009) contends that exploratory case study designs are used in situations where the intervention being evaluated has no clear single set of outcomes. In other words, the case study did the qualitative part while the survey did the quantitative part of this study.

On the other hand, the survey employed in this study was descriptive in nature. This is because it was used to describe some sample in terms of simple proportions and

percentages of research population that provided information on smallholder farmers' adoption of CSA practices in Malosa EPA. The use of exploratory case study and survey as main strategies in the convergent research design ensured the researcher achieve a valid holistic interpretation of the smallholder farmers' adoption status of the CSA practices in Malosa EPA in Zomba District.

3.3 Study area and population

This study was conducted in Malosa EPA in Zomba District. The EPA has 199 villages and 22 sections. Out of the 22 sections, only 2 (namely Matandani and Machinjiri) are implementing the CSA practices under ASWAp-SP-II. This study was conducted in Matandani Section, which has two villages namely Nthiko and Nkaju. In this study, the focus was on Nthiko Village. Nthiko is a group of eight villages namely Nthiko, Napwanga, Masamba, Jali, Wesely, Kaugure, Kandulu, and Isaki. It is located in Traditional Authority (T/A) Malemia at an approximate latitude of 15° 17' S and longitude of 35° 24' E (figure 4).

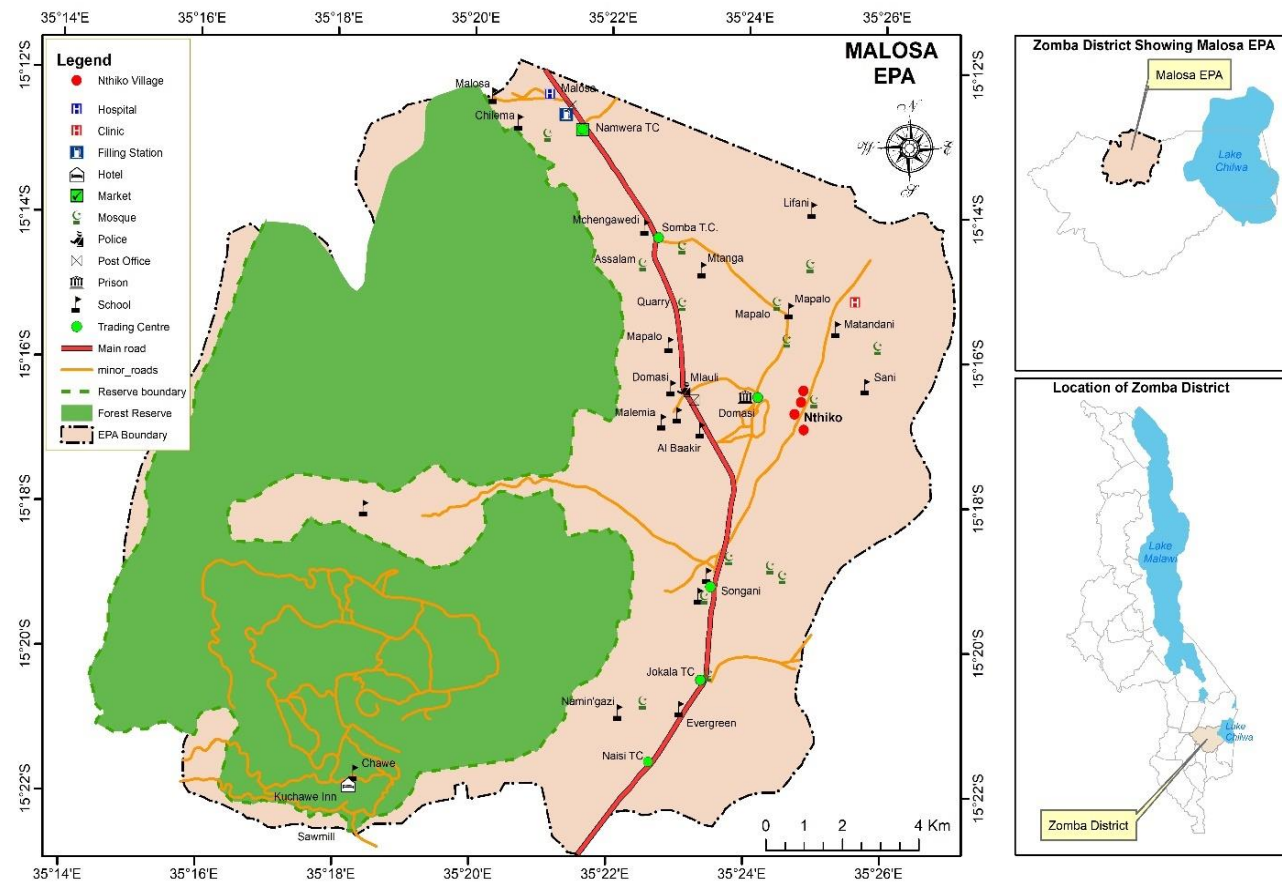


Figure 4: Map showing the study area

The study area lies within the Lake Chilwa Basin and has a savanna climate, with the annual rainfall range between 1100 and 1600 mm (Mvula et al., 2014). It has an average annual temperature between 21°C and 24°C (Chavula, 2000). The area experiences prolonged droughts due to low rainfall and increased temperatures (Kambombe et al., 2021), whose extremes resulted in the drying up of Lake Chilwa in the years 1995 (Njaya, 2001) and 2018 (Kambombe et al., 2021). The soils in the area are sandy loam (41%), loamy sand (26%), sandy clay loam (17%), sand (9%), clay loam (5%), clay (1%), and loam (1%) (Sagona et al., 2016). Maize, which is the staple food, is the main crop grown in the area. This area was purposively selected because it has CSA practices being promoted to smallholder farmers by ASWAp–SP II. Again, it was closer to the researcher’s duty station. This eased mobility and accessibility even during rainy season.

3.3.1 Population sample

The study targeted two groups of respondents namely key informants, and smallholder farmers. The key informants were the Director of Agriculture and Natural Resources Management (DoANRM), the Agricultural Extension Development Coordinator (AEDC), and the Agricultural Extension Development Officer (AEDO). Smallholder farmers were those farmers who were introduced to or sensitised on ASWAp-SP II CSA practices for possible adoption. The study participants were composed of both CSA practices adopters and non-adopters. The research area had a population of 205 smallholder farming families.

The DoANRM was engaged to provide the general status of the CSA practices’ interventions for the district. The AEDC was targeted to provide the CSA practices being promoted or implemented in Malosa EPA. On the other hand, the AEDO was involved in this study to provide specific CSA practices being implemented and promoted in Nthiko Village and the status of smallholder famers’ adoption of the same. The smallholder farmers provided the researcher with the first-hand information regarding the CSA practices being implemented in Nthiko Village and their adoption status.

3.3.2 Sampling techniques

This study used two sampling techniques namely purposive sampling and simple random sampling. Purposive sampling was used to select the three key informants namely the DoANRM, the AEDC, the AEDO, and ten smallholder farmers. Likewise, the research site was purposively selected. On the other hand, the simple random sampling was used to select smallholder farmers in Nthiko Village. The total number of farming households (HH) in Nthiko Village was 205 (National Statistical Office [NSO], 2018). This study employed the Yamane (1967) formula for calculating sample size as follows:

$$n = \frac{N}{1 + N(e)^2}$$

In the formula, n is the sample size, N is the total farming households' population, and e is the level of precision. This study adopted a confidence level of 95%, and a precision of 10%, in a sample of 205 farming households.

$$\begin{aligned} n &= \frac{205}{1 + 205(e)^2} \\ n &= \frac{205}{1 + 205(.10)^2} \\ n &= \frac{205}{1 + 205(.01)} \\ n &= \frac{205}{1 + 2.05} \\ n &= \frac{205}{3.05} \\ n &= 67.2 \end{aligned}$$

The sample (67.2) was then increased to 70 households. This is consistent with what Rumsey (2021) argues that if a sample size has a decimal value, it must always be rounded up. So, the researcher rounded up the sample to the nearest ten. As such, this study had a sample size of 70 respondents who were typically smallholder farmers (table 1). The study opted for Yamane formula because it is ideal for calculating an appropriate sample size when a population size and a preferred value for margin of error

are known. In addition to the smallholder farmers, the study also engaged three respondents who were agricultural experts from the Ministry of Agriculture and its division (table 2).

Table 1: Sample size of smallholder farmers

Number of farming households	Sample size (<i>n</i>) for precision (<i>e</i>) level of $\pm 10\%$
205	67
Additional HH	03
Total	70

Table 1 shows that this study engaged 70 smallholder farmers out of the 205 farming households in Nthiko.

Table 2: Key informants

Title of officer	Number
Director of Agriculture and Natural Resources Management	1
Agricultural Extension Development Coordinator	1
Agricultural Extension Development Officer	1
Total	3

Tables 2 shows this study had a sample of three key informants. This means that in total, the study engaged 73 respondents. This agrees with what Field (2005) argues that a sample is a smaller but hopefully representative collection of units from a given population.

3.4 Data collection

This study collected qualitative and quantitative data concurrently. As such, the study employed data collection methods for both qualitative and quantitative designs. In the case of qualitative data, the study used semi-structured interviews, and field observations. Semi-structured interview guides were used to gather data from the three (3) key informants and ten (10) smallholder farmers (table 3). The decision to have 10

smallholder farmers for qualitative data depended on time and financial constraints. This is in tandem with what Bekele and Ago (2022) contend that there is no universal rule guiding the choice of sample size in qualitative research but factors such as time and resources may dictate the decision.

The 10 smallholder farmers were purposively selected based on being either adopters or non-adopters of CSA practices promoted by ASWAp-SP II. The participants were selected on first come, first served basis. This means that once the smallholder farmer's adoption status was known during the survey, they were picked until the number ten (five CSA practices adopters and five CSA practices non-adopters) was reached. Out of the three key informants, one of them represents the overall in-charge of CSA practices programme at the district level (Director of Agriculture and Natural Resources Management i.e., Key informant A), another one at the EPA level (Agricultural Extension Development Coordinator i.e., Key informant B), and the last one at the village level (Agricultural Extension Development Officer i.e., Key informant C). On the other hand, survey questionnaires were used to collect quantitative data from 70 smallholder farmers.

Table 3: List of qualitative research participants

Participant code name	Sex	Description
Smallholder farmer 1	F	CSA practice(s) adopter
Smallholder farmer 2	F	CSA practice(s) adopter
Smallholder farmer 3	F	CSA practice(s) adopter
Smallholder farmer 4	F	CSA practice(s) adopter
Smallholder farmer 5	M	CSA practice(s) adopter
Smallholder farmer 6	F	CSA practice(s) non-adopter
Smallholder farmer 7	F	CSA practice(s) non-adopter
Smallholder farmer 8	F	CSA practice(s) non-adopter
Smallholder farmer 9	M	CSA practice(s) non-adopter
Smallholder farmer 10	F	CSA practice(s) non-adopter
Key informant A	M	The Director of Agriculture and Natural Resources Management
Key informant B	M	The Agricultural Extension Development Coordinator
Key informant C	M	The Agricultural Extension Development Officer

Table 3 shows that the qualitative research participants comprised 13 people with a composition of ten smallholder farmers and three agricultural experts.

3.5 Data management

In this study, several ways were used to manage data. Data management refers to procedures required for a systematic and coherent process of data collection, storage, and retrieval (Denzin & Lincoln, 1998). In this study, data collected were first transcribed, typed and stored in a computer. Thereafter, the same data was printed to produce hard copies while some was kept in an external hard disk drive as well as uploaded to email and Google Drive as soft copy back-ups. This was done to ensure ease of access and maximum safety of the data. The other forms and platforms were acting as back-ups in case the main storage gadget got damaged. This is consistent with what Punch (2009) argues that the purpose of data management is to foster effective storage and retrieval of data in order to avoid miscoding, mislabelling, mislinking, and mislaying the data. As such, these various procedures, platforms, and formats have been used in this study to help manage data in an effective and efficient manner.

3.6 Data analysis

This study used qualitative and quantitative methods of analysing data. This was because this study collected both qualitative and quantitative data.

3.6.1 Qualitative data analysis

This study used thematic data analysis (Braun & Clarke, 2006) to analyse qualitative data. Thematic analysis is a method that is used to identify, analyse, and report themes or patterns within data (Braun & Clarke, 2006). A theme captures the salient features about the data in relation to the research questions, and represents certain level of patterned response or meaning within the data set. Data analysis in this study provided an assessment of smallholder farmers' adoption of CSA practices in Nthiko Village. The results and findings were integrated with the DoI theory after they fell under a similar element of the theory. This assisted the researcher to effectively interpret the data.

It is important to note that thematic data analysis has six phases namely familiarisation with data, generation of initial codes, searching for themes among codes, reviewing

themes, defining, and naming themes, and producing the final report (Braun & Clarke, 2006). In this study, the researcher played a role of analysing data by determining the themes coming out of the data gathered using field observation guides, and semi-structured interview guides. This concurs with what Ely et al. (1997) state that themes emerge from the researcher's analysis and interpretation of the participants' discussion of their experiences. In order to discover meanings in the data, the researcher was open enough to let unexpected meanings emerge. This is in line with what Giorgi (2011) and Lopez and Willis (2004) contend that qualitative researchers ought to adequately be open and allow the unexpected meanings emerge from their data.

3.6.2 Quantitative data analysis

This study used descriptive statistics (Kaur et al., 2018; Murray & Andrea, 2009) to analyse quantitative data. This was aided by Statistical Package for Social Scientists (SPSS) version 26 and Microsoft Office Excel 2019 software packages (appendix 9). The packages were utilised when analysing different variables of smallholder farmers regarding the adoption of CSA practices in Nthiko Village. The data analysis in this study was descriptive in nature. As such, the analysis made it possible for the study to identify the measures of central tendency, (mode, median, and mean) and dispersion (frequency distribution, and range). It is also important to note that during analysis, the data were merged via a side-by-side system (Creswell & Creswell, 2018). This study has first presented a set of quantitative results before the qualitative complements. This means that quantitative results have been reported first followed by qualitative findings. Qualitative findings, in this study, are either confirming or disconfirming the quantitative results.

3.7 Ethical considerations

Before embarking on data collection, permission was first sought from various and relevant gate keepers. This was done to conform to the agreed norms, procedures, and logistical issues regarding seeking of permission prior to data collection. This is in tandem with what Silverman (2017) warns that disregarding ethical issues in research is like moving downwards on a slippery road. As such, permission was first sought from the University of Malawi Research Ethics Committee (UNIMAREC) (appendix 6 and 7). Likewise, the UNIMAREC compliance officer visited this researcher in the field during data collection to assess the degree of compliance (appendix 8). Permission

from the Ministry of Agriculture was sought through the DoANRM of Zomba District. Permission to conduct research in Malosa EPA was granted after the researcher produced an introductory letter from the University of Malawi. Similarly, a courtesy call was made to the AEDC of Malosa EPA just like the Group Village Head (GVH) Nthiko, and the Heads of the eight villages. Likewise, an informed consent was sought from each of the smallholder farmers before being engaged in the study. The researcher sought informed consent from smallholder farmers by giving his name and other relevant details, stating the purpose of the study, indicating how they were selected, assuring them of confidentiality, providing names that they may contact, and informing them about their voluntary participation and withdrawal. This is in tandem with what was prescribed by Mukherji and Albon (2010), Rudestam and Newton (2007), and Sarantakos (2005). After that, the smallholder farmers were requested to sign the informed consent form (appendix 1).

Furthermore, a preliminary visit was made to the research site. This was done to ensure the researcher gets familiarised with the GVH Nthiko, the eight Village Heads (VH), and the smallholder farmers to avoid distractions on the actual day of data generation. This helped the researcher to create rapport with the respondents and participants prior to the actual day of data collection. It was critical to establish rapport with the respondents and participants who were an essential ingredient to a fruitful data collection exercise. For instance, respondents opened up and expressed themselves freely during interviews. This agrees with what Kabir (2016) contends that the development of rapport with potential research participants is essential in gaining their cooperation, trust, and understanding of the topic, situation, and setting. As a result, this made it possible for the researcher to get correct information regarding the research questions that were asked.

3.8 Pilot study

Before conducting the actual research in the Nthiko Village, a pilot study was carried out in a neighbouring village. The purpose of a pilot study was to test aspects of the research design and allow necessary adjustment before making final commitments to the design as propounded by The Association for Qualitative Research (2015). This pilot study involved trying out all data collection instruments to test the time taken to complete answering the questions and check whether the questions were clear (Bell,

1993). All the three data collection instruments (i.e., questionnaires, field observation guides, and semi-structured interview guides) were tested during the pilot study. In the end, some modifications were made to the instruments. For instance, some questions, which demanded the same answers despite being in different sections, were merged.

Likewise, information of participants, which was also required on the semi-structured interview guides was just copied from the survey questionnaires to avoid asking smallholder farmers about the same for the second time. This helped to avoid repetitions and save time. Similarly, it helped the researcher to determine what was feasible and not. This is in line with what Teijlingen (2002) posits that a pilot study helps the researcher to develop and test adequacy of research instruments, assess whether the research protocol is realistic and workable, and identify logistical problems, which might occur when using the proposed methods. In the end, whatever was out of order was duly reviewed and modified to make this study doable.

3.9 Research dissemination strategy

Results and findings of this study will be disseminated using the following strategies:

- attending research dissemination conferences
- publishing in various peer reviewed journals
- distributing to the Ministry of Agriculture through Malosa EPA
- commenting or writing articles in the media relevant to the topic of this study.

3.10 Study risks and offsetting strategies

This study anticipated various risks. Table 4 shows a summary of the risks and ways used to avert each of them.

Table 4: Risks and ways of averting them

Expected risks	Ways of averting the risks
Exposure to COVID 19 pandemic	Use of PPEs, and following COVID 19 prevention rules and guidelines
Impassable roads due to bad weather	Checking the weather before setting out and utilising the dry weather
Mistaken identity syndrome	Use of identity cards, permission letters, and a local person (the AEDO) as a companion
Absence of respondents due to other activities	Visiting the site in the afternoon hours when most farmers are back from their fields. Making several visits to the research site
Demand for incentives by respondents	Informing respondents the purpose of the study etc., as in the informed consent form.

3.11 Chapter summary

This chapter has described and justified the design and methodology that was used to assess smallholder farmers' adoption of climate smart agricultural practices in Nthiko Village, Malosa EPA. It has looked at the research design, study area and population, data collection, data management, data analysis, ethical considerations, pilot study, research dissemination strategy, and study risks and offsetting strategies. In the following chapter, results of this study have been presented and discussed.

CHAPTER FOUR

RESULTS AND DISCUSSIONS

4.1 Chapter overview

This chapter presents and discusses results of the study assessing smallholder farmers' adoption of climate smart agricultural practices in Malosa EPA. Data were collected from smallholder farmers and key informants using survey questionnaires, field observation guides, and semi-structured interview guides. The results have been presented based on the research objectives by using findings from the survey questionnaires, semi-structured interview, and field observation guides. Interpretation and discussion follow immediately after presentation of each research finding. Data extracts have been used to support qualitative data being presented as complementary findings of this study. Code names have been used to identify data extracts according to each research participant (table 3). Extracts in Chichewa, the vernacular language of research participants, have been translated into English. The Chichewa versions of data extracts have been indicated in italics and brackets after the English versions.

4.2 Socio-economic and demographic characteristics of farmers in Nthiko

Under this section, smallholder farmers have been described in terms of their sex, age, marital status, occupation, economic status, education levels, type of farm terrain, and experience in farming. The results are consistent with the recent national population and household census (NSO, 2018).

Table 5: Characteristics of smallholder farmers in Nthiko

Variable	Percentage
Sex	
• Male	14%
• Female	86%
Age	
• Below 50 years old	71%
• Above 50 years old	29%
Marital status	
• Single	47%
• Married	53%
Occupation	
• Farming	74%
• Business / business	26%
Average monthly income	
• Below MK10,000	71%
• Above MK10,000	29%
Education levels	
• Literate	89%
• Illiterate	11%
Farming experience	
• Less than 10 years	21%
• Above 10 years	79%
Farm terrain	
• Flat	39%
• Low lying	32%
• Hilly	16%
• Water-logged	13%

Table 5 shows that this study engaged 60 female smallholder farmers (85.7%) and 10 male smallholder farmers (14.3%). Most smallholder farmers were females because majority of farming households were female-headed. In terms of age, majority of

smallholder farmers (71%) were below 50 years of age while 29% were above 50 years of age. Among them, 53% were married while 47% were single. Most of the married smallholder farmers (76%) were females while 24% were males. However, during semi-structured interviews, it was discovered that 82% of the married females had part-time husbands while 18% had full-time husbands. This is because majority of the marriages were polygamous and the most females under this study were not first wives in their marriages. Economically, majority of smallholder farmers (74%) solely depended on farming for a living while 26% depended on employment and business. Again, majority (71%) of smallholder farmers had an average monthly income of below MK10, 000 while 29% had an income of above MK10, 000. In terms of literacy levels, majority (89%) of smallholder farmers were literate and very few (11%) had never attended formal education. Again, a good number (39%) of smallholder farmland in Nthiko is flat, 32% is low-lying, 16% is hilly while 13% is waterlogged. It is crucial to note that each of these farmlands requires some specific treatment and management regarding climate change for the farmers to overcome effects of climate change on their farming. Finally, majority (79%) of the smallholder farmers had over 10 years of farming experience. On the contrary, 21% of smallholder farmers had less than 10 years of farming experience.

4.3 CSA practices adopted by smallholder farmers in Nthiko

This section has presented and discussed five aspects namely adoption level of ASWAp-SP II climate smart agricultural practices, ASWAp-SP II promoted climate smart agricultural practices, other climate smart agricultural practices adopted by smallholder farmers, smallholder farmers' perception of climate change, and smallholder farmers' response to changes in climate.

4.3.1 Adoption of ASWAp-SP II climate smart agricultural practices

Under this section, smallholder farmers were asked to indicate whether they have adopted CSA practices promoted by ASWAp-SP II in the area or not. The first part considers the general rate of adoption while the second part focuses on adoption per CSA practice.

4.3.1.1 Rate of climate smart agricultural practices' adoption in Nthiko

This sub-section assesses the general rate of CSA adoption by smallholder farmers. Figure 5 indicates the rate of adoption of CSA practices by smallholder farmers in Nthiko.

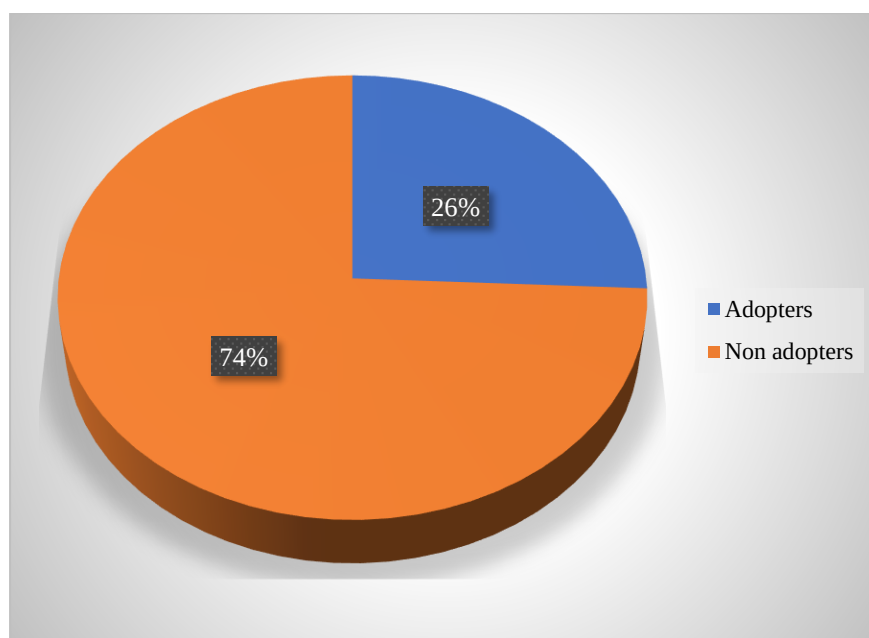


Figure 5: Smallholder farmers' level of CSA practices adoption in Nthiko

Results indicate that most (74%) smallholder farmers have not yet adopted the CSA practices promoted by ASWAp-SP-II while a few (26%) smallholder farmers have adopted. This entails that many smallholder farmers are yet to adopt the CSA practices promoted by ASWAp-SP-II. This was confirmed in the following semi-structured interviews:

My records show that about 30% of the smallholder farmers in Nthiko have adopted at least one of the CSAs we are promoting. Some either directly from our officer and others from lead farmers. This is because most CSA practices take time to produce results and understanding of some interventions seem to be a problem among farmers. So mostly, they revert to what they already know, thus, traditional practices (Key informant A).

In agreement to this, Key informant C said the following:

If I were to assess the current adoption of CSAs by smallholder farmers, you would wonder. The uptake is as low as 25%. This is not as we expected. When you finish your research, you will agree with me. Perhaps, you will tell us what's wrong with our project.

The fact that a few smallholder farmers in Nthiko have adopted the CSA practices corresponds with what was found by Abegunde et al. (2020), Amadu et al. (2019), Makate (2019), Ouedraogo et al. (2019), Sardar et al. (2020), and Zakaria et al. (2020) that the uptake of CSA practices by smallholder farmers is very low worldwide. The similarity in uptake could be attributed to the fact that some basic human behavioural traits are similar worldwide. Probably, most of them will adopt with the passage of time. This concurs with what the Diffusion of Innovations theory (Vishwanath & Barnett, 2011) states that time is a critical factor in determining various human behavioural traits regarding adoption of an innovation.

The fact that 74% of smallholder farmers have not yet adopted ASWAp-SP II promoted CSA practices slightly disagrees with what the Diffusion of Innovations theory (Vishwanath & Barnett, 2011) situates that 84% of the people will take time to adopt an innovation, that is, early majority (34%), late majority (34%), and laggards (16%). The difference could be because of variations in time and space. This means that what Rogers (2003) claims occurred in her time and area, which might not be the case with the current trends in Malawi. It can be argued, therefore, that the levels and rates of adoption can best be determined locally not otherwise. This is in tandem with what FAO (2013) contends that overcoming the effects of climate change on humanity can best be done locally. This study emphasises that the one-size-fits-all solutions cannot work in addressing the issue of climate change to the desired levels.

The fact that 26% of smallholder farmers adopted at least a CSA practice disagrees with what Sardar et al. (2020) found in India that over 50% of smallholder farmers adopted the CSA practices being promoted. The difference could be attributed to variations in factors that may be responsible for promoting or preventing smallholder farmers' adoption of CSA practices. It can be argued, therefore, that although climate change is a global phenomenon, smallholder farmers' response to the effects of climate change

are not uniform and should be addressed so. This is because, despite climate change being a global issue, vulnerability and adaptation to climate change is local. This study, therefore, emphasises that any intervention addressing impacts of climate change on agriculture should have a local smallholder farmers' needs at its centre. Failing which efforts to address needs of local smallholder farmers' using imported measures would render the intervention less effective.

The issue of some smallholder farmers failing to understand the CSA practices thereby reverting to traditional practices of farming tallies with what FAO (2013) contends that CSA practices are knowledge intensive. Again, this finding concurs with what the Diffusion of Innovations theory postulates that some people are bound by tradition, which makes them very conservative and sceptical of change (Vishwanath & Barnett, 2011). This entails that some smallholder farmers are hard to change and would want to see the CSA practice(s) working first before they can adopt. Such a trait makes such smallholder farmers wait until the first adopters benefit from the adopted CSA practice(s). This is consistent with what the Diffusion of Innovations theory (Vishwanath & Barnett, 2011) contests that people adopt an innovation if its results are tangible and visible to others. This implies that in cases where benefits of an CSA practice take long to be visible, some smallholder farmers will take more time too to adopt the CSA practice in question. It can be argued, therefore, that some smallholder farmers will take long to adopt the CSA practices that take long to produce results. In fact, it can also be argued that any CSA practice that takes long to bear fruits will be least or late adopted by smallholder farmers. This study, therefore, emphasises that in cases where such delays are inevitable, smallholder farmers should be informed earlier so that those interested should still adopt. One of the ways is to ensure that videos of smallholder farmers who adopted and benefitted from similar CSA practices are shown to smallholder farmers during awareness campaigns, sensitisation meetings or demonstration sessions.

Similarly, this study emphasises that such videos should be of Malawian or African smallholder farmers. This will increase believability since climate change adaptation is local. This entails that local farmers will not take, as ideal or feasible, any video showing foreign smallholder farmers other than Malawian or nearest neighbours. This is consistent with what FAO (2013) contests that CSA practices are location specific.

This implies that when introducing CSA practices to an area, realities of the locality such as conditions and needs should be taken into consideration. Another way of simplifying this is to establish demonstration fields in the same area where a specific CSA practice will be promoted so that smallholder farmers see for themselves the results and opt to adopt. This can best be done by involving local smallholder farmers using the same language and farmland.

4.3.1.2 Adoption per climate smart agricultural practice in Nthiko

This section presents the ASWAp-SP II CSA practices, which have been adopted by smallholder farmers. The adoption of CSA practices by smallholder farmers in Nthiko has been discriminated per CSA practice. Figure 6 has the results (n=18).

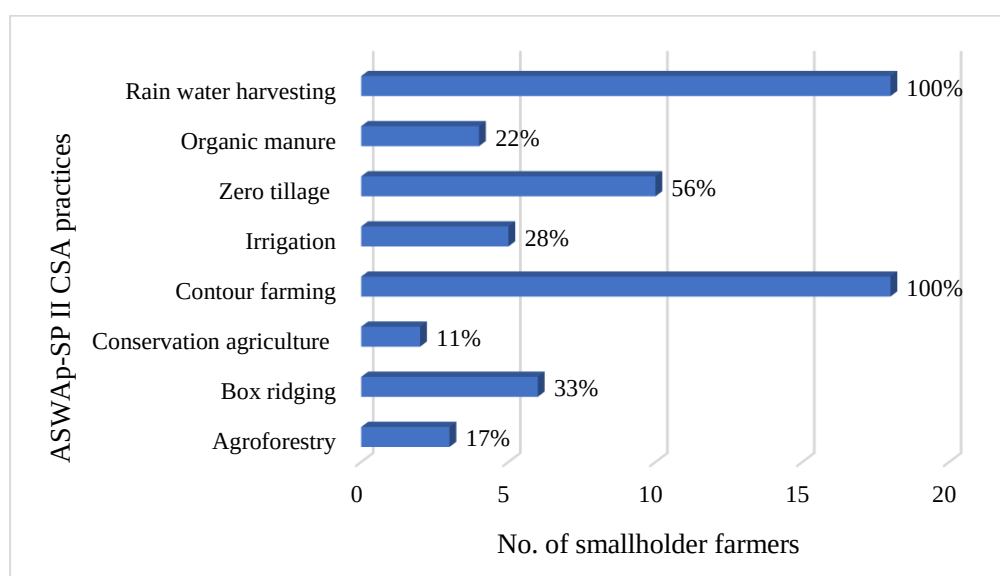


Figure 6: Smallholder farmers' adoption of ASWAp-SP II CSA practices

Overall results indicate that many smallholder farmers have adopted contour farming, and rain water harvesting (100%). On the other hand, very few smallholder farmers have adopted conservation agriculture (11%), agroforestry (17%), and organic manure (22%). This entails that despite promoting eight CSA practices, only two have been well adopted by smallholder farmers in the area.

The fact that the most adopted CSA practices by all farmers are rain water harvesting, and contour farming (100%) while the least being conservation agriculture (11%) disagrees with what Partey et al. (2018) found in Mali that the most adopted CSA

practice by smallholder farmers was organic manure (89%) while the least adopted was intercropping. This difference confirms what FAO (2013) contend that climate change adaptation and vulnerability are local. Again, this finding confirms what Kaplinsky (2011) argues that technology ought to be specific in order to respond effectively to the actual needs of the people in question. This entails that what smallholder farmers in Mali faced as effects of climate change on their agriculture might not necessarily be the same as those faced by their Malawian counterparts. It can be argued, therefore, that the best way of arresting effects of climate change on agriculture is to localise the approaches. This study, therefore, stresses the need for smallholder farmers to adopt the CSA practices that are suitable for solving their specific needs regarding effects of climate change in their area. Likewise, the implementing agencies should bring relevant CSA practices that will suitably help in solving prevailing climate change challenges in the affected areas.

Another insight from this finding is that some smallholder farmers who have not yet adopted the ASWAp-SP II promoted CSA practices have adopted other CSA practices promoted by other organisations. According to these smallholder farmers, the non-ASWAp-SP II CSA practices are equally good and effective in combating the effects of climate change on agriculture. This entails that ASWAp-SP II promoted CSA practices are not the only suitable practices for offsetting the effects of climate change on smallholder farming in Nthiko. This study, therefore, stresses the need for the Ministry of Agriculture to first analyse the climate change situation of an area and explore various suitable and relevant CSA practices to offset them before introducing new ones. This is consistent with what Kaplinsky (2011) warns, under the concept of intermediate technology, that it is critical to find out what people are already doing, and help them to do it better instead of just bringing technologies that ignore local materials and render local skills obsolete.

This finding also corresponds to what the Diffusion of Innovations theory (Vishwanath & Barnett, 2011) postulates regarding relative advantage that, prior to adoption of a CSA practice in question, people (in this case, smallholder farmers) will first find out if the CSA practice being promoted is better than the system they are already using. As such, they would prefer to wait until the CSA practices work in other farmers' fields prior to their adoption. This study, therefore, accents the need for networking among

local smallholder farmers, comprising adopters and non-adopters, to encourage knowledge sharing through learning from each other. Again, the study stresses the need for smallholder farmers to hold agricultural shows or fairs - before and after each growing season - where they will display CSA practices and their corresponding benefits. These would consequently help motivate the would-be adopters to adopt some of the CSA practices, which are suitable and relevant to their conditions and needs in the soonest time possible.

As already alluded to, it is important to note that this adoption is referring to the CSA practices implemented by ASWAp-SP II programme. In some cases, farmers have adopted non-ASWAp-SP II advocated CSA practices and well-known practices, for example, use of hybrid seeds. However, it could have been difficult to measure their adoption as they have been used for a long time. It was easy to trace adoption of ASWAp-led CSA practices because it came as a project in 2017. This study, therefore, argues that failure of some smallholder farmers to adopt ASWAp-SP II promoted CSA practices does not necessarily mean such farmers are not interested in solving climate change related effects on agriculture but opted for other equally effective practices to offset the same. This study, therefore, emphasizes that if the CSA practices will not be appropriate (affordable, simple, and localised), their uptake will remain low. It can be argued, therefore, that to foster high rate of adoption, CSA practices ought to be simple, affordable, locally available, and of relative advantage over other existing practices.

4.3.2 ASWAp-SP II promoted climate smart agricultural practices

Under this section, CSA practices promoted by ASWAp-SP II in Nthiko were identified. Smallholder farmers in Nthiko are encouraged to adopt some of them if they are relevant to their farming needs. In a semi-structured interview, Key informant B said the following:

In Nthiko, as Ministry of Agriculture, under ASWAp-SP II, we are promoting and implementing eight interventions, dubbed CSAs. These practices are agroforestry, box ridging, conservation agriculture (some call it conservation farming), contour farming, irrigation, minimum or zero tillage or mulching (the popular *ntaya khasu*), rainwater harvesting, and organic (or some say compost) manure.

In a separate interview, Smallholder farmer 4 said the following:

The government has brought us two types of farming practices. Some well known and not even new. Of course, others are unique. We have been doing them. All of them, they say, help to fight against the effects of climate change on agriculture. (*Boma latibweretsera ulimi wa mitundu iwiri. Wina wodziwika kale osati watsopano. Komabe winawo ndiwatsopanodi. Ulimi onsewu akuti umathana ndi zovuta za kusintha kwa nyengo paulimi*).

During a field observation, the following CSA practices were observed in Nthiko as shown in figure 7:

- zero tillage
- agroforestry
- box ridging and contour farming
- irrigation and conservation agriculture



Figure 7: Some CSA practices observed in Nthiko

It is interesting to note that all smallholder farmers were aware of the CSA practices being promoted and implemented in Nthiko. The fact that some CSA practices are well-known to smallholder farmers validates what FAO (2013) posits that CSA practices are not a new set of practices but an integrated approach to the implementation of agricultural development programming policies. Similarly, the issue of CSA practices not being new substantiates what Makoka et al. (2015) contend that many practices that comprise CSA already exist worldwide. This entails that some of the CSA practices in Nthiko area are similar to what some smallholder farmers are already practising. This, therefore, implies that some smallholder farmers do not necessarily require to adopt ASWAp-SP II CSA practices promoted in Nthiko since they are already practising similar others. It can be argued, therefore, that non-adoption of some CSA practices in Nthiko is because smallholder farmers see no difference with what they are already practising. At the same time, having prior knowledge of the practices could promote adoption. This is because lack of knowledge of the CSA could make smallholder farmers take their time to learn them before deciding to adopt the same. This confirms what the Diffusion of Innovations theory (Vishwanath & Barnett, 2011) states under the innovation decision process.

Again, the issue of eight farming practices in Nthiko being referred to as CSA tallies well with what Khatri-Chhetri et al. (2016) states that CSA practices include zero tillage, green manuring, agroforestry, irrigation, water harvesting, contour farming, and conservation agriculture. This entails that what ASWAp-SP II is implementing in Nthiko are indeed CSA practices of international standards and recognition. In fact, some of the CSA practices were observed in the area (figure 7) thereby confirming that the Ministry of Agriculture under ASWAp-SP II is indeed implementing and promoting the CSA practices in Nthiko.

4.3.3 Other climate smart agricultural practices adopted by smallholder farmers

In this section, smallholder farmers (n=70) indicated other CSA practices (non-ASWAp-SP II), which they adopted to overcome effects of climate change. Figure 8 has the results.

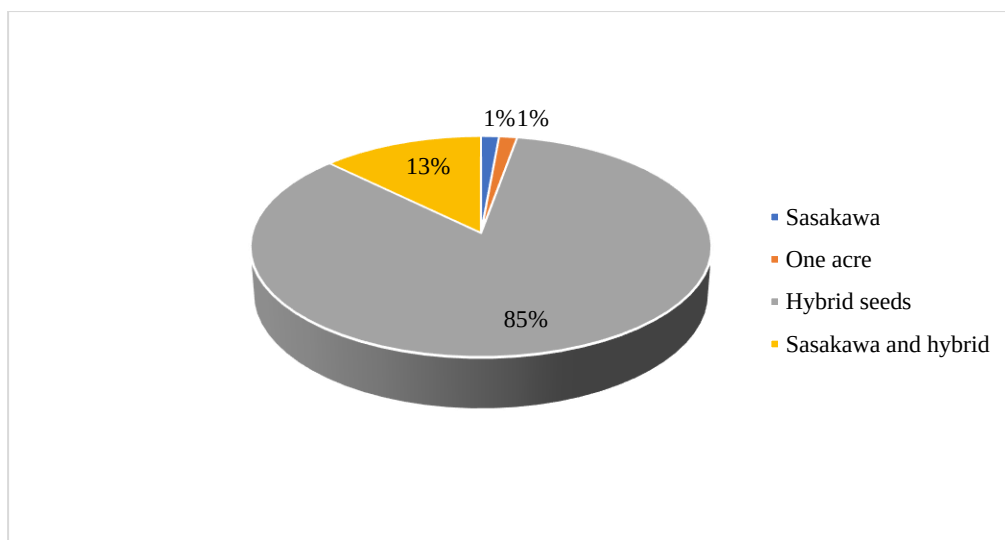


Figure 8: Non-ASWAp-SP II CSA practices adopted by smallholder farmers

Results indicate that majority (85%) of smallholder farmer have adopted the use of hybrid crop varieties while very few (2%) smallholder farmers have adopted sasakawa and one-acre farming system. This entails that failure to adopt ASWAp-SP II CSA practices by some smallholder farmers in Nthiko does not necessarily mean that the farmers are doing nothing to avert effects of climate change on their farming.

Although the number of smallholder farmers who have adopted ASWAp-SP II promoted CSA practices is lower than expected (figure 5), this study found that some smallholder farmers have adopted equally useful CSA practices promoted by other organisation. For example, sasakawa, and use of hybrid seeds. It is also interesting to note that some smallholder farmers adopted CSA practices from both ASWAp-SP II and other organisations. The common CSA practice adopted by most smallholder farmers is use of hybrid seeds. In some cases, what some smallholder farmers were already practising in their farms could not be differentiated with what ASWAp-SP II was advocating. For example, in mulching, they plant maize using sasakawa, apply fertiliser, and use hybrid seeds. The only difference is that in mulching, there is zero (minimum) tillage of the soil while in the others there is tillage done during ridging. One critical difference between sasakawa and mulching is that the former can be done on a large scale while the latter is done on a smaller scale only. This reduced the chances of some smallholder farmers who were already practising sasakawa to adopt mulching. This finding resonates well with what the Diffusion of Innovations theory (Vishwanath & Barnett, 2011) states that potential adopters will first compare what they are already

practising with what is being promoted prior to adoption. This entails that the sasakawa adopters found that mulching was not better than sasakawa and opted not to adopt mulching but continued with sasakawa. One implication from this finding is that some CSA practices being promoted by the Ministry of Agriculture in Nthiko under ASWAp-SP II are not better than what farmers are already practising on their farms. This study, therefore, argues that other CSA practices are better than the ASWAp-SP II promoted CSA practices. As such, some smallholder farmers found it inappropriate to adopt the ASWAp-SP II promoted CSA practices.

This finding is also in tandem with what Kaplinsky (2011) contends for a technology to be appropriate, it must respond to the actual needs of the people. This study accents that CSA practices implementing agencies should first consult the local people to see what practices are already being practised and working before introducing their own. This will ensure that similar CSA practices are mainstreamed so that during sensitisation they get recognised as effective in the fight against the effects of climate change on agriculture. This agrees with what Fabiano and Maganja (2002) contend that the community members should initiate and plan the project since they know what they need and how best their lives can be improved. Otherwise, no matter how well-intentioned a project might be, if the people who are affected have not been consulted, the chances of failure are high. It can also be argued, therefore, that failure to adopt ASWAp-SP II promoted CSA practices does not necessarily mean unwillingness of smallholder farmers to overcome the effects of climate change on their farming but the inappropriateness of some CSA practices. This study, therefore, has assisted in identifying the suitable CSA practices for Nthiko.

4.3.4 Smallholder farmers' perception of climate change

This section assessed smallholder farmers' perception of climate change. Specifically, the section has analysed farmers' perception of occurrence of climate change and associated evidence. The section has two parts. The first part assesses the general perception of climate change. The second part assesses evidence of the climate change related experiences.

4.3.4.1 General perception of climate change

Farmers' perception of climate change is central in understanding their actions or responses to climate issues. In this regard, the study established that all the farmers in the study area perceive that climate change is happening.

4.3.4.2 Evidence of climate change related events

Figure 9 below shows smallholder farmers' evidence of climate change related events experienced in Nthiko.

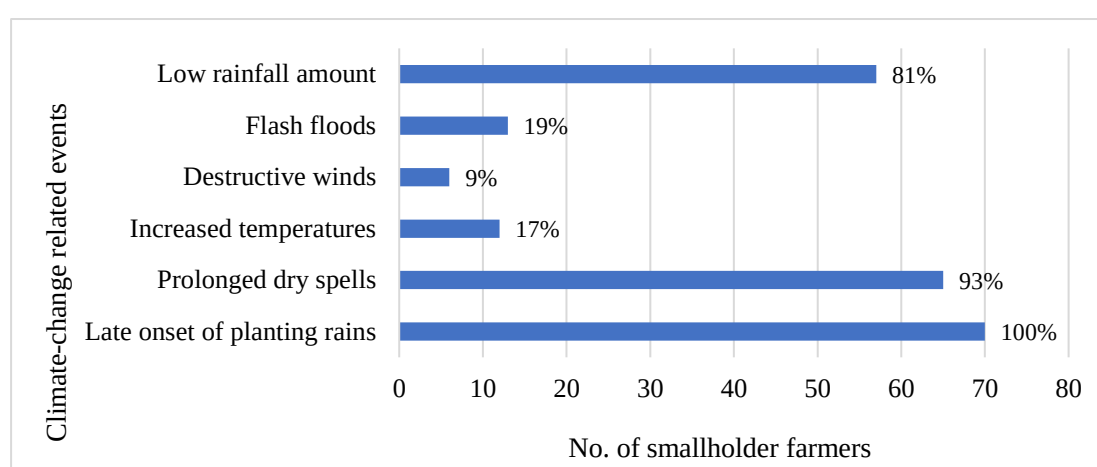


Figure 9: Climate change-related events experienced in Nthiko

Many respondents reported increased experiences of delayed onset of planting rains (100%) followed by experiences of prolonged dry spells and drought (93%) and low rainfall amount (81%) in the past 20 years and this was corroborated by the following semi-structured interviews:

Climate has indeed changed. The onset of planting rains is not predictable as before. Sometimes, the rains come in October, November, or December. However, this year, [2021-22 growing season], eeee, the rains have come in January, mmmh. (*Nyengo yasinthadi. Mabweredwe a mvula sali modziwika ngati kale. Pena mu Okotobala, pena Novembala, pena Disembala. Nanji chaka chino, eeee, mpaka Januwale, mmmh*) (Smallholder farmer 1).

In agreement to that, Smallholder farmer 3 said the following in a semi-structured interview:

The planting rains come late and are also insufficient. Drought has become the order of the day. This year we have planted three times. (Mvula ikuchedwa komanso kuchepa. Ng'amba ndiye nayo yakhazikika. Moti ife tadzala mpaka katatu chaka chino).

Similar issues emerged from semi-structured interviews with key informants. On his part, Key informant A said the following:

Nthiko Village has experienced several climate change-related events such as increasing temperatures, and a shift in rainfall patterns leading to delayed onset of planting rains, and longer dry spells.

The fact that all (100%) smallholder farmers have ever experienced some climate change related events in various ways validates findings of Nyang'a et al. (2021), Teshome et al. (2021), and Zeleke et al. (2022) that a higher percentage of smallholder farmers are aware of the changes occurring in their area with regard to temperature and rainfall as in the increase in temperature, a decrease in precipitation, changes in the onset of rains and an increase in the frequency droughts and floods. Likewise, this finding confirms the position of Tompkins and Adger (2004) that climate change is manifested in various ways in various places. This entails that every smallholder farmer is likely to face some climatic changes either in average conditions of climate, seasonal variability, increased frequency of climatic events or rapid changes resulting in some shifts in weather patterns. Likewise, this finding resonates well with what Abegunde et al. (2020) found that smallholder farmers are victims of the effects of climate change. Again, the fact that Nthiko is a rural area in a developing country confirms what Barbier and Hochard (2018) found in their study that rural people in developing countries are the most vulnerable population to the effects of climate change. In the same vein, the result agrees with what Ngongondo et al. (2014) found in Malawi that effects of climate change were behind the dwindling economy of the country as smallholder farmers heavily depend on rain for agriculture. This study, therefore, stresses the need for every smallholder farmer to find suitable coping mechanisms to offset the specific climate related effects on their agriculture.

The fact that the area under study has been receiving low rainfall is in tandem with what GoM (2010) contends that Malawi's agriculture has been faced with unreliable rain. For instance, in 2021-22 farming season, smallholder farmers planted thrice because the amount of rainfall they were receiving was not enough. On the late onset of planting rains, the finding agrees with what Ngongondo et al. (2011), Coulibaly et al. (2015), Mwanakatwe and Katedew (2015) found that Malawi has been experiencing effects of climate change as manifested in the late onset of planting rains. During the time of this study, the area had received the planting rains in January, which has never been the case before. In normal cases, the area was supposed to receive the planting rains in November. This entails that the planting rains in the 2021-22 farming season delayed by two months.

The fact that the area experienced increased temperatures and heat waves resonates well with what IPCC (2014) discovered in their study that globally, climate change is taking place as evidenced by rising temperatures and changing rainfall patterns. The similarity in findings is because climate change is a global phenomenon affecting all countries as a global village in which Malawi is part. Again, this finding relates well with what was found in Malawi by Ngongondo et al. (2014), and Mwanakatwe and Katedew (2015) that Malawi as a country faces a rising temperature resulting in heat waves. This study, therefore, argues that some effects of climate change on agriculture in Nthiko may be a result of global phenomena. As such, this study argues that global climate change issues require global solutions. This entails that all countries should come together to help solve what is causing climate change, and consequently overcome its effects on smallholder farming.

Further, the issue of the study area experiencing prolonged dry spells confirms what was found by Ngongondo et al. (2014), and Joshua et al. (2016) that occurrence of dry spells is one of the impacts of climate change in Malawi. This correlates well with what the World Bank (2010) found that Zomba is one of the districts in Malawi hard hit by drought due to effects of climate change. This entails that smallholder farmers in Nthiko are among the ones worst hit by prolonged dry spells in Malawi. This, therefore, means that one of the CSA practices suitable for Nthiko is the one offsetting drought (dry spells). It can be argued, therefore, that mulching (zero or minimum tillage) was introduced to Nthiko as a CSA practice that would help overcome the effects of dry

spells. This is in line with what Kuzucu (2021) found that mulching materials help to conserve soil moisture by retaining the moisture, reducing evaporation from the surface, and reducing the requirements of water by plants in dry conditions.

Since mulching is an example of conservation agriculture, it can be argued, therefore, that adoption of conservation agriculture in general, and mulching in specific is vital in overcoming drought. This verifies what Phiri (2023) found that smallholder farmers who adopted conservation farming in Karonga overcame dry spells. This study, therefore, emphasises the need for smallholder farmers in Nthiko to adopt conservation farming to avert effects of dry spells. It is also important to recall that vulnerability and adaption to any effect of climate change is local. This means that what might work elsewhere might not always do likewise in Nthiko. As such, this study calls for concerted efforts by all stakeholders to arrest the known effects of climate change and overcome its subsequent impacts on smallholder farmers' agriculture and livelihoods.

4.3.5 Smallholder farmers' response to changes in climate

Since the area has been experiencing various climate change-related events in the past 20 years, smallholder farmers were asked if they have made any changes in the way they practice their farming. Figure 10 below has the results.

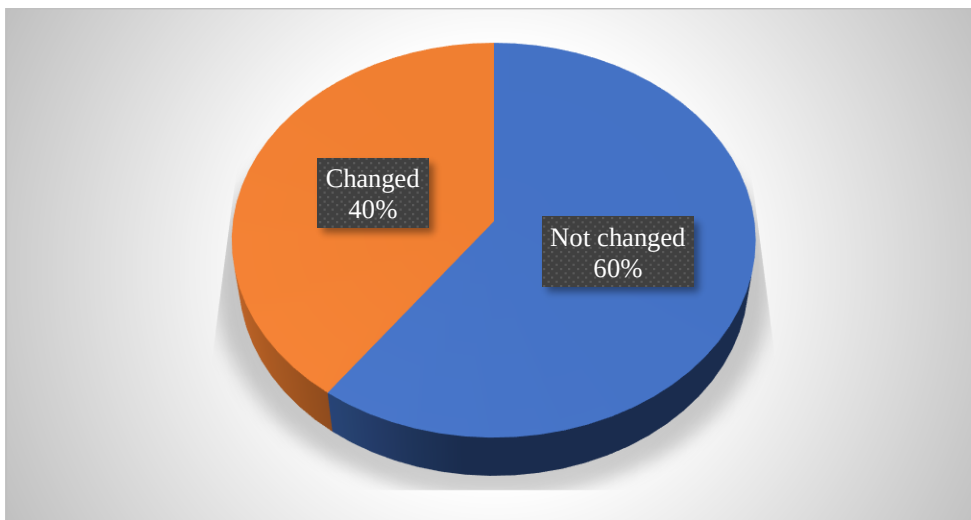


Figure 10: Smallholder farmers' response to changes in climate

In response to climate change, over half (60%) of smallholder farmers indicated that they have not made any changes in their farming practices whereas two-fifth (40%) reported to have made some changes to their farming activities.

The fact that about 60% of smallholder farmers have not changed their farming practices corresponds to what the theoretical framework guiding this study (Vishwanath & Barnett, 2011) contends that in order to change, time is an integral part as some individuals require more time than others. This entails that smallholder farmers who have not yet made changes in the way they do their farming require more time to make such a decision. Again, it is possible that some smallholder farmers are not interested or ready to make such changes for their own reasons. This study, therefore, argues that failure for some farmers to change their farming practices could denote two things: either they are still making decisions or they are not willing or interested in making the expected changes.

On the other hand, the fact that some 40% of the smallholder farmers have changed their farming practices in response to the climate change related events experienced in Nthiko is commendable and in tandem with what Arslan et al. (2015), and Lipper et al. (2014) advocate that in order to successfully support sustainable agricultural production in the wake of climate change, farmers should transform and re-orient their agricultural systems and practices. This study, therefore, argues that failure of smallholder farmers to change their practices in the wake of climate change is tantamount to promotion of food insecurity among smallholder farming households.

On the other hand, when asked about their knowledge of CSA practices, almost all smallholder farmers indicated that they know them. Table 6 assesses smallholder farmers' knowledge of CSA practices.

Table 6: Smallholder farmers' knowledge of CSA practices

CSA practice	# of smallholder farmers	%
Agroforestry	56	80
Box ridging	69	99
Changing cropping date	59	84
Climate information services	66	94
Conservation agriculture	48	67
Contour farming	64	91
Crop rotation	70	100
Destocking	35	50
Diversification of crop varieties	51	73
Diversification of livestock breeds	35	50
Drought tolerant crop varieties	67	95
Efficient use of nitrogen fertiliser s	10	14
Improved crop varieties	68	97
Integrated soil fertility management	49	70
Intercropping with legumes	48	69
Irrigation	69	99
Making ridges across the slope	64	91
Minimum / zero tillage	69	99
Organic manure (fertiliser)	68	97
Pit planting	10	14
Rain water harvesting	28	40
Use of compost manure	51	73
Use of cover crops	10	14
Use of herbicides	31	44
Use of live barriers	15	21
Use of terraces	12	17
Water management measures	22	31

Many respondents identified crop rotation (100%), box ridging, irrigation, zero tillage (about 99%), organic manure and improved crop varieties (97%) while very few identified pit planting, efficient use of nitrogen fertilisers and cover crops (14%).

The fact that all smallholder farmers know about CSA practices entails that all of them have arrived at the knowledge stage of the Diffusion of Innovations theory (Vishwanath & Barnett, 2011) where they are expected to familiarise themselves with the innovation. The possibility is that all the smallholder farmers, individually, are aware of the existence of CSA practices. This, therefore, implies that all smallholder farmers are or have been asking themselves critical questions regarding the CSA practices in terms of

what they are and how they work. However, this study contends that knowledge of the CSA practices alone is not adequate but doing something with the knowledge is paramount if smallholder farmers will successfully transform their farming systems in the face of climate change. It can be argued, therefore, that a comprehensive understanding of CSA practices in question is critical in promoting smallholder farmers' adoption of the same.

4.4 Determinants of CSA practices' adoption by smallholder farmers in Nthiko

This section has presented and discussed seven aspects namely determinants of the adoption of climate smart agricultural practices, barriers to the adoption of climate smart agricultural practices, factors influencing smallholder farmers' adoption of CSA practices, household decision making regarding climate smart agricultural practices, challenges faced with the adopted climate smart agricultural practices, reasons for not adopting climate smart agricultural practices, and requirements for smallholder farmers to change their farming practices.

4.4.1 Determinants of the adoption of climate smart agricultural practices

In this section, smallholder farmers were asked to rate how each of the factors below could determine (for non-adopters) or determined (for adopters) their adoption or non-adoption of various CSA practice(s) in Nthiko. Figure 11 has the results.

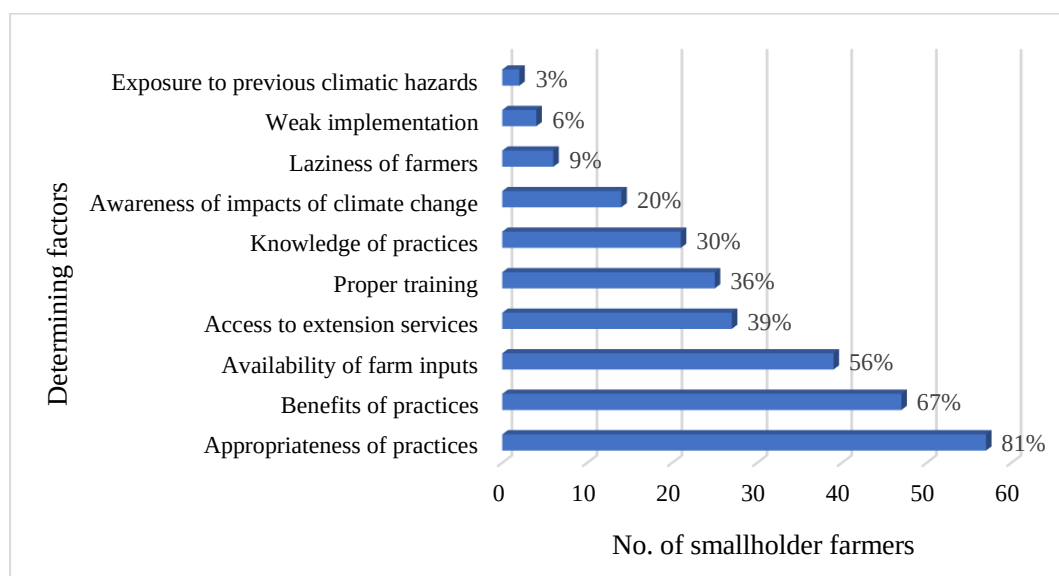


Figure 11: Determinants of CSA practices' adoption in Nthiko

Many smallholder farmers reported that appropriateness (81%) and benefits (67%) of the CSA practices could influence their adoption of the same while few smallholder farmers said exposure to previous climatic hazards (3%) could determine their adoption of CSA practice(s). This entails that no matter how effective the CSA practices could be, if they are not suitable for arresting effects of climate change on farming, farmers will not adopt them. Again, farmers who have experienced effects of climate change on their farming are likely to adopt relevant CSA practices to offset the effects. Evidence in the following semi-structured interviews confirms this:

I can adopt any CSA practice as long as I see its benefits and if it is easy to use. (Ndikhoza kuchita nawo ulimi uliwonse wothana nkusinthwa kwa nyengo bola ntaona phindu lake koma ukhale osavuta). (Smallholder farmer 3).

Adding on the same, another respondent said the following:

A person participates when they see benefits of something. Without seeing, eee, you fear being carried away and lose your money. (Munthu kuona phindu la chinthu umayesetsa kuchita nawo. Koma osaona eee umaopa kutengeka nkuononga ndalama) (Smallholder farmer 5).

In a separate interview, another respondent said the following:

To me, availability of farm inputs or finances plus access to CSA information services, are enough to enable me adopt. How can one adopt if they don't know the practice to be adopted? (Kwa ine, kupezeka kwa zipangizo za ulimi, ndalama, ndi kudziwa za ulimiwo nzokwanira kundipangitsa kupanga nawo ulimiwu. Nanga munthu osazidziwa angachite nawo bwanji?) (Smallholder farmer 4).

To sum everything up, Key informant C said the following:

The understanding of climate change phenomenon and the availability of good agricultural extension services are likely to make farmers adopt. In some cases, unreliable rains, low soil fertility, and soil erosion are key determinants. Again, low yields, dry spells, and wash aways may help farmers adopt CSAs.

The fact that majority (81%) of smallholder farmers said, to a larger extent, appropriateness of CSA practices could determine their adoption resonates well with what is advanced by the Diffusion of Innovations theory (Vishwanath & Barnett, 2011) under compatibility that an innovation's rate of adoption will increase when it is clear, proven, and evident that the innovation will address the needs of the potential adopters. Again, this finding is compatible with what Schumacher (1999) argues that agricultural technology ought to respond to the real needs of the people. This entails that most smallholder farmers would prefer to adopt a CSA practice, which will solve actual problems emanating from the impacts of climate change on their agriculture. This study, therefore, argues that appropriateness is the chief determiner of CSA practices adoption by smallholder farmers in Nthiko. One implication from this finding is that most smallholder farmers are ready to adopt a CSA practice, which will help overcome effects of climate change on their farming without being capital and labour intensive. In other words, appropriateness entails being affordable (cheap), simple (easy to use), and localised (meeting the needs of the smallholder farmers) as propounded by Schumacher (1999) in what has been dubbed technology of the people, by the people, for the people.

The fact that benefits of CSA practices in question could determine their adoption corresponds to what Mwandira (2016) found that farmers tend to accept and adopt practices, technologies, and innovations when they see the benefits themselves. In the same way, this finding concurs with what the Diffusion of Innovations theory (Vishwanath & Barnett, 2011) contests that before taking up an innovation, prospective adopters will first ensure its results are visible and tangible. This entails that if prospective adopters observe the fruits of an innovation on their own, chances of adopting them will be very high. It can be argued, therefore, that absence of associated benefits will lower the likelihood of smallholder farmers adopting the CSA practices in question. One implication from this finding is that in order to promote the rate of adoption, benefits of a CSA practice should be timely and outdo that of other existing farming practices.

The issue of adequate knowledge of CSA practices themselves determining their adoption by smallholder farmers confirms what FAO (2013) found that CSA practices are knowledge intensive hence need for smallholder farmers to fully comprehend them

prior to adoption. This also echoes what the Diffusion of Innovations theory (Vishwanath & Barnett, 2011) advances that the process of making a decision to adopt an innovation begins with an individual learning about the what, how, and why of an innovation. This entails that if smallholder farmers have adequate knowledge of the CSA practice in terms of what it is, how it works, and why it works, its adoption will be based on an informed decision. This study, therefore, argues that unless these knowledge gaps are filled in potential adopters, the rate of adoption of CSA practices will remain low.

It is interesting to note that very few smallholder farmers could be prompted to adopt CSA practices due to exposure to previous climate hazards. This finding conflicts with what Katengeza (2018) found that most smallholder farmers' adoption of CSA practices was determined by their exposure to previous harsh weather conditions, which influenced the use of CSA practices as adaptive mechanisms. Much as Katengeza (2018) found this as one of the critical elements in determining adoption of CSA practices, this study argues that such a response would only prompt farmers to impulsively embrace a CSA practice out of fear instead of first understanding the practice and make a rational decision about its adoption. This study, therefore, stresses the need for smallholder farmers to first understand their climate change related challenges and how best they can be solved before adopting any CSA practice. It can be argued, therefore, that much as immediate shocks may prompt some smallholder farmers to adopt CSA practices, such adoption will not be sustainable. This is because impulse adoption may be based on desperation and irrational choices and not informed decisions.

Another issue emanating from the findings is that some smallholder farmers do not need to first be aware of the impacts of climate change on their farming before adopting. This disagrees with what Chandra (2017) found in South East Asia that lack of awareness of the impacts of climate change on agriculture prevented smallholder farmers from adopting the CSA practices. This entails that smallholder farmers in Nthiko are aware of the impacts of climate change on their farming. As such, non-adoption of CSA practices cannot be attributed to the purported lack of awareness of the impacts of climate change on agriculture. It can be argued, therefore, that most smallholder farmers are now aware of the impacts of climate change on their farming

even though not all of them have adopted the CSA practices being promoted to offset the same in their areas.

The fact that farm inputs or finances could determine adoption of the CSA practices resonates well with what Ouedraogo et al. (2019) found that farmers with access to farm inputs, finances or credit facilities have a high likelihood of adopting CSA practices. This entails that most CSA practices require inputs, which are not cheap or easy to find by most smallholder farmers. This is against what Schumacher (1999) propounds that an appropriate technology should not require huge capital investments but be cheap and affordable. It can be argued, therefore, that input intensiveness and cost ineffectiveness of most CSA practices prevent some smallholder farmers from adopting them. This is a worrisome development considering how expensive farm inputs have become over the years especially from 2022 with the effects of devaluation, recession, and the Russia-Ukraine war. This study, therefore, emphasises the importance of deliberate efforts by nations to subsidise farm inputs or provide credit facilities to smallholder farmers for them to use when implementing CSA practices.

The fact that training is a prerequisite to adoption of CSA practice cannot be overemphasised. In fact, this finding is consistent with what CCARDESA (2019) argues that CSA practices are not just a simple set of practices and technologies that can be easily replicated in every context but are complex systems that must be understood in connection with climate, weather, soil, the farmers' own socio-economic context, gender dynamics, markets, and regulatory environments. This entails that smallholder farmers who know the CSA practices are likely to adopt them than otherwise. This correlates well with what the Diffusion of Innovations theory (Vishwanath & Barnett, 2011) contends that a prospective adopter of an innovation requires to know more about the innovation in terms of what it is, and how and why it works. Such an understanding is necessary to help the smallholder farmers adopt the suitable practices to solve their climate change challenges. This study, therefore, accents comprehensive and regular trainings of smallholder farmers on CSA practices fitting their conditions prior to promotion of their adoption. It can be argued, therefore, that training smallholder farmers on CSA practices will ultimately promote their knowledge and foster adoption.

The issue of weak implementation being a determining factor for CSA adoption by smallholder farmers was also reported by MCSAA (2016) as one of the factors determining adoption of CSA practices by smallholder farmers. This entails that in some cases, smallholder farmers failed to adopt the CSA practices not because they were not willing but the implementing agencies failed to properly roll out the intervention. Again, this could include failure of the implementing agencies to identify the relevant smallholder farmers to be part of the beneficiaries. No wonder in some cases, non-adopters thought that only those smallholder farmers whose farms are close to the road were eligible for the project. This study, therefore, calls for careful planning, coordination, targeting, monitoring, and evaluation of the CSA practices programme such as ASWAp-SP II. In so doing, it will be easy to check what is working or not and find ways of improving on the weaknesses to foster adoption of relevant CSA practices by smallholder farmers. Consequently, the effects of climate change on agriculture will be arrested.

On the other note, the fact that access to extension services and information, to some extent, could prompt smallholder farmers' adoption of CSA practices correlates with what Pagliacci et al. (2020) and Partey et al. (2019) found in their separate studies that access to extension services or institutions, weather forecasting information, and knowledge or capacity of extension workers is crucial in determining adoption of CSA practices by smallholder farmers. This entails that some smallholder farmers failed to adopt CSA practices because they have never been in contact with information regarding their existence and purpose. This is in tandem with what the Diffusion of Innovations theory (Vishwanath & Barnett, 2011) advocates that prospective adopters ought to first have knowledge about the existence of an innovation before they decide to adopt the same. This study, therefore, stresses that information about CSA practices should be made available to all smallholder farmers for them to make informed decisions regarding adoption. It can be argued, therefore, that lack of access to information on CSA practices is one of the factors affecting adoption of the same by smallholder farmers in Nthiko.

4.4.2 Barriers to the adoption of climate smart agricultural practices

This section presents the barriers to CSA practices' adoption by smallholder farmers (n=70). The farmers were asked to rate what would deter them from adopting various CSA practices being promoted in their area. Figure 12 has the results.

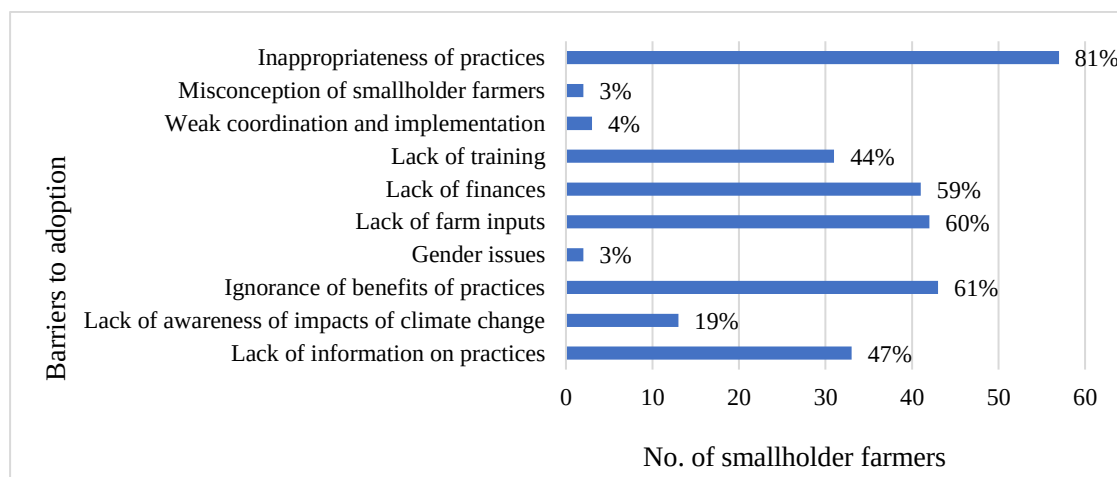


Figure 12: Barriers to CSA practices' adoption in Nthiko

On the overall, majority of smallholder farmers said, to a larger extent, inappropriateness of the CSA practices (81%) and ignorance of benefits (61%) of the CSA practices could prevent them from adopting. On the contrary, few smallholder farmers reported that implementation strategies (representing 4%) could prevent their adoption of CSA practices. This entails that the main factor retarding adoption of CSA practices is inappropriateness of the practices themselves. If suitable CSA practices could be invented, likelihood of smallholder farmers' adoption would be very high. This has been validated in the following semi-structured interviews:

What I have noted is that some practices being promoted require too much effort yet the benefits are not that significant. (Ndimaona kuti ulimi wina umene akutiuza kuti tipangewu ndi wopatsa busy kwambiri kusiyanana ndi mmene timalimira, chonsecho phindu lake silionekanso). (Smallholder farmer 6).

In addition, Smallholder farmer 4 said the following:

What discourages one is the number of inputs needed versus lack of finances. At first, we were provided now they have stopped. (Zimene zimatha kukubweza m'mbuyo ndi kuchulukitsa kwa zipangizo zofunikira ndi kusowa kwa ndalama. Poyambatu ankatipatsa koma pano anasiya).

Similarly, Smallholder farmer 2, in a separate interview said the following:

Perhaps, ignorance is playing a role. Some do not know the benefits of CSA practices. Others say it is bringing worms. That is a lie. (Komatu wina ndi umbuli wavuta. Ena sadziwa ubwino wa ulimiwu. Enanso akumati umabweretsa mbozi. Limenelo ndi bodza).

Confirming this, Smallholder farmer 8, in a separate interview added the following:

We are not given a chance. They pick farmers along the road only. When they will involve the entire village, we shall adopt. (Sitipatsidwa mwayi. Amasankha am'mbali mwa msewu okha. Akadzapanga mudzi onse, tidzachita nawo).

In addition to that, Key informant C, in a separate interview said the following regarding smallholder farmers' attitude towards adoption:

Local farmers are mostly late adopters because they wait to see a particular practice materialise first then adopt in large numbers. They are impatient. They can't wait for three to five years to see results of CSA. So, we are in the same situation.

The largest percentage of smallholder farmers (81%) indicated that inappropriateness of the CSA practices could deter them from adoption. This entails that some CSA practices did not fit the criteria of "appropriate" as advanced by Schumacher (Kaplinsky, 2011). For instance, the issue of affordability (being cheap and not demanding huge capital investments), simplicity (being easy to implement and not demanding special skills, and localisation (being responsive to the real needs of the people). This resonates well with what the Diffusion of Innovations theory (Vishwanath & Barnett, 2011) contests that if an innovation is compatible with an individual's needs, then uncertainty will decrease and the rate of adoption of the innovation will increase. This entails that if the CSA practice is not viable or suitable to meet the needs of the individual farmer, its adoption rate will be very low. For instance, during interviews, it was revealed that mulching is not suitable for a large farm but a small area. This prompted many smallholder farmers not to adopt it because it does not help them achieve what they desired. This study, therefore, emphasises that among the barriers to

CSA practices' adoption, inappropriateness tops the list. This calls for concerted efforts by implementing agencies to improve the practices so that they effectively overcome the real effects of climate change on smallholder farming in Nthiko.

The fact that smallholder farmers said lack of farm inputs could hinder their adoption of CSA practices resonates what Amadu et al. (2019) found that adoption of CSA practices by smallholder farmers was hindered by lack and scarcity of resources such as fertiliser and seeds. This entails that some smallholder farmers failed to adopt some CSA practices because they required improved seeds and fertiliser, whose prices were not affordable to them. It was also learnt during interviews that a certain smallholder farmer implemented a CSA practice in one season and disadopted it in the following season due to lack of money to buy seeds and fertiliser. This study, therefore, accents that CSA practices must be cheap to implement. Otherwise, most smallholder farmers in Nthiko are not well to do economically (table 5). As such, they cannot afford to buy the seeds and fertiliser. One implication from this finding is that the best way of addressing the effects of climate change on agriculture is to introduce easy to implement CSA practices. These will ensure that smallholder farmers manage them within their ability – physically, culturally, and economically. It can be argued that failure to make CSA practices affordable promotes continued rejection or discontinuance of the same.

Again, some smallholder farmers indicated that ignorance of the benefits of CSA practices could bar some from adopting them. This study argues that unless smallholder farmers see the benefits of CSA practices, adoption of the same will remain very low. This position agrees with what the Diffusion of Innovations theory (Vishwanath & Barnett, 2011) contends under observability that the degree to which the results of an innovation are visible and tangible is key in determining adoption of the same. One implication from this is that results of CSA practices alone are not enough to prompt adoption but their tangibility. If the results are not positive, smallholder farmers will not adopt the CSA practices. This study, therefore, calls for the establishment of demonstration and model farms where the benefits of CSA practices will be observable to all prospective adopters of CSA practices.

The issue of poor coordination and implementation hindering adoption of CSA practices by some smallholder farmers coincides with what FANRPAN (2014) and

FAO (2013, 2015) found in their separate studies that weak coordination, targeting, implementation, and monitoring of CSA practices were among the common barriers to smallholder farmers' adoption of CSA practices. However, it was also discovered that some smallholder farmers misunderstood the implementation strategy of ASWAp-SP II. This was mainly due to their literacy levels (table 5). For instance, during the first trial, the project provided farm inputs to willing smallholder farmers so that they use their piece of land for demonstration. Unfortunately, some smallholder farmers did not interpret it well. They thought that ASWAp-SP II was targeting only those along the road. Similarly, those who volunteered to demonstrate on their farms along the road misunderstood the initial issuance of farm inputs. They thought they would be receiving such inputs every growing season. As such, when the inputs stopped coming, some smallholder farmers also stopped implementing the CSA practice in question. This study argues that failure of implementing agencies to clearly inform and elaborate issues regarding implementation to smallholder farmers will result in creating a barrier to adoption of CSA practices. This study, therefore, accents that implementing agencies should not give smallholder farmers starter packs in form of farm inputs unless this will be sustainable. Instead, implementing agencies should just borrow the land and try the CSA practices on their own without giving out handouts to smallholder farmers. This will help prevent smallholder farmers from misrepresenting and misinterpreting the initiative. Otherwise, once the starter packs stop, disadoption or discontinuance will follow. This agrees with what Shani (2006) found in Mzuzu City that once incentives were withdrawn, people stopped implementing some essential activities promoted by a certain communal water tap project.

4.4.3 Factors influencing smallholder farmers' adoption of CSA practices

This section presents factors that prompted and influenced smallholder farmers to adopt CSA practices in the area. Figure 13 has the results (n=18).

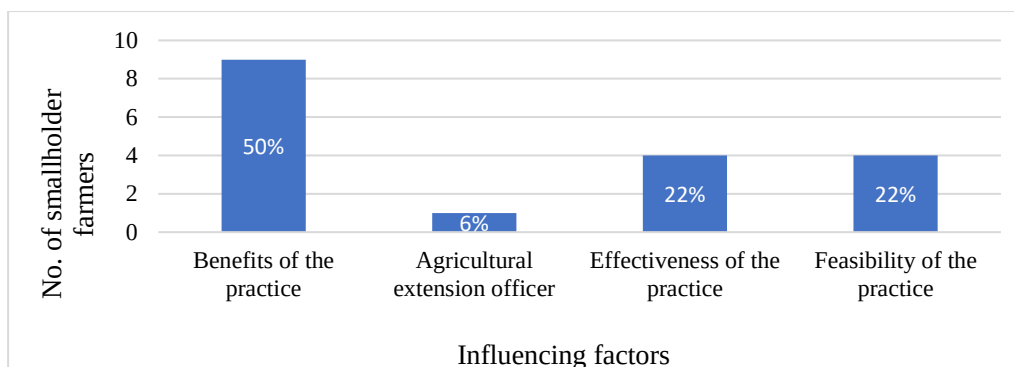


Figure 13: Factors influencing smallholder farmers' adoption of CSA practices

Results indicate that half (50%) of the smallholder farmers adopted the CSA practice(s) after seeing benefits of the practices while very few (6%) adopted the same after being convinced by the agricultural extension officer. This entails that rewards of the CSA practices made a positive impact on promoting the adoption of the same by smallholder farmers in Nthiko.

The fact that half (50%) of smallholder farmers who adopted the CSA practices got attracted by the benefits they observed in other adopters' fields confirms what the Diffusion of Innovations theory (Vishwanath & Barnett, 2011) contends that observability is critical in influencing adoption of an innovation. This study, therefore, accents that there should be deliberate efforts by the project implementors to locate demonstration fields in focal places of the impact areas. This will ensure that all members of the impact area see for themselves the benefits of the CSA practices being promoted. A good example is what happens with seed companies; they mount their demonstration fields close to the main road of the targeted area. This helps all passers-by, who are would-be adopters, to see for themselves and appreciate the benefits. It can be argued, therefore, that locating demonstration fields away from the potential adopters' eyes denies the would-be adopters an opportunity to adopt the CSA practices being promoted. This study stresses that the demonstration fields be located at the water points, market places, community parks or any place where the targeted smallholder farmers regularly gather or pass.

The issue of some farmer only adopting the CSA practices after being convinced by an agricultural extension officer is worrisome considering that the Government of Malawi through the Ministry of Agriculture entrusted the officer to encourage smallholder farmers adopt the same. This study emphasises that the best way of convincing

smallholder farmers to adopt CSA practices should be to let them see for themselves the fruits of the practices through a demonstration field. It can be argued, therefore, that the “seeing is believing” syndrome is pivotal in persuading smallholder farmers to adopt the CSA practices.

Further, the fact that some smallholder farmers adopted after seeing the effectiveness of the CSA practice in the adopters’ fields is evident enough that smallholder farmers will not adopt any CSA practice, which does not yield the expected results. This concurs with what the Diffusion of Innovations theory (Vishwanath & Barnett, 2011) emphasises, under relative advantage and compatibility, that a person will first check if the innovation being promoted is better than the previous one or the one it is intending to replace, and if it is addressing their real needs. In the same way, this relates well with what Kaplinsky (2011) contends under localisation that a technology, in this case CSA practice, becomes appropriate if it responds to the actual needs of the people. This entails that if the smallholder farmer finds the promoted CSA practice comparatively less effective than the one being practised, adoption will not take place.

In the same way, the fact that some smallholder farmers adopted the CSA practices based on their implementability resonates well with what the Diffusion of Innovations theory (Vishwanath & Barnett, 2011) advances that the degree to which an innovation seems fairly easy to understand and use plays a critical role in promoting its own adoption. This also agrees with what the concept of appropriate technology (Kaplinsky, 2011; Schumacher, 1999) postulates that a technology ought to be easy to implement and not demanding special skills. This entails that if a CSA practice is deemed complex to use and implement, chances of smallholder farmers adopting it will be very low. It can be argued, therefore, that if smallholder farmers will adopt CSA practices, their practicability and simplicity must be guaranteed. Failing which, winning the approval of smallholder farmers to adopt such a CSA practice would be a nightmare.

4.4.4 Household decision making regarding climate smart agricultural practices

In this section, smallholder farmers were asked to mention the one responsible for making decisions for the household regarding the use CSA practices. Figure 14 has the detailed results.

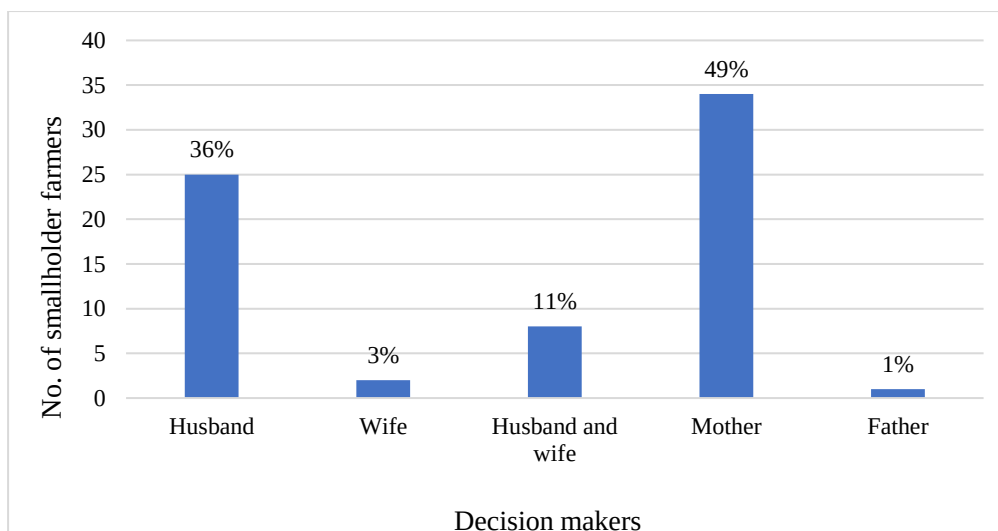


Figure 14: Household decision makers on agricultural practices

Most decisions about use of CSA practices are made by mothers (49%) followed by husbands (36%) while fathers (1%) and wives (3%) make very few. It is important to note that where a mother or father is making decisions, a single parent is heading the household. In some cases, even where husbands make decisions, some husbands are not resident in the households. Likewise, in some cases where wives make decisions, the husbands are working elsewhere and not involved much in the actual household farming.

The fact that in 52% of smallholder farming households, decisions about use of CSA practices are made by female (wives and mothers) may suggest why more than half (74%) of the smallholder farmers have not yet adopted the ASWAp-SP II promoted CSA practices (figure 5). This finding concurs with what Lizárraga et al. (2007) found that gender affects decision making in that women delay in making up their minds as they are more concerned with uncertainty and doubts regarding the consequences of the decisions made. As a result, they take more time to adopt a CSA practice. Likewise, this finding is consistent with what Minasyan and Tovmasyan (2020) found in their study that women are impatient and like consulting before arriving at a decision. As such, they tend to make decisions in groups while men make the same independently. This entails that for females to decide to adopt a CSA practice, they need to consult other people to assure them that what they are about to do is just right. In cases where the one to be consulted is not found or far away, adoption will obviously be delayed. One implication from this finding is that some female smallholder farmers failed to

adopt CSA practices because of lacking peer influence. During the study, it was learnt that there were no groups for smallholder farmers who are yet to adopt. The only group was for those who joined during the initial establishment. This means that several non-adopters lack support from adopters as they are not incorporated in farming groups. This study, therefore, accents formation of farmers' groups or clubs for the purpose of helping the yet-to-adopt female smallholder farmers in decision making regarding adoption of CSA practices. These will enforce interpersonal networks of close friends and peers that will positively persuade those in doubts to adopt.

Although the Diffusion of Innovations theory (Vishwanath & Barnett, 2011) does not consider the role of gender in decision making, this study argues that an individual's decision whether to adopt or not does not only depend on their awareness of the innovation but also sentiments and views from colleagues – in which women are major victims. This study, therefore, stresses that the innovation-decision process of the Diffusion of Innovations theory (Vishwanath & Barnett, 2011) ought to include gender as an aspect under the decision stage. Such a move will help female smallholder farmers who are already suffering. This aligns well with what Lipper et al. (2014) found that women are the most vulnerable and exposed to the negative effects of climate change and its impacts. Yet women comprise the majority of smallholder farmers who provide about 70% of the household food (Asfaw et al., 2014). This is in tandem with what ActionAid (2011) found that women make up the biggest proportion of smallholder farmers in most developing countries and 80% of rural smallholder farmers worldwide. This means that failure to address issues preventing females from adopting will suffocate efforts to combat effects of climate change on agriculture in sub-Saharan Africa including Malawi and Nthiko to be specific. This study, therefore, accents that female smallholder farmers should be encouraged to form farmers' clubs for the purpose of motivating and encouraging each other. It can be argued, therefore, that females do not only trust their own decisions but also value views and comments of their friends. This, therefore, implies that if Nthiko had many male smallholder farmers, the rate of CSA adoption would have been higher than is the status now. It can be argued, therefore, that the rate of adoption of CSA practices in Nthiko is higher in male-headed families than otherwise since men are confident and make decisions independently.

It is worth noting that in Nthiko, most households are headed by single female parents (table 5). In cases where other female smallholder farmers are married, very few have permanent resident husbands. The husbands come and go because their marriages are mostly polygamous. This is because the area is dominated by Moslems. In such cases, decisions regarding farming practices remain in the hands of the female heads. In other cases, the husband may belong to a working class and does not necessarily help in farming physically but financially. Still in some cases, the husband is outside the country. Although in some families the husbands still make decisions regardless of whether they are present or not, to a larger extent, such decisions are baseless as they are not supported by evidence on the ground. This study, therefore, argues that unless males (husbands) take active roles and interest, decision making regarding adoption of CSA practices will remain a challenge in Nthiko. This study stresses the need for deliberate efforts to encourage husbands take part in farming just like health workers are encouraging them to take interest in family planning. On the other hand, this study also emphasises that women should be empowered to make independent decisions regarding their farming practices. The women empowerment programmes should involve taking them through the Diffusion of Innovations theory especially the innovation-decision process. In so doing, most women will start making own decisions regarding farming practices thereby promoting adoption of CSA practices by the same.

4.4.5 Challenges faced with the adopted climate smart agricultural practices

In this section, smallholder farmers who adopted the ASWAp-SP II CSA practices (n=18) were asked to outline challenges they face with the practices in question. Figure 15 has the detailed results.

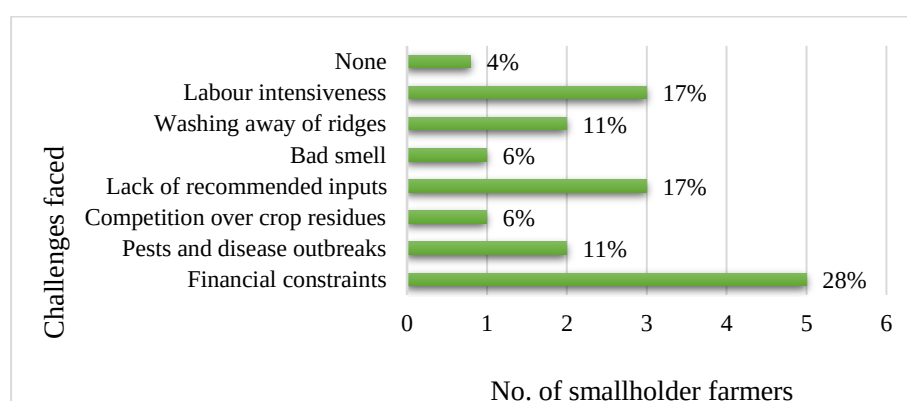


Figure 15: Challenges facing adopters of CSA practices in Nthiko

Results indicate that majority (96%) of smallholder farmers faced challenges with the adopted CSA practices while very few (4%) faced no challenges. A good number (28%) of smallholder farmers reported that financial constraints were a challenge they faced with the adopted CSA practice(s) while very few (6%) indicated bad smell and competition over crop residues. This implies that many smallholder farmers faced challenges with the adopted CSA practices due to their capital intensiveness as corroborated by the following semi-structured interview:

Lack of fertiliser and seeds. These are now very expensive. Worse still, zero tillage requires more fertiliser than other systems. (Kusowa feteleza ndi mbewu. Zimenezi zadula kwambiri pano. Komanso ntaya khasu amafuna feteleza wambiri kusiyana ndi ulimi winawu) (Smallholder farmer 1).

During observation, Smallholder farmer 1 showed how the same amount of fertiliser is applied to one maize plant in zero tillage as opposed to three maize plants in conventional farming (figure 16).



a. Zero tillage



b. Regular farming

Figure 16: One of the challenges faced by CSA practices adopters

In figure 16, Smallholder farmer 1 demonstrates how fertiliser is applied to a maize plant in zero tillage. In field a., each planting station has one maize plant spaced 30 centimetres away from the other station. In field b., each planting station has three maize plants spaced 90 centimetres away from the other station.

On the other hand, some smallholder farmers failed to access the required quantity of maize stalks for implementing some CSA practices such as zero tillage. This has been confirmed in the following semi-structured interview:

Maize stalks are scarce. People set the stalks ablaze after harvesting. We just do it around the homestead. It's too involving to do the entire field. Again, residues bring worms. (Mapesi amasowa. Anthu amawaotcha tikakolola. Mapesiwa timangochita pakhomu pokha. N'chintchito, sitingachite munda onse. Komanso mapesi amabweretsa mbozi) (Smallholder farmer 2).

In addition to the above, some smallholder farmers lack necessary farm inputs to implement the desired CSA practices as echoed in the following interview:

We lack farm inputs. The agricultural advisor promised us but we were not given. Only those in positions are given. (Timasowa zipangizo zaulimiwu. Alangizi anatonjeza koma sanati patse. Amangopereka kwa amaudindo okhaokha) (Smallholder farmer 4).

It was also reported that some smallholder farmers are sidelined when it comes to selecting beneficiaries of CSA practices as can be seen in the following interview:

They should allow everyone in this group. We just learnt from our colleagues but we are not part of their group. We should all benefit. Compost manure produces a bad smell for 21 days. As such, many do not do it. (Gulu limeneli aloleze aliynse. Iye tumangophunzira kwa anzathu koma sanatiyike mu gulu lawolo. Tonse tipindule. Komanso manyowa amanunkha zedi masiku 21. Ndiye ambiri sachita nawo) (Smallholder farmer 5).

On their part, key informants also admitted that each CSA practice has its own challenges and that smallholder farmers face different challenges after adopting the CSA practices.

Some practices are labour intensive hence neglected by some farmers. For example, soil and water conservation practices, minimum tillage, and manure making. Again,

conflicting uses of some resources like crop residues, which are needed for conservation agriculture and fodder for animals (Key informant A)

In addition to that, Key informant B said the following in a separate interview:

Adoption of CSAs is faced with problems like labour constraints, poor coordination, high cost of inputs, disjointed efforts by individual farmers and discouragement from non-adopters.

The fact that smallholder farmers face several challenges with the adopted CSA practices is consistent with what Kitsao (2016) found in Phalombe, Nkhosha, and Dowa that smallholder farmers faced different challenges with the adopted CSA practices such as lack of farm inputs and finances, pests and diseases, competition over crop residues. The similarity in finding could be attributed to the fact that all the districts are in Malawi, as such, chances of sharing similar characteristics are very high. This study emphasises that the challenges smallholder farmers face with the adopted CSA practices can easily deter the potential adopters and prompt the adopters to disadopt them in the soonest time possible. Although the Diffusion of Innovations theory (Vishwanath & Barnett, 2011) does not indicate this, it can be argued that, at some point in time, the early adopters may opt to disadopt the CSA practices. This study, therefore, posits that most CSA adopters in Nthiko are early adopters who may at some point in time opt to discontinue implementing the CSA practice(s) that may turn out to be unproductive.

Although the Diffusion of Innovations theory contends that people should be prepared to cope with unsuccessful innovations and a certain level of uncertainty about the innovation (Vishwanath & Barnett, 2011), this study argues that such an experience, which can be felt at any stage of adoption, is crucial in influencing adoption of CSA practices by smallholder farmers. Likewise, despite the Diffusion of Innovations theory (Vishwanath & Barnett, 2011) forgetting to suggest the actual time an early adopter will take before adopting an innovation, this study found that for smallholder farmers, early adopters will take one farming season (one year), early majority 3 years, the late majority 4 years, while the laggards, being sceptical, might not even adopt.

The fact that some CSA practices are fertiliser intensive corresponds with what Wiegel (2009) found that input costs on a farm implementing a CSA practice were 50% higher than the cost of a conventional farm of a similar size and crops would be. This is a worrisome situation considering the income levels of most smallholder farmers in Nthiko (table 5), Malawi, and other developing countries. In fact, during field observation (figure 7), it was observed that the amount of fertiliser applied to a single maize crop in zero tillage could be applied to three maize crops on a conventional farm. In principle, field a. would require three times the amount of fertiliser to meet the demand of three maize plants while in field b., three maize plants would utilise the amount of fertiliser equivalent to one maize plant in field a. This entails that fertiliser usage in conventional farming to zero tillage is in the ratio of 1:3. This implies that a zero tillage maize field uses three times the amount of fertiliser, which a conventional farm does. However, according to agricultural experts, there are some substantial differences in the size of cobs per maize stalk between zero tillage and conventional farm (figure 20). Nevertheless, considering the education levels of smallholder farmers in Nthiko (table 5), it would be difficult for them to understand this explanation from the agricultural expert.

The behaviour of some non-adopters discouraging smallholder farmers who adopted some CSA practices is counter-productive. This finding is similar to what Wiegel (2009) found that some smallholder farmers were teased by their friends for adopting and implementing a certain CSA practice in their farms. This entails that the teased smallholder farmers felt embarrassed and regretted adopting the CSA practices in question. This study, therefore, stresses that during orientation of CSA practices, smallholder farmers should be trained to withstand ridicules and other discouraging statements from non-adopters. Again, this study accents that there be networking opportunities between adopters and non-adopters where they will share knowledge and information regarding the CSA practices in their area. This resonates well with what the Diffusion of Innovations theory recommends under observability (Vishwanath & Barnett, 2011). It can be argued, therefore, that bringing together adopters and non-adopters could help promote positive friendships between the two groups and foster increased adoption.

The issue of bad smell emanating from an adopted CSA practice as faced by one smallholder farmer concurs with what Wiegel (2009) found that smallholder farmers who adopted and implemented organic fertiliser felt discomfort with the bad smell produced by organic fertiliser. This entails that the bad smell made the smallholder farmers feel uncomfortable than the practices they used before adopting organic fertiliser. This is consistent with what the Diffusion of Innovations theory (Vishwanath & Barnett, 2011) stipulates that an innovation ought to be better than the previous or existing ones. This study, therefore, emphasises the need for some improvements to be made on organic manure to prevent the bad smell, which may otherwise prevent many smallholder farmers from adopting it. On the other hand, it is critical for smallholder farmers to understand that farming is not a white-collar job. As such, the issue of bad smell from manure should be withstood as they are naturally so. Even when manufacturing inorganic fertilisers, some bad smell is produced. One insight from this finding is that some smallholder farmers (in Nthiko) are more concerned about their status in society instead of what is actually demanded of them as farmers. For instance, the smallholder farmers may feel ashamed to collect cow dung and other animal droppings for manure yet they themselves lack money to buy inorganic fertiliser.

The fact that one smallholder farmer faced no any challenge with the adopted CSA practice might entail that the practice in question was appropriate to the needs of her farming situation. This corroborates what Schumacher (1999) argues that technologies ought to meet the actual needs of the people. However, during a semi-structured interview, the smallholder farmer contradicted herself on this saying “our agricultural advisor should at times be providing us with seeds and fertiliser to motivate us. Currently prices have skyrocketed. (*Alangizi athu a zaulimiwa, akanamatipatsako mbeu ndi feteleza kuti tizilimbikira. Panopa mitengo yapengeratu*)”. This implies that the positive remarks made about the CSA practice was not entirely a true reflection of what was happening on the ground. One insight from this finding could be that sometimes smallholder farmers would want to appear to conform to the agreed farming practices even if they are facing challenges. This study accents that smallholder farmers, as consumers of CSA practices, should give constructive feedback to the implementors and inventors so that they improve the practices for effective implementation in the next phases.

4.4.6 Reasons for not adopting climate smart agricultural practices

In this section, smallholder farmers who did not adopt any ASWAp-SP II CSA practices (n=52) were asked to give reasons for their failure to adopt the practices in question. Table 7 has the detailed results.

Table 7: Reasons for not adopting ASWAp-SP II promoted CSA practices

Reasons	# of smallholder farmers	%
Material and financial constraints	6	11.5
No difference with conventional farming	12	23.1
Waiting to see benefits in adopters	1	1.9
Lack of training (knowledge and skills)	11	21.2
Laziness or lack of interest	12	23.1
Not given a chance	3	5.8
Labour intensiveness	6	11.5
Lack of land	1	1.9

Results indicate that over half (56%) of smallholder farmers have not adopted CSA practice(s) either because they do not see any difference with the conventional way of farming, they are lazy or lack of interest, skills, and knowledge about the CSA practices. On the other hand, very few (4%) smallholder farmers have not yet adopted the CSA practices because they first want to see the benefits of the practices in fields of adopters or they do not have land of their own. These have been validated in the following semi-structured interviews:

For me it's just apathy. Too much laziness (laughs). I saw the benefits of CSA practices in the field of our village head but I have done nothing about it honestly. My problem is just laziness. (*Ineyo ndiye ndi mphwayi chabe. Ulesi wangokula (kuseka). Ubwino wa ulimi umenewu ndinauona pa munda wa a mfumu paja koma sindinachitepodi kanthu nsaname. Vuto langa ndi ulesi basi*) (Smallholder farmer 6).

In addition to that, in a separate semi-structured interview, the following was added:

There is no difference with what I am already doing. I plant hybrid maize and apply fertiliser. I realise bumper yield. Are the CSA practices really appropriate? I doubt if they are helpful. Perhaps I should first see benefits from adopters. (*Palibe kusiyana ndi mmene ndimalimira ineyo. Ndimadzala hybrid nkuthira feteleza. Ndimakolora kwambiri. Ulimi umenewu ngoyeneradi? Ndakaika ngati ngothandiza. Mwina ndione kaye enawo phindu lake*) (Smallholder farmers 7).

Likewise, another participant said the following:

I see no any difference with what I am doing. Of course, I don't have enough information or interest for those other practices. I am just okay with what I am doing - sasakawa and hybrid plus fertiliser I am okay. Maybe I should see how others are benefiting from what is being promoted. (*Sindiona kusiyana ndi mmene ndimalimira. Chabwino, sindidziwa zambiri zake komanso ndilibe nazo chidwi. Mmene ndimalimiramu zili bwinobwino – sasakawa, hybrid ndi feteleza. Mwina ndione kaye mmene ena apindulire*) (Smallholder farmer 10).

On a different note, Smallholder farmer 8 said the following in a separate interview:

I do not practice zero tillage because I don't have a field (land) along the road. If given a chance, I can choose some best CSA practices. (*Ineyo sindipanga nawo ntaya khasu chifukwa ndilibe munda wa ku mseu. Atandipatsa mwayi ndikhoza kusankhapo malimidwe angapo amene ali abwinowo*).

During observation, it was noted that zero tillage was mainly practised by smallholder farmers along the main road of the village (figure 17).



Figure 17: One of the sites for CSA practices along the main road in Nthiko

Figure 17 shows a field planted with maize using zero tillage. The field is along the main road in Nthiko. Confirming that lack of land is among the challenges facing adoption of CSA practices, another participant said the following in an interview:

I am just new to this area. Where I am coming from, I was doing some of them. I may try one next season. Most farmers just lack interest. I'm an agricultural advisor for a certain organisation promoting similar practices. Farmers lack interest. Again, our counterparts choose to work with only those along the road which is not good. (*Ndine mlendo m'dera lino. Komwe nduchokera, ndachitapo ngati zimenezi. Chaka chikubwerachi ndiyesako chimodzi. Alimi ambiri amangosowa chidwi. Ineyo ndi mlangizi wa bungwe lina lolimbikitsa ulimi ngati omwewu. Alimi chidwi palibe. Komanso anzathuwo akusankha anthu am'mbali mwa mseu* which is not good) (Smallholder farmer 9).

The fact that some smallholder farmers have not yet adopted the CSA practices because they do not see any difference with what they are already practising in their farms coincides with what the Diffusion of Innovations theory (Vishwanath & Barnett, 2011) contends that potential adopters of an innovation will be interested to know if the innovation to be adopted is better than the previous practice or the one being used by the potential adopter. This entails that knowledge of the relative advantages of a CSA practice over what the smallholder farmer is using can help to differentiate between the two and foster adoption. In case the relative advantage of the CSA practice is not known, chances of the prospective adopter adopting it will be very slim. This, therefore,

calls for immediate provision of information regarding the benefits of the promoted CSA practices over the previous or existing practices. Again, this study emphasises that implementing agencies should harness practices that farmers are already doing and are effective so that they are main-streamed in their projects. After all, the CSA practices are not a new set rather already exist and farmers are practising them elsewhere.

The issue of some smallholder farmers not adopting because of laziness and apathy is similar to what Tiarniyu et al. (2018) found in Nigeria that laziness is a critical factor in influencing the decision of farmers to adopt a CSA practice or not. In the same way, this finding resonates well with what Kitsao (2016) found in Dowa that some smallholder farmers failed to adopt the promoted CSA practices due to their own laziness. The similarity in findings could probably be because both Malawi and Nigeria are African countries, whose smallholder farmers share similar physical characteristics. Perhaps, it should be noted that the issue of laziness emerges because such CSA practices demand smallholder farmers to be hard workers. As such, those farmers who fail to dedicate themselves, their time, resources, and enthusiasm into implementing the adopted CSA practices end up failing.

On the other hand, the issue of a smallholder farmer not adopting a CSA practice because she was not given an opportunity to do so relates well to what MCSAA (2016) found that weak coordination, implementation, targeting, and monitoring of CSA intervention programmes play a pivotal role in lobbying smallholder farmers to adopt. This entails that any initiative that is promoting adoption of CSA practices by smallholder farmers should carefully plan how it will coordinate, implement, target, monitor, and even evaluate its programme to meet the needs of the targeted population. However, this study finds the issue of “not given an opportunity” as a lame excuse by smallholder farmers who are not initiative, determined, and interested in the CSA practice per se. This is because the implementing agency did not necessarily provide land but knowledge and skills. As such, smallholder farmers were supposed to practice the same in their fields on their own. It can be argued, therefore, that some non-adoption of CSA practices is due to smallholder farmers’ lack of seriousness and interest in the practices.

On a similar note, the claim that implementors (ASWAp-SP II) select only smallholder farmers along the road to adopt and implement some CSA practices, in this case, mulching (zero tillage) is not entirely true. Although it happens sometimes that implementors would do so to appear to be doing a commendable job in a targeted area, this is not entirely the case with this study. During observation mulching was indeed mainly visible along the main road (figure 17), despite a few others situated away from the main road. This entails that some smallholder farmers who have not adopted mulching misunderstood the point regarding implementation strategy. This study, therefore, argues that although it might appear that smallholder farmers along the road are favoured (targeted), this study finds that such a strategy was intentional and deliberate to ensure that results of a CSA practice being implemented are visible to potential adopters. This is in tandem with what the Diffusion of Innovations theory (Vishwanath & Barnett, 2011) advocates under the concept of observability. It can be argued, therefore, that implementing a CSA practice along the road where other smallholder farmers can see is one way of promoting the practice for possible adoption by potential adopters once the benefits become visible.

On the other hand, the fact that some smallholder farmer did not adopt a CSA practice because it was similar to what he was already practising in his farm agrees with what FAO (2013) stresses that CSA practices are already in existence and not a new set of practices. On the other hand, the smallholder farmer did not adopt because he first compared the CSA practice with the practices implemented on his farm. This finding is in line with what the Diffusion of Innovations theory (Vishwanath & Barnett, 2011) contests that before adopting an innovation farmers will check the extent to which the practice is better than the one being practised. This comparison could be in terms of cost of production, rate of return or immediacy of rewards. This entails that the smallholder farmer in question discovered that the CSA practice being promoted was not better than the one he was already practising. One implication from this finding is that implementing agencies (in this case, ASWAp-SP II) should appraise and accommodate similar practices so that farmers already implementing them should be part of adopters and not non-adopters. This study, therefore, argues that some smallholder farmers in Nthiko who have not yet adopted the ASWAp-SP II promoted CSA practices have adopted CSA practices promoted by other organisations. This would be a welcome development considering that the aim is to fight against effects of

climate change on agriculture. As such, any workable practices ought to be recognised as CSA practices as well.

4.4.7 Requirements for smallholder farmers to change their farming practices

In this section, smallholder farmers who did not change anything in the way they practice agriculture in the wake of climate change (n=41) were asked to mention what they would require to enable them change. Figure 18 below has the results.

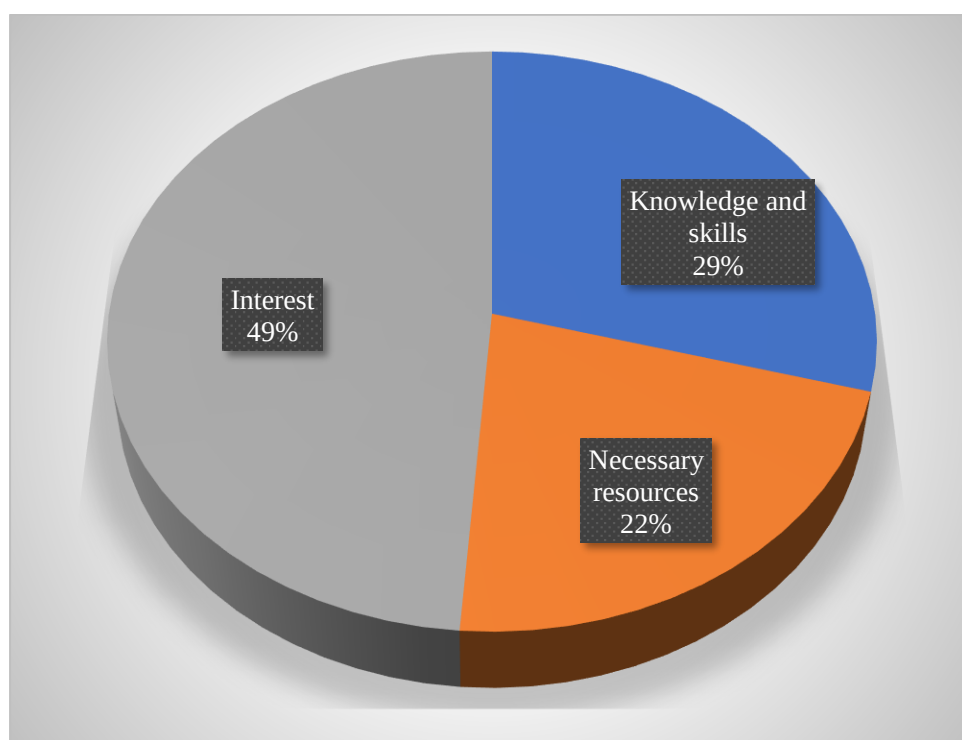


Figure 18: Requirements for smallholder farmers to change farming practices

In response, majority (49%) of the smallholder farmers indicated that they would require interest if they are to change their farming practices in response to climate change. Inversely, a few (22%) smallholder farmers reported that having access to necessary resources was critical for them to change their farming practices in response to climate change. This may entail that most smallholder farmers know the benefits of CSA practices but are discouraged by some of its demands and requirements.

The fact that some smallholder farmers would require knowledge and skills about the CSA practices before adopting is critical and corresponds to what CCARDESA (2019) and FAO (2013) postulate that CSAs are knowledge intensive and location specific

hence must be understood in connection with climate, weather, soil, farmers' own socio-economic context, gender dynamics, markets, and regulatory environments. This entails that before adopting any CSA practice, smallholder farmers should understand their needs to select the CSA practice that best fits their situation in order to effectively overcome the effects of climate change on their agriculture. This is also in line with what FAO (2013) contends that climate change is location specific. As such, every smallholder farmer should select the appropriate CSA practice to solve their climate related challenges. This position relates well to what Schumacher (1999) argues that a technology ought to respond to the actual needs of the adopter. Likewise, this is consistent with what the Diffusion of Innovations theory (Vishwanath & Barnett, 2011) contends under the knowledge stage that a person first strives to understand what the innovation is and how and why it works prior to adoption of the same. This study, therefore, accents that there should be adequate civic education and sensitisation campaigns to orient smallholder farmers on the CSA practices suitable for their areas.

It is also important to note that some smallholder farmers lacked necessary resources for implementing the CSA practice promoted by ASWAp-SP II. These resources are mainly farm inputs such as seeds and fertiliser. This finding tallies with what Murray et al. (2016) found that some smallholder farmers in Nkhamenya and Kabudula areas of Malawi failed to adopt some of the CSA practices due to lack of agricultural inputs, resources, and credit facilities. The similarity in the finding is due to the fact that all these areas are in Malawi. As such, chances of sharing some demographic characteristics are very high. This entails that such smallholder farmers failed to access farm inputs, which were essential in implementing their desired CSA practices. The issue of farm inputs has been of great concern among smallholder farmers since the cost of farm inputs have just skyrocketed in 2022 with the Russian war on Ukraine. This resonates well with what International Food Policy Research Institute [IFPRI] (2023); Borrell (2023); and Yusuf (2023) argued that apart from climate change, the global and African food insecurity has been worsened by the market disruptions emanating from the Russia's war on Ukraine. This shows how globalization affects countries. It can be argued, therefore, that although vulnerability and adaptation to climate change are local, some critical issues can best be solved globally. For instance, supply of fertiliser from warring nations requires global cooperation measures.

The issue of some potential smallholder farmers failing to adopt CSA practices due to lack of interest speaks volumes regarding the farmers themselves and the CSA practices. This might entail that either the CSA practices were not better than what they were doing or the farmers lacked what it takes for one to implement a CSA practice. This finding coincides with what Jellason et al. (2020) found that the participating farming households showed lack of interest in some of the promoted CSA practices and were not willing to try new ideas. It can be argued, therefore, that such smallholder farmers are far from embracing new ideas. This study argues that, according to the Diffusion of Innovations theory (Vishwanath & Barnett, 2011), such smallholder holders are not innovators. This is because, according to Rogers (2003), innovators are venturesome, interested, and willing to experience new ideas. This study, therefore, emphasises the need for deliberate sensitisation campaigns to motivate potential adopters to activate their interest in the CSA practices. For instance, organising competitions among smallholder farmers to reward best achievers. Again, where possible and sustainable, farm inputs should be made available to smallholder farmers either through a soft loan or a subsidy.

4.5 Impacts of adopted CSA practices on agricultural production among farmers

This segment has presented and discussed two aspects namely reasons for adopting the climate smart agricultural practices, and benefits of the adopted climate smart agricultural practices

4.5.1 Reasons for adopting the climate smart agricultural practices

In this section, the smallholder farmers, (n=18), were asked why they adopted the CSA practices promoted by ASWAp-SP II. Figure 19 has the results.

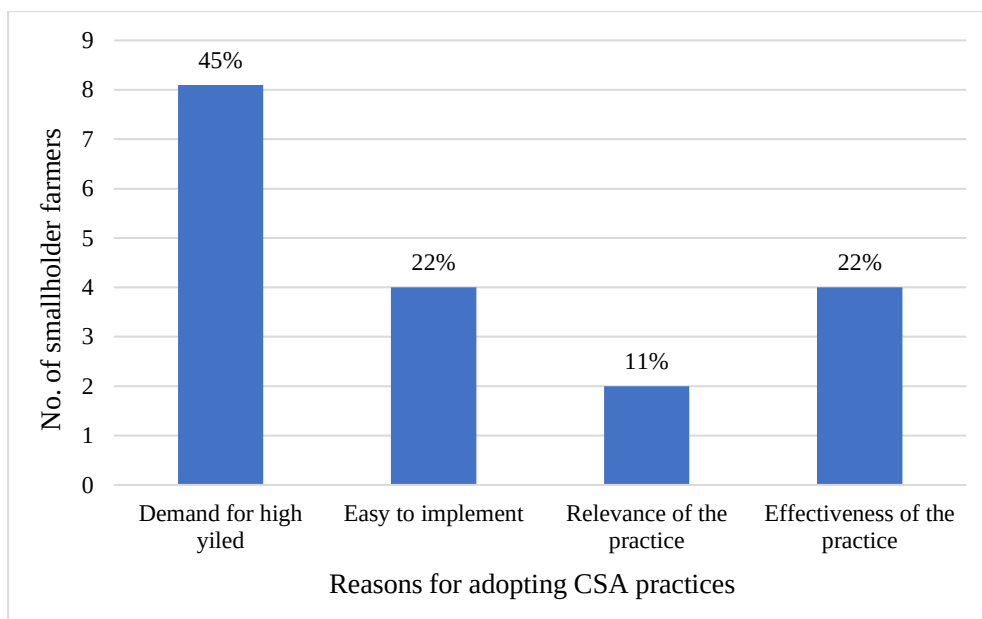


Figure 19: Smallholder farmers' reasons for adopting CSA practices

Evidence indicates that many smallholder farmers adopted the CSA practices to realise high yield (45%), because they were easy to implement (22%), and effective in solving climate change related impacts on farming (22%). On the other hand, a few (11%) smallholder farmers adopted the CSA practices because they were relevant to their farming needs with regard to climate change.

During observation, the following was observed in two different fields: one belonging to Smallholder farmer 3, and the other to Smallholder farmer 7. Figure 20 has the detailed results.



a. Regular farming



b. Mulching (zero tillage)

Figure 20: A comparison of zero tillage and regular farming in Nthiko

In figure 20, Smallholder farmer 7 (in field a.) planted maize following the traditional (regular) practices. On the other hand, Smallholder farmer 3 (field b.) planted maize using zero tillage, a CSA practice by ASWAp-SP II in Nthiko. The two fields were planted on the same date using the same maize seeds. Results show that maize crops looked greener and healthier in a zero tillage field than in a regular field.

The fact that 45% of smallholder farmers adopted the CSA practices to realise high yield coincides with what Neufeldt et al. (2013) posit that the CSA practices employ several agricultural practices that sustainably increase agricultural productivity. Again, this finding relates well with what FAO (2013) and Jellason et al. (2020) assert that CSA practices are a suitable strategy, promising approach, and key element in the successful response to food insecurity to feed the growing world population in the wake of climate change. Similarly, this finding is also in line with what Ouya et al. (2020) and Quinion et al. (2010) found that CSA practices increased the food security status to smallholder farming households. In the same way, this finding confirms what Ghosh (2019) found that in India farmers who adopted CSA practices achieved higher yield than those who did not. Further, the finding matches with what Branca et al. (2011) and Sapkota et al. (2015) found that the CSA practices improved crop yields to those farmers implementing them.

Likewise, this finding corroborates what Shahzad and Abdulai (2020) found that adoption of CSA practices significantly reduced household food insecurity in Pakistan. In addition to that, this finding connects well to what Gairhe and Adhikari (2018) found in Nepal that plant density, ear number, filled grains per cob, and grain yield was substantially higher in fields that used some CSA practices than those that did not. Moreover, this finding confirms what Hunga and Mussa (2016) contend that ASWAp is aimed at promoting CSA practices that assist smallholder farmers in Malawi to improve their agricultural productivity regardless of climate change prevalence. This entails that smallholder farmers adopting and correctly implementing the CSA practices can be assured of realising high yield. It can be argued, therefore, that adoption of CSA practices alone is not enough but successful implementation of the same is vital in helping smallholder farmers achieve their desired outcome. This implies that some smallholder farmers may adopt the CSA practices and implement them wrongly thereby not realising high yield.

The fact that 22% of smallholder farmers adopted the CSA practices because they were easy to implement echoes what the Diffusion of Innovations theory (Vishwanath & Barnett, 2011) contends that one of the factors influencing adoption of an innovation is complexity. Likewise, this finding is consistent with what Kaplinsky (2011) contends that an innovation must be simple and easy to implement instead of demanding special skills. This implies that some smallholder farmers who found some CSA practices difficult did not adopt them. It can be argued, therefore, that the degree to which the CSA practices are feasible to local smallholder farmers will promote adoption of the same. In the same way, the fact that some smallholder farmers adopted the CSA practices based on their implementability resonates well with what the Diffusion of Innovations theory (Vishwanath & Barnett, 2011) advances that the degree to which an innovation seems fairly easy to understand and use plays a critical role in promoting its own adoption. This also agrees with what the concept of appropriate technology (Kaplinsky, 2011; Schumacher, 1999) postulates that a technology ought not to be difficult to implement.

The fact that 11% of smallholder farmers adopted the CSA practices due to their relevance in solving effects of climate change fits well with what the Diffusion of Innovations theory (Vishwanath & Barnett, 2011) advances that when an innovation is perceived as consistent with the existing needs of the potential adopters, it becomes easy for them to adopt. Again, this finding is consistent with what Kaplinsky (2011) argues that technologies should respond to the actual needs or skills of the people. This, therefore, means that some of the CSA practices were not adopted because of lacking compatibility of solving the climate change related impacts facing smallholder farming. It can be argued, therefore, that to promote adoption of CSA practices by smallholder farmers, implementors should carefully match the CSA practices with the effects of climate change smallholder farmers are facing in an area.

The fact that another 22% of smallholder farmers adopted the CSA practices after seeing effectiveness of the same in solving climate change related impacts on farming of other farmers confirms what the Diffusion of Innovations theory (Vishwanath & Barnett, 2011) postulates that one of the factors influencing adoption of an innovation is observability, which is the extent to which the results of an innovation are visible to others. This is also in line with what Kaplinsky (2011) argues that a technology must

be oriented in a way that it addresses the real needs and requirements of the people implementing them. Evidence shows that smallholder farmers will not adopt any CSA practice, which does not yield expected results. This relates well with what Kaplinsky (2011) contends under localisation that a technology, in this case CSA practice, becomes appropriate if it responds to the actual needs of the people. This entails that if the smallholder farmer finds the promoted CSA practice comparatively less effective than the one being practised, adoption will not take place. This study, therefore, stresses the need for smallholder farmers to first try a potential CSA practice and compare its benefits with the already existing similar practices prior to making a decision to adopt. This implies that the best practice will carry the day.

The issue of maize cobs being visibly bigger in a field implementing CSA practices than in a regular field (figure 20) is very critical to attract non-adopters. Indeed, one can hardly see maize cobs developing on maize stalk in field a., but on field b., big cobs are visible. In other words, there is stunted growth in field a., but health growth in b., yellowish/light green in a., and dark-green in b. This finding is similar to what Gairhe and Adhikari (2018) found, in Nepal, that plant density, ear number, and filled grains per cob was substantially higher in fields that implemented some CSA practices than those who did not implement any CSA practice. One insight from this finding is that to lobby smallholder farmers adopt CSA practices, establishment of demonstration fields is critical. This resonates well with what the Diffusion of Innovations theory (Vishwanath & Barnett, 2011) contests that if an innovation is perceived as consistent with the existing needs of potential farmers, its rate of adoption will increase. However, one challenge observed with zero tillage is that it was not being implemented in large farms but small portions of land only. It can be argued, therefore, that such portions of land may not guarantee high yield when the larger portions continue to use conventional farming practices. This study, therefore, accents that implementing agencies deal with what prevents smallholder farmers from implementing zero tillage in the entire farm. Otherwise, the issue of compatibility is obviously highly compromised in such situations thereby discouraging both adopters and non-adopters.

4.4.2 Benefits of the adopted climate smart agricultural practices

In this section, smallholder farmers who adopted CSA practice(s) were asked to state how they are benefitting from the adopted practice(s). Figure 21 has the results.

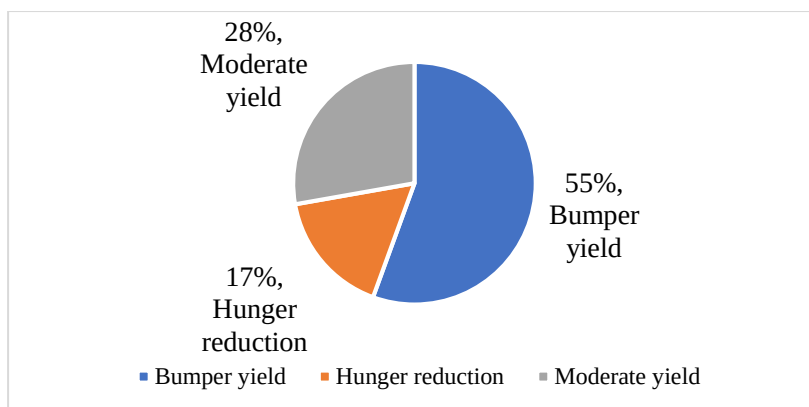


Figure 21: Benefits of adopted CSA practices to smallholder farmers

Evidence from many (55%) smallholder farmers indicates that they reaped bumper yield from using the CSA practices, and very few (17%) smallholder farmers have managed to reduce hunger in their households from using the CSA practices. This has been substantiated by the following semi-structured interview:

Nowadays, I have enough maize remaining to harvest than before. In the past, we were finishing it whilst green. (*Panopa ndikumakhala ndi chimanga mpaka kukolola. Kale timathera kudya dowe*) (Smallholder farmer 1).

In addition to that, Smallholder farmer 4 said the following:

Before adopting the CSA practices, I was harvesting as little as 7 bags of maize. Currently, my yield has almost doubled. (*Ndisanayambe ulimi wamakonowu, ndinkakolola mwina matumba 7 okha. Panopa ndi pafupifupi times two kuchuluka kwake*)

On the contrary, Smallholder farmer 2 said the benefits from CSA practices are just minimal.

The benefit is just very little. No matter how hard the task is, we have a minimal increase in harvests. (*Phindu lake ndi lochepa zedi. Moti chintchito chikulirenji koma zokolora kungochulukirako pang'ono*).

The fact that smallholder farmers who implemented some CSA practices realised bumper yield and reduced hunger in their households is commendable and agrees with what Gairhe and Adhikari (2018) and Ghosh (2019) that adopting CSA practices

improved food and nutrition of smallholder farmers' households than those who did not implement any of the promoted CSA practices. This entails that some smallholder farmers adopted the CSA practices to maximise their yield to meet the feeding needs of their households, which is crucial in most developing countries including Malawi. The fact that one of the smallholder farmers confessed that before using CSA practices, she was finishing her maize whilst green (fresh) is evident that using the CSA practices yield increases. This also agrees with what was reported by Buliyani (2023) that a female smallholder farmer in Mzimba doubled her yield from using home-made manure and new maize planting methods promoted by Malawi Government through the Ministry of Agriculture under ASWAp-SP II. Likewise, this finding confirms what Phiri (2023) found that a smallholder farmer who adopted conservation agriculture in Karonga was set to realise a bumper harvest.

On the other hand, the fact that another smallholder farmer realised minimal yield not corresponding to the effort and input invested in implementing the CSA practice is a sad development. This may suggest that the adopter in question will no longer implement the CSA practice in the following growing season. This is in line with what the Diffusion of Innovations theory (Vishwanath & Barnett, 2011) advocates regarding trialability and observability that the extent to which an innovation is tried and provides tangible results promotes adoption. Although trialability and observability are said to correlate positively with the rate of adoption, this study argues that this hinges on the results of trying and observing the practice. This entail that in cases where the results of the adopted CSA practice are negative and observed results undesirable, adoption of the same will be inhibited. It can be argued, therefore, that trialability and observability can either positively or negatively correlate with the rate of CSA practice's adoption. This study, therefore, stresses that implementors should bring relevant and effective CSA practices for promotion to increase the rate of adoption after trying and observing them. This resonates well with the Diffusion of Innovations theory (Vishwanath & Barnett, 2011) which advances that a CSA practice should be better than the practices it is replacing. In this case, should the opposite happen, chances of smallholder farmers adopting it will be very slim if any.

However, it is possible also that the smallholder farmer did not effectively or correctly implement the adopted CSA practice. As such, it could be unfair to expect such to bring

out good results as the saying goes “garbage in garbage out”. This means what smallholder farmers put into farming will equal what they will get out of it. It can be argued, therefore, that successful implementation of CSA practices will yield successful results and the opposite will also be true. For instance, if the CSA practice requires that a smallholder farmer applies fertiliser twice, the farmer should do as recommended. If procedures are not well followed, chances of failure will be very high. This entails that the smallholder farmer will get undesirable results than what is expected. This study, therefore, stresses that some negative results from an implemented CSA practice emanates from failure of smallholder farmers to follow the agreed set of procedures and guidelines for implementing the CSA practice in question. This study, therefore, stresses that smallholder farmers should follow the required steps for implementing the CSA practice failing which the expected results will not be desirable.

4.6 Chapter summary

This chapter has presented and discussed the research findings on smallholder farmers’ adoption of climate smart agricultural practices in Malosa EPA. Three specific objectives guided this study – level of CSA practices adoption by smallholder farmers, determinants of CSA practices’ adoption by smallholder farmers, and impacts of CSA practices on agricultural production among smallholder farmers. Findings have been presented and discussed, in relation to the existing literature and theoretical framework. The findings fall under adoption level of ASWAp-SP II CSA practices, ASWAp-SP II promoted CSA practices, other CSA practices adopted by smallholder farmers, smallholder farmers’ perception of climate change, smallholder farmers’ response to changes in climate, determinants of the adoption of CSA practices, barriers to the adoption of CSA practices, factors influencing smallholder farmers’ adoption of CSA practices, household decision making regarding CSA practices, challenges faced with the adopted CSA practices, reasons for not adopting CSA practices, requirements for smallholder farmers to change their farming practices, reasons for adopting the CSA practices, and benefits of the adopted CSA practices. It has been observed that only a quarter of smallholder farmers have adopted the CSA practices in Nthiko. Main factors influencing smallholder farmers’ adoption of CSA practices in Nthiko are compatibility and appropriateness. Benefits of CSA practices include bumper yield leading to the reduction of hunger. The main argument of this study is that if smallholder farmers are to adopt CSA practices in large numbers, issues of compatibility and appropriateness

should be well addressed. Failing which, the same challenges will continue frustrating efforts to arrest the effects of climate change on smallholder farming. In the following chapter, conclusions and recommendations of this study have been presented.

CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

5.1 Chapter overview

This chapter presents conclusions, and recommendations of the study assessing smallholder farmers' adoption of climate smart agricultural practices in Malosa EPA within the theoretical framework of Diffusion of Innovations theory by Rogers (2003). It has four sections. The first section presents conclusions of the study, the second section provides recommendations of the study, the third section states limitations of the study, and the last section suggests areas for further research. The main objective of this study was to assess smallholder farmers' adoption of climate smart agricultural practices in Malosa EPA in Zomba District. Questionnaires, semi-structured interview, and observation guides were used to collect data to achieve the following specific objectives:

1. to ascertain the level of climate smart agricultural practices' adoption by smallholder farmers;
2. to explore the determinants of climate smart agricultural practices' adoption by smallholder farmers; and
3. to evaluate the impacts of climate smart agricultural practices on agricultural production of smallholder farmers.

5.2 Conclusions

On the objective of the level of climate smart agricultural practices' adoption by smallholder farmers, it can be concluded that smallholder farmers' adoption of CSA practices in Nthiko is very low (26%). This is because results indicate that 74% of smallholder farmers have not yet adopted the CSA practices promoted by ASWAp-SP-II in Nthiko. This study argues, therefore, that although climate change is a global phenomenon, smallholder farmers' response to the effects of climate change are not uniform and should be addressed so. This is because vulnerability and adaptation to climate change is local. As such, any intervention addressing the impacts of climate

change on agriculture should have smallholder farmer's needs at its centre. Failing which efforts to address needs of local smallholder farmers' using imported measures would render the intervention less effective.

On the objective of determinants of climate smart agricultural practices' adoption by smallholder farmers, it can be concluded that the main factor influencing smallholder farmers' adoption of the CSA practices is appropriateness of the CSA practices (81%) themselves followed by benefits of the CSA practices (67%) and availability of farm inputs (56%). This study argues that input intensiveness and cost ineffectiveness of most CSA practices prevent some smallholder farmers from adopting them. Again, CSA practices that take long to produce desirable results will also take long to be adopted by smallholder farmers.

On the objective of the impacts of climate smart agricultural practices on agricultural production of smallholder farmers, it can be concluded that over half (55%) of smallholder farmers realised bumper yield, over a quarter (28%) of smallholder farmers realised moderate yield, and almost a fifth (17%) of smallholder farmers reduced hunger in their households. This study argues, therefore, that successful implementation of CSA practices will yield successful results and the opposite will also be true. As such, if procedures for implementing a CSA practice are not well followed, chances of failure will be very high. If the impacts of CSA practices will be desirable, smallholder farmers should always follow the required steps for implementing them in their fields.

5.3 Recommendations

This study makes several recommendations, which might help to improve the implementation of climate smart agriculture to foster high level of CSA practices' adoption by smallholder farmers. One of them is that the implementing agencies should accommodate and appraise similar practices so that farmers already implementing them should be part of adopters and not otherwise. In other words, practices that farmers are already doing and are effective should be harnessed so that they are main-streamed in the projects. Likewise, the implementing agencies should first consult the local people to see what practices are already being practised and working before introducing their own so as to introduce and promote appropriate CSA practices. Similarly, the implementing agencies should promote networking opportunities between adopters and

non-adopters where they will share knowledge and information regarding the CSA practices in their area.

Furthermore, deliberate efforts should be made to encourage husbands to take part in farming just like health workers are encouraging them to have interest in family planning. Women should also be empowered to make independent decisions regarding choices of their farming practices in the wake of climate change. There should be adequate civic education and sensitisation campaigns to orient smallholder farmers on the CSA practices suitable for their areas. Establishment of demonstration and model farms where the benefits of CSA practices will be observable to all prospective adopters is also ideal.

5.4 Limitations of the study

This study had two main limitations. The first one was that it used a relatively small number of respondents due to the adoption of a 95% confidence level and a 10% precision level in a sample of 205 farming households. This made it difficult to find some significant connections in the data. The last one was time constraints as the study was conducted during the weekdays. This made it impossible to wait for some respondents who were not available due to other equally important engagements. The study overcame these limitations by utilising the available respondents as well as triangulating the results and crystalising the findings using quantitative and qualitative techniques respectively.

5.5 Areas for further research

This study suggests two areas for further research. Firstly, a similar study using a different confidence and precision level to ensure a much larger sample. Finally, a study exploring use of indigenous knowledge in overcoming effects of climate change on smallholder farming.

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APPENDICES

Appendix 1 Informed consent form

Dear Respondent (*Okondedwa Oyankha*),

I am Feston Ken Shani, a Master of Science (Geography and Earth Sciences) student at the University of Malawi (*Ine ndi Feston Ken Shani, wophunzira wa Sayansi ya Dziko ku Univesite ya Malawi*). I am conducting a research project for my thesis (*Ndikupanga kafukufuku okhudza maphunziro angawo*). The purpose of my study is to assess the adoption of climate smart agricultural practices by smallholder farmers' in Malosa EPA in the rural areas of Zomba District in Malawi (*Cholinga cha kafukufuku ameneyu ndi kuyesa katengedwe ka ulimi wothana ndi kusintha kwa nyengo pakati pa alimi ang'onoang'ono a ku Malosa EPA ku Zomba*). The findings will bring to light the CSA practices that smallholder farmers are adopting, the determinants of CSA practices' adoption by smallholder farmers, the impacts of CSA practices on agricultural production of smallholder farmers, and the level of CSA practices' adoption by smallholder farmers (*Zotsatira za kafukufukuyu zibweretsa poyera ulimi othana ndi kusintha kwa nyengo umene alimi ang'onoang'ono akutenga, zimene zikuwapangitsa kutenga ulimi wamtunduwu, zotsatira zotenga ulimiwu, komanso mulingo wa katengedwe ka ulimu umenewu*). These findings will assist in finding the best CSA practices for smallholder farmers in Malawi, which will in turn save resources that could otherwise been spent on non-popular CSA practices (*Zotsatira zimenezi zidzathandiza kupeza ulimi wabwino othana ndi kusintha kwa nyengo pakati pa alimi ang'onoang'ono m'Malawi, zimene zidzapangitsenso kuti katundu ndi ndalama zisadzaonongeke ndi ulimi opanda phindu umene alimi alibe nawo chidwi*).

You have been selected because you have the information that I am looking for since the study is targeting smallholder farmers in Nthiko Village where ASWAp SP II is promoting CSA practices among smallholder farmers (*Inuyo mwasankhidwa kukhala nawo mu kafukufuku ameneyu chifukwa ndinu m'modzi mwa alimi ang'onoang'ono opezeka m'mudzi wa Nthiko m'mene Unduna wa Zamalimidwe ukulimbikitsa ulimi othana ndi kusintha kwa nyengo kudzera ku ndondomeko yotchedwa ASWAp SP II*). However, your participation in this study is voluntary (*Komabe, kutenga mbali kwanu mu kafukufuku ameneyu*

nkosakakamizidwa). You are free not to participate and you may withdraw at any time you wish without giving a reason and without consequences of any kind (*Muli ndi ufulu wosatenga nawo mbali ndipo mukhoza kusiya kutenga nawo mbali nthawi ina iliyonse mungafuneyo popanda kupereka chifukwa ndiponso popanda chotsatira chilichonse*). Data will be collected using field observation guide, questionnaires, and semi-structured interview guide (*Malipoti onse atengedwa kudzera ku mafunso ndi mchezo*). An audio recorder will also be used (*Mau anu panthawi ina adzatepedwa*). To ensure maximum confidentiality, all data collected will remain private and will not be released to any third party (*Pofuna kuonetsetsa kuti pali chinsinsi, malipoti onse mu kafukufuku ameneyu sadzapatsidwa kwa munthu wina kupatula ine mwini*). Instead of your name, a code name will be used to maintain the anonymity. Your identify will be hidden throughout the study period. Data will be used for the purpose of this study only and will be destroyed once the thesis is produced. When reporting findings of this study to the public, your name or any other individual information by which you could be identified, will not be included (*Dzina lanu silidzatchulidwa pena paliponse mu kafukufuku ameneyu ngakhale mu lipoti lonse. Kumapeto kwa zonse, malipoti onsewa adzaotchedwa kuti ena asadzawaonenso*).

Should you, at any time have questions regarding this study, my contact details are as follows (*Ngati muli ndi mafunso okhudza kafukufuku ameneyu, ndifunseni pondiyimbira foni kapena kundilemba kalata pa adiresi yotsatirayi*):

Name: Feston Ken Shani

Email: msc-geo-sci-08-19@unima.ac.mw or fkenshani@gmail.com

Phone number: 0 999 337 223 or 0 888 192 163

Should you have concerns about this study and wish to contact someone independent, you may wish to contact the Chairperson of University of Malawi Research Ethics Committee (UNIMAREC) on following address (*Ngati mungakhale ndi chidandaulo chilichonse chokhudzana ndi kafukufuku ameneyu mukhoza kuyankhulana ndi*

Wapampando woona za Ndondomeko za Kapangidwe ka Kafufufuku ku Sukulu ya Ukachenjede ya Malawi pa adiresi yotsatirayi):

Professor Alister Munthali
UNIMAREC Chairperson
P.O. Box 280
Zomba
Cell: 0 888 822 004
Email: unimarec@unima.ac.mw

Before signing below, please, read the following statements (*Musanasainire pansipa, chonde, werengani mfundo zotsatirazi*):

- I have read and understood the information above (*Ndamvetsa zonse zili m'mwambamu*).
- I understand what the study is about, and what the results will be used for.
- I know that my participation is voluntary and that I can withdraw from the project at any stage without giving a reason (*Ndikudziwa kuti nditenga nawo mbali mosakakamizidwa*).
- I am aware that my details will be kept confidential and destroyed after producing the final thesis (*Ndikudziwa kuti zonse zokhudza ine zisingidwa mwa chinsinsi mu kafukufukuyu*).
- I am sure that when reporting findings of this study to the public, my name or any other individual information by which I could be identified, will not be included.

Name of Respondent (*Dzina la Oyankha*):.....

Signature (*Saini*):..... Date (*Tsiku*):

Name of Researcher (*Dzina la Ofukula*):.....

Signature (*Saini*):..... Date (*Tsiku*):

Appendix 2 Questionnaire for smallholder farmers

Section A: Information of a Respondent (*Zokhudza oyankha*)

No.:.....

- a. Age (*Zaka*):
- b. Sex (*Mamuna/mkazi*):
- c. Marital status (*Zokhudza banja*):.....
- d. Occupation (*Ntchito*):
- e. Average monthly income per month (*Ndalama zopeza pa mwezi*):
MK.....
- f. Level of education (*Mulingo wa maphunziro*):
.....
- g. Size of HH (*Kukula kwa banja*):
- h. Land ownership in the HH (*Umwini wa malo m'banja*):
- i. Size of farming land (*Kukula kwa munda*):
- j. Terrain of the farmland (*Maonekedwe a malo*):
- k. Distance to the farm (*Mtunda wokafika ku munda*):
.....
- l. Experience in farming (*Zaka mu ulimi*):
.....
- m. Number of years resident in the area (*Zaka zomwe mwakhala mmduzi muno*):
- n. Source of labour in the HH (*Amene amalima m'munda wanu*):.....
- o. Animals raised (*Mumaweta zinyama zanji?*):
.....

Section B: Knowledge of Climate Change (*Kudziwa za kusintha ka nyengo*)

1. Have you ever heard anything about climate change? (*Munamvapo kalikonse kokhudza kusintha kwa nyengo?*) Yes No
.....
2. Has there been any change regarding climate in your area in the past 20 years? (*Kodi nyengo ya mmudzi mwanu muno yasinthako mu zaka 20 zapitazo?*) Y / N

3. What climate-related events have been experienced in your area? (*Ndi zochitika ziti zokhudza nyengo zomwe mwazionako m'dera lanu lino?*)

.....
.....

4. Have you changed in the way you practice your farming following changes in the climate of your area? (*Mwasinthapo chiyani mu ulimi wanu potengera kusintha kwa nyengo m'dera lanu?*) (**if nothing, go to question 8**)

.....
.....

5. Why have you made the changes in the way you practice your agriculture as indicated in question 6 above? (*N'chifukwa chiyani mwasintha zimene mwanenazi pa ulimi wanu?*) (**after this, do not proceed to questions 8 & 9**)

6. Why haven't you made any changes as expected? (*N'chifukwa chiyani simunasinthepo kanthu mu ulimi wanu?*)

.....
.....
.....

7. What would you require to make changes to the way you practice your agriculture? (*Mungafune chiyani kuti musinthe mu ulimi wanu pothana ndi kusintha kwa nyengo?*)

.....
.....

Section C: Knowledge of Climate Smart Agriculture (*Kudziwa za ulimi othana ndi kusintha kwa nyengo*)

8. What do you know about Climate Smart Agriculture? (*Mukudziwapo chani chokhudza ulimi othana ndi kusintha kwa nyengo?*)

.....

9. Which of the following CSA practices do you know? (*Mukudziwako ziti mmunsimu?*)

Knowledge of CSA practice	#	Yes	No
Agroforestry (Kudzala mitengo pamodzi ndi mbeu)	1		
Box ridges (Mizere yakatseka)	2		
Changing cropping date (Kusintha masiku odzalira mbeu)	3		
Climate information services (<i>Kutsatira nkhani zanyengo</i>)	4		
Conservation agriculture (<i>Ulimi osunga chinyontho</i>)	5		
Contour farming (<i>Kulima akalozera</i>)	6		
Crop rotation (Kasinthasinthwa wa mbeu mmunda)	7		
Destocking (kuchepetsa ziweto pa malo amodzi)	8		
Diversification of crop varieties (<i>kudzala mbeu zamitundu</i>)	9		
Diversification of livestock breeds (<i>kuweta ziweto zamitundu</i>)	10		
Drought tolerant crop varieties (<i>mbeu zopilira ku chilala</i>)	11		
Efficient use of nitrogen fertiliser s (<i>kuthira feteleza mosamala</i>)	12		
Improved crop varieties (<i>mbeu zamakono</i>)	13		

Integrated soil fertility management (<i>kulera nthaka</i>)	14		
Intercropping with legumes (<i>ulimi wophatikiza zanyemba</i>)	15		
Irrigation (<i>mthilira</i>)	16		
Making ridges across the slope (<i>mizere yopingasa</i>)	17		
Zero tillage (<i>mtaya khasu</i>) Mulching (<i>ulimi wa mapesi</i>)	18		
Organic manure (fertiliser) (<i>manyowa</i>)	19		
Pit planting (<i>ulimi wamayenje</i>)	20		
Rain water harvesting (<i>kukolola mvula</i>)	21		
Use of compost manure (<i>kompositi</i>)	22		
Use of cover crops (<i>mbeu zophimbira</i>)	23		
Use of herbicides (<i>makhwala opha udzu</i>)	24		
Use of live barriers e.g., vetiver grass (<i>udzu wa vetiva</i>)	25		
Use of terraces (<i>ulimi wa m'phiri</i>)	26		
Water management measures (<i>kusamala madzi</i>)	27		
Others (<i>zina</i>) (specify) (<i>tchulani</i>):	28		

10. Which of the above CSA practices have you adopted? (*Mwa ulimi uli mwambawu, munasankha kuchita uti?*) (if none, go to question 20)

.....
.....

11. Why did you choose to use adopt such type of CSA practices?
(*Munasankhiranji ulimi wa mtundu umenewo?*)

.....
.....

12. Explain how the above adopted practice has helped you to cope with climate change. (*Fotokozani mmene ulimi umenewu wakuthandizirani kuthana ndi kusintha kwa nyengo?*)

.....
.....

13. Who in the households makes the decision about the use of CSA practices? (*Ndi ndani amene amapanga ziganizo posankha mtundu wa ulimi mnyumba mwanu?*)

.....
.....

14. What influenced your choice to adopt the CSA practices being used? (*Chinakupangitsani nchiyani kuti mutenge ulimi wa mtundu umenewu pothana ndi kusintha kwa nyengo?*)

.....
.....

15. What benefits do you get from using CSA practices? (*Mumapeza phindu lanji ndi ulimi umenewu?*)

.....
.....

16. What challenges do you face when using the CSA practices adopted? (*Mumakumana ndi mavuto anji ndi ulimi wa mtundu umenewu?*) (after this, go to section D)

.....
.....

For non-adopters only

17. Why did you not adopt any CSA practice? (*N'chifukwa chiyani simunatengeko ulimi ulionse pofuna kuthana ndi mavuto akudza pa ulimi kaamba ka kusintha kwa nyengo?*)

.....

.....

Section D: Determinants of CSA practices adoption (*Zopangitsa alimi kusankha ulimi*)

18. Which of the following determines smallholder farmers' adoption of CSAs?
Rate them. (*Ndi ziti zomwe zimapangitsa alimi kutenga ulimi wothana ndi kusintha kwa nyengo?*)

Determinants of CSA practices adoption	#	High	Medium	Low
Access to climate change information (<i>Zakusintha nyengo</i>)	1			
Access to extension services and information (<i>Za ulangizi</i>)	2			
Access to markets (<i>Mwai wa misika</i>)	3			
Access to weather forecasting information (<i>Za nyengo</i>)	4			
Adequate information on CSA practices (<i>Kumvera za ulimi</i>)	5			
Age of farmers (<i>zaka za mlimi</i>)	6			
Awareness of the impacts of climate change (<i>zotsatira za kusintha kwa nyengo</i>)	7			
Benefits of the CSA practices (<i>phindu la ulimi wakewo</i>)	8			
Competition for the use of crop residues (<i>kulimbirana mapesi</i>)	9			
Distance between farmer's home and farm (<i>Kutalika</i>)	10			
Exposure to previous climatic hazards (<i>Chiopsezo cha mavuto azanyengo am'mbuyo</i>)	11			

Farmers dependency syndrome (<i>Moyo wongodalira</i>)	12			
Farmers' education levels (<i>Maphunziro a mlimi</i>)	13			
Farmer's misconception	14			
Farming experience (<i>Zaka pa ulimi</i>)	15			
Gender (zosiyanitsa pakati pa mkazi ndi mamuna)	16			
Household sizes (small) (<i>banja laling'ono</i>)	17			
Household sizes (large) (<i>banja lalikulu</i>)	18			
Inaccessibility to CSA information (<i>kusowa zokhudza ulimi</i>)	19			
Knowledge and/or capacity of extension workers (<i>kusadziwa kwa alangizi a zaulimi</i>)	20			
Lack of clear guidelines for a specific CSA practice (<i>kusowa ndondomeko za kachitidwe ka mtundu wa ulimiwu</i>)	21			
Lack of farm inputs (<i>kusowa zipangizo za ulimi</i>)	23			
Lack of finances (<i>kusowa ndalama</i>)	24			
Lack of labour (<i>kusowa olima</i>)	25			
Lack of land (<i>kusowa malo</i>)	26			
Lack of markets (<i>kusowa misika</i>)	27			
Lack of training (<i>kusaphunzitsidwa</i>)	28			
Lack of water (<i>kusowa madzi</i>)	29			
Lack of other resources (<i>kusowa zina</i>) (specify) (<i>tchulani</i>)	30			
Land size (kukula kwa malo)	31			
Land tenure (mtundu wa malo pokhudza umwini)	32			
Laziness (<i>ulesi</i>)	33			
Marital status (zokhudza banja – kukwatira/kukwatiwa)	34			
Novel or unfamiliar CSA practices (<i>ulimi wosadziwika</i>)	35			
Policy issues (<i>Mfundo za boma</i>)	36			

Single female headed households (<i>banja loyendetsa amayi</i>)	37			
Weak coordination (<i>kayendetsedwe kofooka</i>)	38			
Weak implementation (<i>kachitidwe kofooka</i>)	39			

Section E: Barriers to CSA practices adoption

22. Rate the following as barriers to CSA practices' adoption by smallholder farmers

Barriers to CSA practices adoption	#	High	Medium	Low
Access to climate change information (<i>Zakusintha nyengo</i>)	1			
Access to extension services and information (<i>Za ulangizi</i>)	2			
Access to markets (<i>Mwai wa misika</i>)	3			
Access to weather forecasting information (<i>Za nyengo</i>)	4			
Adequate information on CSA practices (<i>Kumvera za ulimi</i>)	5			
Age of farmers (<i>zaka za mlimi</i>)	6			
Awareness of the impacts of climate change (<i>zotsatira za kusintha kwa nyengo</i>)	7			
Benefits of the CSA practices (<i>phindu la ulimi wakewo</i>)	8			
Competition for the use of biomass (<i>kulimbirana mapesi</i>)	9			
Distance between farmer's home and farm (<i>Kutalika</i>)	10			
Exposure to previous climatic hazards (<i>Chiopsezo cha mavuto azanyengo am'mbuyo</i>)	11			
Farmers dependency syndrome (<i>Moyo wongodalira</i>)	12			
Farmers' education levels (<i>Maphunziro a mlimi</i>)	13			

Farmer's misconception	14			
Farming experience (<i>Zaka pa ulimi</i>)	15			
Gender (zosiyanitsa pakati pa mkazi ndi mamuna)	16			
Household sizes (small) (<i>banja laling'ono</i>)	17			
Household sizes (large) (<i>banja lalikulu</i>)	18			
Inaccessibility to CSA information (<i>kusowa zokhudza ulimi</i>)	19			
Knowledge and/or capacity of extension workers (<i>kusadziwa kwa alangizi a zaulimi</i>)	20			
Lack of awareness of the impacts of climate change (<i>kusadziwa zotsatira za kusintha kwa nyengo</i>)	21			
Lack of clear guidelines for a specific CSA practice (<i>kusowa ndondomeko za kachitidwe ka mtundu wa ulimiwu</i>)	22			
Lack of farm inputs (<i>kusowa zipangizo za ulimi</i>)	23			
Lack of finances (<i>kusowa ndalama</i>)	24			
Lack of labour (<i>kusowa olima</i>)	25			
Lack of land (<i>kusowa malo</i>)	26			
Lack of markets (<i>kusowa misika</i>)	27			
Lack of training (<i>kusaphunzitsidwa</i>)	28			
Lack of water (<i>kusowa madzi</i>)	29			
Lack of other resources (<i>kusowa zina</i>) (specify) (<i>tchulani</i>)	30			
Land size (<i>kukula kwa malo</i>)	31			
Land tenure (<i>mtundu wa malo pokhudza umwini</i>)	32			
Laziness (<i>ulesi</i>)	33			
Marital status (<i>zokhudza banja – kukwatira/kukwatiwa</i>)	34			

Novel or unfamiliar CSA practices (<i>ulimi wosadziwika</i>)	35			
Policy issues (<i>Mfundo za boma</i>)	36			
Single female headed households (<i>banja loyendetsa amayi</i>)	37			
Weak coordination (<i>kayendetsedwe kofooka</i>)	38			
Weak implementation (<i>kachitidwe kofooka</i>)	39			

End of Questionnaire

Thank You for Taking Your Time to Respond to these Questions!

(Zikomo Kwambiri Popereka Nthawi Yanu Kuyankha Mafunso Amenewa!)

Appendix 3 Key informants interview guide

Section A: Preliminary Information of a Respondent

- a. Age:
- b. Sex:
- c. Marital status:
- d. Occupation:
- e. Level of education:

Section B: Climate change and smallholder farming

1. Are there some pieces of evidence that Zomba is one of the areas hit by effects of climate change in Malawi?
2. If yes, what are the pieces of evidence in question 1?
3. In your opinion, how has climate change affected smallholder farmers in Zomba District in general and Nthiko Village (Malosa EPA) in specific?
4. What is the main cause of climate change in Zomba in general and Malosa EPA in specific, and Nthiko Village in particular?

Zomba:

Malosa EPA:

Nthiko Village:

5. What incidences of climate change ever occurred in Malosa EPA (Nthiko Village) in the recent past?
6. How were smallholder farmers in the EPA affected?
7. What solutions did your office give to such smallholder farmers?

Section C: Adoption of climate smart agricultural practices

8. What CSA practices are promoted by your office (under ASWAp-SP II) in Nthiko Village?
9. Who decided to intervene (in Malosa EPA) with the CSA practices in question 1? Why?
10. How would you rate the uptake of the above CSA practices by smallholder farmers in Nthiko Village? Why?
11. In your opinion, are farmers adopting the CSA practices as expected?

12. Give a reason for your answer to question 3.
13. What needs to be done differently in the quest to encourage adoption of CSA practices in Nthiko Village?

Section D: Impacts of CSA practices on smallholder farming

14. From your records, how are farmers benefiting from the adopted CSA practices?
15. In terms of the harvest, what percentage increase or decrease would you estimate to have arisen from the use of CSA practices?
16. Do you see more farmers adopting the practices in the near future due to the observable impacts? Why?

Section E: Determinants of CSA practices' adoption by smallholder farmers

17. In your opinion, what factors influenced smallholder farmers to adopt CSA practices in Nthiko Village?
18. Are there some challenges faced by smallholder farmers when using the CSA practices?
19. Using some examples, explain your answer to question 3.

Section F: Level of CSA practices' adoption by smallholder farmers

20. How would you rate the adoption of CSA practices in Nthiko Village?
21. In your opinion, is your office doing enough to promote CSA practices by smallholder farmers in Nthiko Village (Malosa EPA)?
22. What additional information do you have regarding climate change, CSA practices, and smallholder farming in Malosa EPA?

End of Questionnaire

Thank You for Taking Your Time to Respond to these Questions!

Appendix 4 Semi-structured interview guide

Section A. Information of a Participant (*Zokhudza oyankha*)

No.:....

Extract this information from the questionnaire for smallholder farmers.

Section B. Knowledge of Climate Change (*Kudziwa za kusintha ka nyengo*)

1. Explain what you know about climate change. (*Fotokozani zomwe mukudziwa za kusintha kwa nyengo*)
2. How did you know about the climate change information explained? (*Munazidziwa bwanji?*)
3. Explain how you have been affected by climate change in your farming. (*Fotokozani mmene mwakhudzidwira ndi kusintha kwa nyengo pa ulimi wanu*)
4. How did you overcome the effects? (*Munathana nazo bwanji zotsatirazo?*)

Section C. Knowledge of Climate Smart Agriculture (*Kudziwa za ulimi othana ndi kusintha kwa nyengo*)

5. Explain what you know about climate smart agriculture? (*Fotokozani zomwe mukudziwapo zokhudza ulimi othana ndi kusintha kwa nyengo*)
6. How did you know about climate smart agriculture? (*Munadziwa bwanji za ulimiwu?*)
7. Which CSA practices do you know? (*Ndi ulimi utiuti umene mumaudziwa othana ndi vuto la kusintha kwa nyengo?*)
8. Which of the CSA practices have you adopted? (*Ndi ulimi uti umene mumachita mmunda mwanu pothana ndi kusintha kwa nyengo*) → **(for non-adopters, go to section D)**
9. Who motivated you to adopt the CSA practices? (*Ndi ndani anakulimbikitsani kuchita ulimi umenewu?*)
10. What benefits have you realized from such CSA practices in question 6? (*Mu ulimi umenewu mwapezamo phindu lotani?*)
11. If you compare the yield before and after adoption of CSA practices, what is the difference? (*Mukayerekeza zokolola zapoyamba ndi panopa, pali kusiyanana kotani? (relative advantage)*)

12. How was your experience when you first adopted the CSA practices?
(*Mutayamba kumene kuchita ulimi umenewu, munakumana ndi zotani?*) (**compatibility**)
13. How did you understand the CSA practice adopted? (*Munakamvetsa mwa njira yanji kalimidwe ka mtundu umenenewu?*) (**complexity**)
14. How did you test the applicability of the CSA practice adopted?
(*Munayeselera motani kalimidweka musanayambe kuchitsa mmunda wanu onse?*) (**trialability**)
15. Where did you observe the CSA practice before adopting? (*N’kuti kumene kalimidwe kameneka munakaonelerako musanakayambe mmunda mwanu?*) (**observability**)
16. Are there some challenges you are facing with the CSA practices adopted? (*Mukukumana ndi vuto lanji ndi kalimidwe kameneka?*)
17. What solutions could solve the challenges? (*Mavuto amenewa ngathetsedwe bwanji?*)
18. Why did you not adopt **some** CSA practices? (*Nchifukwa chiyani simunatsatire ulimi wa mitundu ina othananso ndi mavuto akudza kamba ka kusintha kwa nyengo?*)
19. What should be done to promote adoption of the non-adopted CSA practices? (*Pakufunika pachitike chiyani kuti alimi alimbikitsidwe kutsata ulimi ngati umenewo?*)
20. Do you have any relevant information to share with this researcher on this topic? (*Muli ndi mau ena oonjezera okhudza nkhani yomwe timakambiranayi?*)

Section D. For non-adopters only (Kwa osachita ulimi othana ndi kusintha kwa nyengo)

21. Why have you not adopted any of the CSA practices? (*Nchifukwa chiyani simunatsatire ulimi uliwonse othana ndi mavuto akudza kamba ka kusintha kwa nyengo?*)
22. What should be done to encourage farmers adopt the CSA practices?
(*Pakufunika pachitike chiyani kuti alimi alimbikitsidwe kutsata ulimi umenewo?*)

23. How do you overcome effects of climate change in your farming?

(Mumathana bwanji ndi mavuto akudza kamba ka kusintha kwa nyengo pa ulimi wanu?)

24. Do you have any relevant information to share with this researcher on

this topic? *(Muli ndi mau ena oonjezera okhudza nkhani yomwe timakambiranayi?)*

End of Semi-Structured Interview Guide

Thank You for Taking Your Time to Respond to these Questions!

(Zikomo Kwambiri Popereka Nthawi Yanu Kuyankha Mafunso Amenewa!)

Appendix 5: Field observation guide

Name of Place:..... No:.....

1. Types of CSA practices observed.

.....
.....
.....

2. How the CSA practices are being utilised.

.....
.....

3. Pictures of the CSA practices observed.

.....
.....

4. Are the practices well demonstrated?

.....
.....

5. Adopted CSA practices: are they well done or used?

.....
.....

6. Indicate any observable benefits of the CSA practices.

.....
.....

7. Are there some possible CSA practices not adopted but could have helped the farm? (aka missed opportunities)

.....
.....
.....

8. Are there any observable determinants of CSA practices adoption?

.....
.....

9. Any relevant observations made.

.....
.....

.....
.....
.....
.....

End of Field Observation Guide

Appendix 6: UNIMAREC covering letter

Domasi College of Education

P.O. Box 49

Domasi

05 January 2022

The Chairperson

UNIMAREC

P.O. Box 280

Zomba

Dear Sir,

APPLICATION FOR ETHICAL CLEARANCE FOR MY PROPOSED RESEARCH

I write to request for ethical clearance and approval for my study Assessing smallholder farmers' adoption of climate smart agricultural practices in Zomba District.

I am a Master of Science (Geography and Earth Sciences) student at the University of Malawi. My registration number is MSC/GEO/SCE/08/19. After submitting my research proposal to the Department of Geography and Earth Sciences, I was advised to come to your office for the purpose of ethical clearance and approval. This letter serves such a purpose.

I am looking forward to your timely assistance.

Yours faithfully,

Feston Ken Shani.

(MSC/GEO/SCE/08/19)

Attachments:

My research proposal

Checklist for ethical review submission

UNIMAREC processing fee deposit slip

Appendix 7: UNIMAREC approval letter



ACTING VICE-CHANCELLOR
Prof. Alfred D. Mtenje, BEd Mhr, MA S. Illinois, PhD London.

Our Ref: P. 01/22/114
Your Ref:

UNIVERSITY OF MALAWI
P.O. Box 280, Zomba, Malawi

Telephone: (265) 526 622
Fax: (265) 524 031
E-mail: vc@unima.mw

10th March, 2022

Mr. Feston Shani
University of Malawi
Geography and Earth Sciences Department
P.O Box 280
Zomba

Dear Mr Shani

**RESEARCH ETHICS AND REGULATORY APPROVAL AND PERMIT
FOR PROTOCOL NO. P.01/22/114 AN ASSESSMENT OF SMALL
HOLDER FARMERS ADOPTION OF CLIMATE CHANGE
AGRICULTURE PRACTICES IN ZOMBA DISTRICT IN MALAWI**

Having satisfied all the relevant ethical and regulatory requirements, I am pleased to inform you that the above referred research protocol has officially been approved. You are now permitted to proceed with its implementation. Should there be any amendments to the approved protocol in the course of implementing it, you shall be required to seek approval of such amendments before implementation of the same.

This approval is valid for one year from the date of issuance of this approval. If the study goes beyond one year, an annual approval for continuation shall be required to be sought from the University of Malawi Research Ethics Committee (UNIMAREC) in a format that is available at the Secretariat.

Once the study is completed, you are required to furnish the Committee and the Principal with a final report of the study. The Committee reserves the right to carry

out compliance inspection of this approved protocol at any time as may be deemed by it. As such, you are expected to properly maintain all study documents including consent forms.

Wishing you a successful implementation of your study.

Yours Sincerely,



Prof. Alistair Munthali
CHAIRPERSON OF UNIMAREC

CC: Acting Vice Chancellor
Acting University Registrar
College Finance Officer
Dean of Research
Compliance Officer



Appendix 8: UNIMAREC compliance report



ACTING PRINCIPAL
Prof. Samson Sajidu, BSc MSc, MPhil Cantab, PhD MSc

Our Ref: P.01/22/114

Your Ref:

CHANCELLOR COLLEGE
P.O. Box 280, Zomba, Malawi

Telephone: (265) 524 222
Fax: (265) 524 046
E-mail: principal@cc.ac.mw

27th April, 2022

Mr Feston Shani
University of Malawi
Geography and Earth Sciences Department
P.O. Box 280
Zomba

Dear Mr Shani

FEEDBACK ON INSPECTION FOR PROTOCOL NO. P.01/22/114. ASSESSING SMALLHOLDER FARMERS' ADOPTION OF CLIMATE- SMART AGRICULTURAL PRACTICES IN ZOMBA DISTRICT IN MALAWI

The University of Malawi Research Ethics Committee inspected the above-mentioned study on 24th March 2022. The following were the findings:

1. RESEARCH DESIGN

You were able to stick to the research design that was proposed. This is a good ethical practice.

2. SAMPLE SIZE

The sample size was within the UNIMAREC Approved sample size. This is a good ethical practice

3. METHODOLOGY AND OBJECTIVES

You adhered to study objectives and methodology without deviation. This is a good ethical practice

4. SAMPLING TECHNIQUE AND STUDY PARTICIPANTS

The participants demonstrated to be well conversant with the topic which you were investigating. This implies that your sampling framework represented the participants who would contribute significantly to your findings.

Overall, the participants expressed a positive experience in taking part in the study. Participants expressed their views during the discussion that I had with them.

5. RESEARCH DISSEMINATION

You highlighted to the participants how the research findings will be communicated to them. This is another example of adhering to ethical standards.

6. INFORMED CONSENT FORM

You disseminated study information to participants and got written informed permission from them. This is another acceptable ethical practice because it demonstrates that the subjects fully comprehended the study and actively participated in it without being coerced.

7. PARTICIPANTS' PRIVACY

You ensured that participants were interviewed in a private setting as an investigator. This is an excellent ethical practice that you followed throughout the study. The usage of a private location for doing research indicates that privacy was achieved.

8. RISKS

You were successful in complying with the use of face masks as a covid-19 prevention method. This is an excellent indicator of compliance in risk reduction during the study.

9. CONFIDENTIALITY OF RESEARCH RECORDS

You exhibited a good method for maintaining and preserving study participants' rights and anonymity. This was demonstrated by restricting access to study files to just individuals who were involved in the research.

10. INSPECTOR JUDGEMENT

The research is being carried out by UNIMAREC guidelines. Maintaining approved objectives and techniques, working with the allowed sample size, and using the approved informed consent form are just a few of them. You are strongly advised to follow the approved research framework until the study is completed.

Thank you for cooperating with us throughout our inspection.

Yours Sincerely,



Prof Alistair C. Munthali
CHAIRPERSON OF UNIMAREC



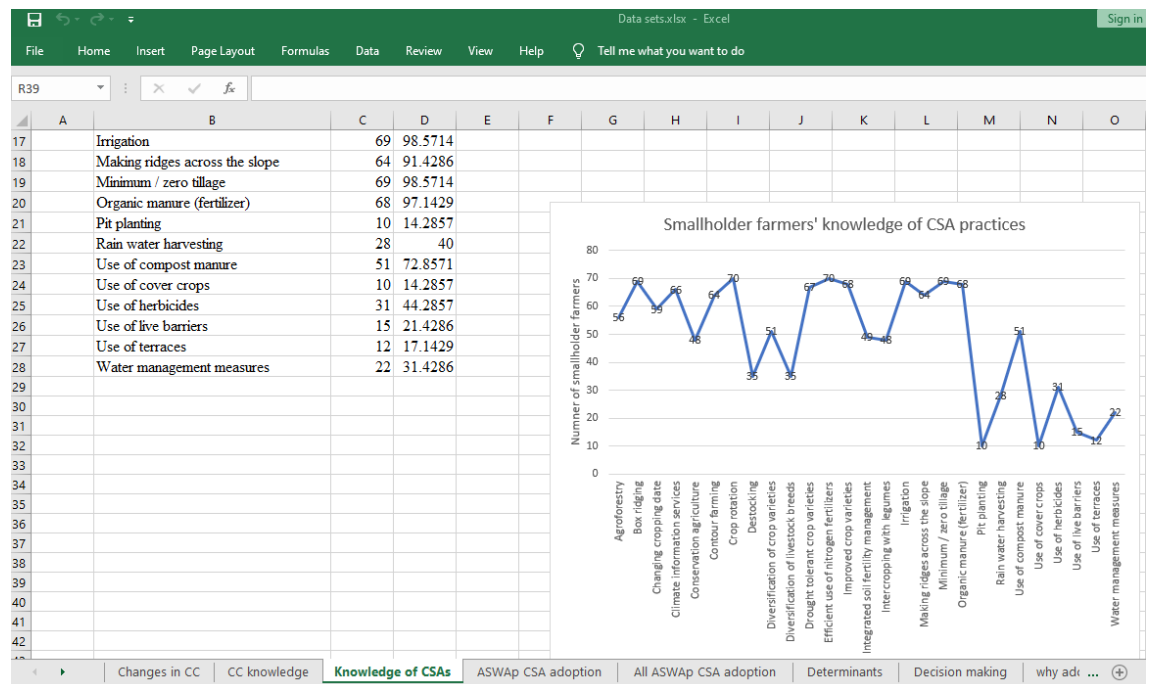
CC: Vice-Chancellor
Acting University Registrar
Dean of Research
UNIMAREC Administrator
UNIMAREC Compliance Officer

Appendix 9:Data analysis using IBM SPSS and Microsoft Office Excel

TayaTako.sav [DataSet1] - IBM SPSS Statistics Data Editor

	Name	Type	Width	Deci...	Label	Values
13	Farming_experience	Numeric	8	0	Years of farming experience of smallholder farmers	{1, Less than 1 year}...
14	Resident_years	Numeric	8	0	Years of resident in Nthiko Village	{1, Less than 1 year}...
15	Labour_source	Numeric	8	0	Source of labour for farming	{1, Household}...
16	Animals_raised	Numeric	8	0	Animals raised by smallholder farmers	{1, Chickens}...
17	CC_knowledge	Numeric	8	0	Smallholder farmers' knowledge of climate change	{1, Yes}...
18	CC_prevalence	Numeric	8	0	Changes in climate in Nthiko Village in the past 20 years	{1, Yes}...
19	CC_experienced	Numeric	8	0	Climate change related-events experienced in Nthiko Village	{1, Yes}...
20	CCE1	Numeric	8	0	Late onset of planting rains	{1, Yes}...
21	CCE2	Numeric	8	0	Prolonged dry spells (drought)	{1, Yes}...
22	CCE3	Numeric	8	0	Increased temperatures	{1, Yes}...
23	CCE4	Numeric	8	0	Destructive winds	{1, Yes}...
24	CCE5	Numeric	8	0	Flash floods or too much rain	{1, Yes}...
25	CCE6	Numeric	8	0	Low rainfall amount	{1, Yes}...
26	Change_in_practice	Numeric	8	0	Changes made in the farming practice	{1, Yes}...
27	Why_changed	Numeric	8	0	Why making the changes in farming practice	{1, To increase yield}...
28	Why_not_changed	Numeric	8	0	Why no changes made in farming practice	{1, Lack of interest}...
29	Change_requirement	Numeric	8	0	What smallholder farmers would require to make changes in farming	{1, Knowledge and skills}...
30	CSA_knowledge	Numeric	8	0	Smallholder farmers' knowledge of climate smart agriculture	{1, Yes}...
31	KCSA1	Numeric	8	0	Agroforestry	{1, Yes}...
32	KCSA2	Numeric	8	0	Box ridging	{1, Yes}...
33	KCSA3	Numeric	8	0	Changing cropping date	{1, Yes}...
34	KCSA4	Numeric	8	0	Climate information services	{1, Yes}...
35	KCSA5	Numeric	8	0	Conservation agriculture	{1, Yes}...
36	KCSA6	Numeric	8	0	Contour farming	{1, Yes}...

Data View Variable View



Appendix 10: Study work plan

Activity / Time	Oct. 20 to Jan. 21	Aug. 21 to Feb. 22	Mar.22 to Apr. 22	Aug. 22 to Dec. 22	Feb. 23	
Concept development						
Proposal refining and presentation						
Data collection						
Data analysis						
Thesis writing and editing						
Thesis submission						

Appendix 11: Study budget

Qty	Item description	Unit price (MK)	Total (MK)	Purpose
1	Reams ruled papers	4,000	4,000	Drafting and documenting
5	Reams plain papers	4,000	20,000	Printing
2	Photocopying	500	1,000	Some documents e.g., permission letters, questionnaires
20	Ball point pens	100	2,000	Drafting, writing, and documenting
8	Printing cost	4,000	32,000	Research tools and thesis
5	Binding cost	5,000	25,000	Thesis (soft and hard binding)
1	External Hard Disk Drive (32GB)	10,000	10,000	Research data management
100	Face masks	50	5,000	For respondents
5ltrs	Alcohol based hand sanitizer	3,000	15,000	For respondents
1	UNIMAREC processing fee	150USD	123,000	For ethical approval
15	Routes fuel	2,000	30,000	Transport to research site
15	Food and drinks	1,200	18,000	During data collection
2	Transport to Malosa EPA	5,000	10,000	Data collection for KI @ EPA
2	Lunch allowances to Malosa	2,500	5,000	Data collection for KI @ EPA
1	Research assistant allowance	100,000	100,000	1 assistant
1	Research compliance fee	10% of total	40,000	For ethical approval
	Grand total		440,000	