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ADOPTION OF PARTICIPATORY INTEGRATED CLIMATE SERVICES FOR AGRICULTURE (PICSA) METHODOLOGY: CHALLENGES AND OPPORTUNITIES IN CHIKWAWA DISTRICT, MALAWI

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ABSTRACT

In Malawi, the agriculture sector faces significant biophysical and socio-economic challenges such as low agricultural productivity and population growth. Highly variable rainfall has made it difficult for farmers to plan which crops to plant and when to plant them. The Ministry of Agriculture and Food Security introduced the Participatory Integrated Climate Services for Agriculture (PICSA) methodology in 2015 as one of the approaches for delivering agricultural extension services. The aim of the methodology is to build the capacity of agriculture extension agents and farmers to use and integrate downscaled seasonal forecasts and climate information with relevant and location-specific crop, livestock and livelihood information. Chikwawa is one of the districts in Malawi implementing this methodology. Frontline staff have so far trained 4,360 Lead Farmers in the PICSA methodology. Despite many benefits offered by the methodology, adoption in the district is low. This study was conducted to identify factors that affect adoption of the PICSA methodology in adapting and mitigating the effects of climate change in Chikwawa district. It was assumed that understanding the key factors that affect adoption could help agriculture extension workers and otkher stakeholders to make informed decisions on the best strategies to be used to address the contextual needs of farmers. The study used qualitative methods to collect data. Key informant interviews with experts and household interviews with farmers were

conducted. The results of the study suggest that low levels of education, low income levels and small land holding sizes could affect adoption of the methodology. Benefits of the methodology include informed decision making on the best enterprises to pursue, increased resilience to the effects of climate change, and improved agricultural productivity. Built on the study, the following strategies for improving adoption are suggested: improving extension services, intensifying awareness campaigns, incorporating the methodology in the school curriculum and programmes of the Ministry of Agriculture, and increasing the coverage of equipment for recording climatic information for accurate and efficient delivery of seasonal weather forecasts and advisories.

Key words: PICSA methodology, climate information, climate-smart agriculture, sustainable land management, Malawi

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ABBREVIATIONS

ADB	Asian Development Bank
AEDO	Agriculture Extension Development Officer
AIDS	Acquired Immune Deficiency Syndrome
APES	Agriculture Production Estimates Survey
CCAFS	Climate Change, Agriculture and Food Security
CGIAR	Consortium of International Agricultural Research Centers
CSA	Climate-Smart Agriculture
DAES	Department of Agriculture Extension Services
DAESS	Decentralised Agricultural Extension Services System
EPA	Extension Planning Area
FAO	Food and Agriculture Organization
FDG	Focus Group Discussion
GDP	Gross Domestic Product
GIS	Geographic Information System
GPS	Global Positioning System
HIV	Human Immunodeficiency Virus
ICF	International Classification of Functioning, Disability and Health
IPC	Integrated Food Security Phase Classification
JCE	Junior Certificate of Education
KII	Key Informant Interview
LRCD	Land Resources Conservation Department
MSCE	Mlawi School Certificate of Education
MGDS	Malawi Growth and Development Strategy
NAIP	National Agriculture Investment Plan
NGO	Non-Governmental Organization
PICSA	Participatory Integrated Climate Services for Agriculture
PSLCE	Primary School Leaving Certificate of Education
RAM	Resource Allocation Map
SDG	Sustainable Development Goals
SMS	Subject Matter Specialist
SSA	Sub-Saharan Africa
UNDP	United Nations Development Programme
UNEP	United Nations Environmental Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
USAID	United States Agency for International Development
VCPC	Village Civil Protection Committee
VDC	Village Development Committee
VSL	Village Savings and Loans
WFP	World Food Programme

1. INTRODUCTION

1.1 Background

In Malawi, the agriculture sector faces significant biophysical and socio-economic challenges that have hindered poverty reduction and employment creation despite the growth of the agricultural gross domestic product (National Planning Commission 2020). The sector faces persistent low productivity largely as a result of degraded soils. It is estimated that 29 tonnes of soil per hectare are lost each year due to poor agricultural practices and rapid population growth, which have forced production to marginal areas like slopes and river banks (Vargas & Omuto 2016). Vargas and Omuto (2016) observed that these practices often lead to deforestation and increased soil erosion. On the other hand, highly variable rainfall has always made it difficult for farmers to plan which crops to plant and when to plant them (Government of Malawi 2017). Various extension service approaches, promoted by the Ministry of Agriculture and Food Security, have fallen short in terms of the need to incorporate farmer-specific problems that have negatively affected the adoption of climate-smart agriculture practices in Malawi (Government of Malawi 2016).

Part of the solution to the numerous challenges that Malawian farmers are facing is incorporating improved climate forecasting and more information about historical climate patterns using the Participatory Integrated Climate Services for Agriculture (PICSA) methodology. This is one of the approaches that the Ministry of Agriculture and Food Security, in collaboration with the Department of Climate Change and Meteorological Services (DCCM), are using to deliver agricultural extension services to farmers in Malawi. The approach is aimed at building the capacity of agriculture extension agents and farmers to use and integrate downscaled seasonal forecasts and climate information with relevant and location-specific crop, livestock and livelihood information (Vargas & Omuto 2016). The implementation of agricultural and livelihood options promoted by the approach has the potential to address climate-related risks, increase agricultural production and improve the livelihoods of farmers (Vargas & Omuto 2016; Government of Malawi 2017). Success stories have been registered in other countries where the methodology has been implemented. For instance, Dayamba et al. (2018) reported that 97% of the farmers in Senegal found the approach very useful. It included making changes to the timing of implementation of land management activities, the selection of suitable crop varieties and the adaptation of plans for the season, based on the forecasted weather information and actual resources available to farmers.

So far, over 200,000 farmers from different districts in Malawi, including Chikwawa, have received training on the PICSA methodology (Government of Malawi 2022a). Frontline extension workers in Chikwawa district have trained 4,360 Lead Farmers in the methodology since 2015 (Government of Malawi 2022a). The implementation approach is designed in a such a way that the frontline extension workers from the Extension Planning Areas (EPA), in collaboration with Subject Matter Specialists (SMS) from the District Agriculture Office, the Department of Climate Change and Meteorological Services and non-governmental organisations, conduct a series of meetings with farmers in their communities during the growing season. This is done by chronologically following all steps outlined by the PICSA methodology field guide. The methodology emphasizes the need to provide climate and weather information for farmers to consider long before the onset of the rainfall season and to conduct joint analysis of information on crops, livestock and livelihood options and their risks by field staff and farmers. This process is done with the aid of different participatory tools like the Resource Allocation Map (RAM) and seasonal calendar in order to enable farmers to use this information in planning and decision making for their individual

circumstances (Vargas & Omuto 2016). The series of these meetings ends with a review of the whole implementation process shortly after the rainfall season in order to make appropriate adjustments based on the performance of the approach.

However, uptake of this methodology by the farmers in Chikwawa district has been slow since its introduction in 2015 (Government of Malawi 2022a). Despite discussing progress of the PICSA implementation in several review meetings, there is inadequate documentation of the key factors leading to low adoption of the technologies advocated by the methodology in Chikwawa district. As a result, farmers are still facing the adverse effects of weather-related events, such as prolonged dry spells, floods, pest and disease infestation. Furthermore, the increasing human population in Chikwawa district is intensifying the pressure on natural resources, including arable land, which leads to unsustainable agricultural practices and low productivity (Government of Malawi 2017).

1.2 Objectives

The main objective of this study was to identify the factors that affect adoption of the PICSA methodology for adapting and mitigating the effects of climate variability and/or change in Chikwawa district, Malawi. Specifically, the study sought to achieve the following objectives:

a) To identify socio-economic factors that affect adoption of the PICSA methodology in Chikwawa district.
b) To assess farmers' perception of the impact of the PICSA methodology in managing the effects of climate change in Chikwawa district.
c) To determine appropriate measures and practices that could increase adoption of the PICSA methodology in Chikwawa district.

1.3 Research questions

The main research question guiding the present study was: what are the factors that lead to adoption of the PICSA methodology in Chikwawa district?

The study sought to specifically address the following questions:

a) What are the socio economic factors affecting adoption of the PICSA methodology in Chikwawa district?
b) What are farmers' perceptions of the importance of the PICSA methodology in Chikwawa district?
c) What measures and practices should be put in place to enhance adoption of the PICSA methodology in Chikwawa district?

1.4 Importance of the study

Several issues affecting adoption of climate-smart agriculture practices in Malawi have been widely discussed and documented by extension workers, experts and implementing partners during meetings, workshops and conferences. However, a detailed study on the factors affecting adoption of PICSA methodology in Malawi, Chikwawa district in particular, has never been conducted since its introduction in 2016. The paramount importance of the present study is to add to the existing body of knowledge on the factors affecting adoption of PICSA methodology in Chikwawa district. The outcome of this study will help agriculture extension workers and other stakeholders have a better understanding of the adoption process of the PICSA methodology and to make informed

decisions on the best strategies to address the contextual needs of farmers in as far as PICSA implementation is concerned in Chikwawa district. Furthermore, the results of the study could have the potential of influencing the adoption of sustainable land management practices promoted by the PICSA approach in other districts in Malawi and other countries where the methodology is being practiced. Implementation of climate smart agriculture practices and livelihood options promoted by the PICSA methodology has immense potential to increase crop yield and reduce poverty levels among communities, which is one of the priority areas outlined in Malawi Vision 2063 (National Planning Commission 2020).

2. LITERATURE REVIEW

This chapter introduces the concept of Participatory Integrated Climate Services for Agriculture (PICSA) and key issues affecting its implementation in Malawi and other countries. Under this section, literature was reviewed on relevant topics such as definition of key words and concepts of the approach, challenges that farmers are facing in agricultural production, current extension methods in the Ministry of Agriculture and Food Security in Malawi and their impact on agricultural production. The chapter also reviewed the impact of effective policy implementation in agricultural production.

2.1 Importance of the agriculture sector in world economies and development

Globally, agriculture accounts for a relatively small share of the economy in comparison to other industries such as mining and trade but it still remains central to the livelihoods of many people (Alston & Pardey 2014; van Arendonk 2015; FAO 2021). A 2021 report by the Food and Agriculture Organization (FAO), showed that about one billion of the world's population has been directly engaged in farming activities for the past two decades (FAO 2021). Nevertheless, in middle and low-income countries where most of the world's farmers live, agriculture contributes substantially more to national income and employment (van Arendonk 2015; Alston & Pardey 2014). For instance, in India, agriculture accounted for 18% of the national income and 54% of employment in 2014 (Alston & Pardey 2014).

In Sub-Saharan Africa, agriculture is a key sector in development given its huge contribution to the overall economy in the region (African Development Bank 2018; Diao et al. 2010; FAO 2021). A case in point is Ghana and Uganda where agriculture had been contributing stable gross domestic product (GDP) growth rates of 4.5% and 6.5% respectively between 1990 and 2004 (Diao et al. 2010). In Malawi, agriculture has remained a major contributor to the gross domestic product over the years, moving from 38% in 1994 to 30.2% in 2017 (Government of Malawi 2017). Furthermore, the agricultural sector accounts for over 80% of Malawi's labour force. It is one of the priority areas in Malawi Growth and Development Strategy (MGDS) III alongside water development and climate change management (Government of Malawi 2017; Mucavele 2013). Agriculture is therefore undeniably an important economic activity in Malawi and has huge potential to contribute to economic development (National Planning Commission 2020).

2.2 Impact of climate change on agricultural production

The nature of agriculture and farming practices in any particular location are strongly influenced by weather and climate (Gornall et al. 2010). The unprecedented rise in global temperatures has resulted in increased droughts, irregular patterns of precipitation, heat waves and other extreme

events (Arora 2019). The impact of climate change is comprehensive but its far reaching effects are now clearly visible in the agricultural sector, which has a huge bearing on food production and the global economic system (Arora 2019). FAO data published in 2016 showed that there will be a major decline in the production of major cereals by the year 2100: 20–45% in maize yields, 5–50% in wheat and 20–30% in rice (Arora 2019). FAO (2016) emphasized that the effects of climate change on agricultural production and livelihoods are expected to intensify over time and to vary across countries and regions, thereby severely affecting the productivity of crops, livestock, fisheries and forestry.

Furthermore, prolonged dry spells which are usually experienced in Chikwawa district have have a negative effect on agricultural production. Apart from causing the wilting of crops and total crop failure, the dry condition enhances pest infestation, mostly by Fall Armyworms, which destroy a wide range of crops in the fields (Day et al. 2018). Fall Armyworms were first reported in Malawi in 2016 and have caused enormous damage to agricultural production, especially in fields where farmers practice monoculture (Government of Malawi, 2022a). Day et al. (2018) reported that several countries in eastern and southern Africa lost a lot of maize in 2017 due to Fall Armyworm attack. Malawi, for example, lost an average of 1,380.3 tonnes of maize, and economic losses were between 225.3 – 561 million US dollars due to the Fall Armyworm attack in the 2017 growing season (Day et al. 2018). Again, an estimated 382,000 hectares of maize, sorghum and millet was reported to have been damaged by Fall Armyworms in the 2018 growing season, affecting over one million farm families (Government of Malawi, 2018b).

On the other hand, agricultural production in Malawi has failed to keep pace with population growth in the past decade, resulting in instances of food shortages during times of erratic rainfall. According to Malawi Growth and Development Strategy (MGDS) III for 2017-2022, the government of Malawi has put emphasis on the need for farmers to shift from relying on rain-fed agriculture to irrigation farming as an adaptation measure to climate variability and/or change (Government of Malawi 2017). Increases in the frequency of droughts and floods are projected to affect local crop production negatively, especially in subsistence sectors (Ching 2010). Therefore, there is urgent need to have adequate strategies to mitigate and adapt to the effects of climate change by establishing infrastructure, investing in local farming practices and indigenous knowledge (Gornall et al. 2010).

2.3 The role of effective extension service delivery in agricultural production

Agriculture production activities of smallholder farmers in sub-Saharan Africa (SSA) are usually facilitated by governmental and/or non-governmental extension services. In many cases, extension services serve as a mechanism for facilitating research into agricultural problems, and providing solutions to farmers who need them (Wesley & Faminow 2014). However, Wesley and Faminow (2014) noted that agricultural extension in some countries follows a common pattern, where technical prescriptions derived from controlled conditions are disseminated using top-down approaches, with little attention to local conditions, often making the content unworkable. The efficiency of rural sector assistance is further complicated by the high ratio of farmers to extension staff, which is a common problem in Sub-Saharan Africa (Dayamba et al. 2018).

In Malawi, the Ministry of Agriculture and Food Security has various strategies for delivering extension services to farmers in order to improve agricultural productivity. Specifically, the Department of Agriculture Extension Services (DAES) in the ministry has the mission to provide pluralistic demand-driven extension services and promote equality and co-ordination to achieve

food security at household level (Government of Malawi 2016). The department is therefore mandated to carry out the following key functions in order to realize this mission:

1) Coordinating agricultural extension activities for all technical departments under the Ministry of Agriculture and Food Security.
2) Institutionalizing a decentralized agricultural extension service system in all districts.
3) Developing and disseminating agricultural extension messages.
4) Enhancing research/extension/farmer linkages.
5) Coordinating formation and management of farmer organizations.
6) Enhancing mainstreaming of gender and HIV/AIDS issues in all agricultural programs.
7) Enhancing agribusiness knowledge and skills in staff and farmers.
8) Enhancing community nutrition knowledge and skills in staff and farmers.

The providers of extension services use different methods, approaches and systems for farmer and client engagement. Some of the approaches promoted by DAES are farmer field schools; farm business schools; integrated homestead farming; lead farmer approach; household approach; agriculture resource centre; and radio listening groups among others (Government of Malawi 2018). Effective provision of extension services through these approaches is important as it enhances the adoption of sustainable agricultural practices. However, delivery of extension services through the various approaches mentioned above has faced a number of challenges emanating from climate change, population growth and other socio-econmic factors, including poor policy implementation on land and livelihood support (IPC 2022). According to the Government of Malawi (2016), weak agricultural extension service delivery is attributed to, among other factors, poor coordination and inadequate staff recruitment and training, which affect dissemination and adoption of improved farming technologies. The combined effect of ineffective service delivery, climate variability and/or change, population pressure and land degradation reduces agricultural production, leaving the farming community vulnerable, poor and food insecure (IPC 2022).

2.4 Climate information services in agricultural production

Climate information services, such as seasonal weather and climate forecasts, associated climate risks and periodic weather advisories, have a vital role to play in enabling evidence-based decision-making to address climate-related risks (Srinivasan et al. 2019). It is important to note that there is often a mismatch between the available information and what is needed to support decision-making (Singh et al. 2018), disparity in the capacities of individuals and institutions to utilize climate services (Dinku et al. 2014) and broader ethical, governance and funding challenges (Daron et al. 2022). In South Asia, the World Meteorological Organization supported the National Meteorological and Hydrological Service to implement the Global Framework for Climate Services and establish and strengthen engagement with policy and planning processes for regional and national level linkages (Srinivasan et al. 2019; Daron et al. 2022). Using climate information services, farmers in South Asia are now able to plan and improve management of risks to wheat, maize and rice cropping systems (Daron et al. 2022).

While farming communities are well known for their ability to cope with variations in climate, they are ill-prepared to deal with the increasing frequency of extreme weather events and uncertainty of climate change due to global warming (Ncoyini et al. 2022). Many studies have documented that extension systems in many countries are struggling to shift to more farmer-oriented approaches that emphasize the importance of mutual learning between different knowledge systems as well as

multiple disciplines (Wesley & Faminow 2014). The ability to build effective capacity based on local climate knowledge is therefore vital for sustaining agricultural production in the face of climate change. Thus, farmers could make strategic decisions about maintaining and increasing agricultural production with access to climate information (Ncoyini et al. 2022). This information should always be packaged with possible strategies to cope with the predicted weather events. This was echoed in a research conducted by Ofoegbu and New (2021) in Namibia, where some farmers did not have the interest to access and use climate information which was not accompanied by information detailing the possible response to the projected climate events. The study recommended the establishment of innovative and effective communication by mobile phone, promotion of peer-to-peer learning, collaboration among stakeholders and more attention to long-term forecasts and their implications for adaptive actions (Ofoegbu & New 2021).

2.5 The effect of using the PICSA approach in agricultural production

Having noted that the various extension methodologies are not achieving the intended purpose of food security at household level, the Ministry of Agriculture in Malawi adopted a relatively new approach called Participatory Integrated Climate Services for Agriculture (PICSA). It was first developed in Zimbabwe by a team of researchers from the University of Reading in 2011 under a Consortium of International Agricultural Research Centers (CGIAR) programme on Climate Change, Agriculture and Food Security (CCAFS) (Dorward et al. 2015). Later on, the methodology was piloted and improved in Tanzania and Kenya in 2013. Having registered success stories in Tanzania and Kenya, the methodology was formalised in 2015 and scaled out to several countries in Africa including Ghana, Burkina Faso, Mali, Niger, Senegal, Rwanda, Ethiopia., Lesotho and Malawi, as well as in Asia and Latin America (Dorward et al. 2015). As part of this approach, frontline extension staff work with groups of farmers ahead of the agricultural season to analyze historical climate data and then use participatory tools to determine which crops, livestock, and livelihood options are most suitable for individual farmers (Dorward et al. 2015). Delivery of extension services using this approach is done collaboratively with national meteorology agencies, government extension agents and non-governmental organisations (NGOs). Figure 1 illustrates the steps that are followed when delivering extension services using the PICSA methodology.

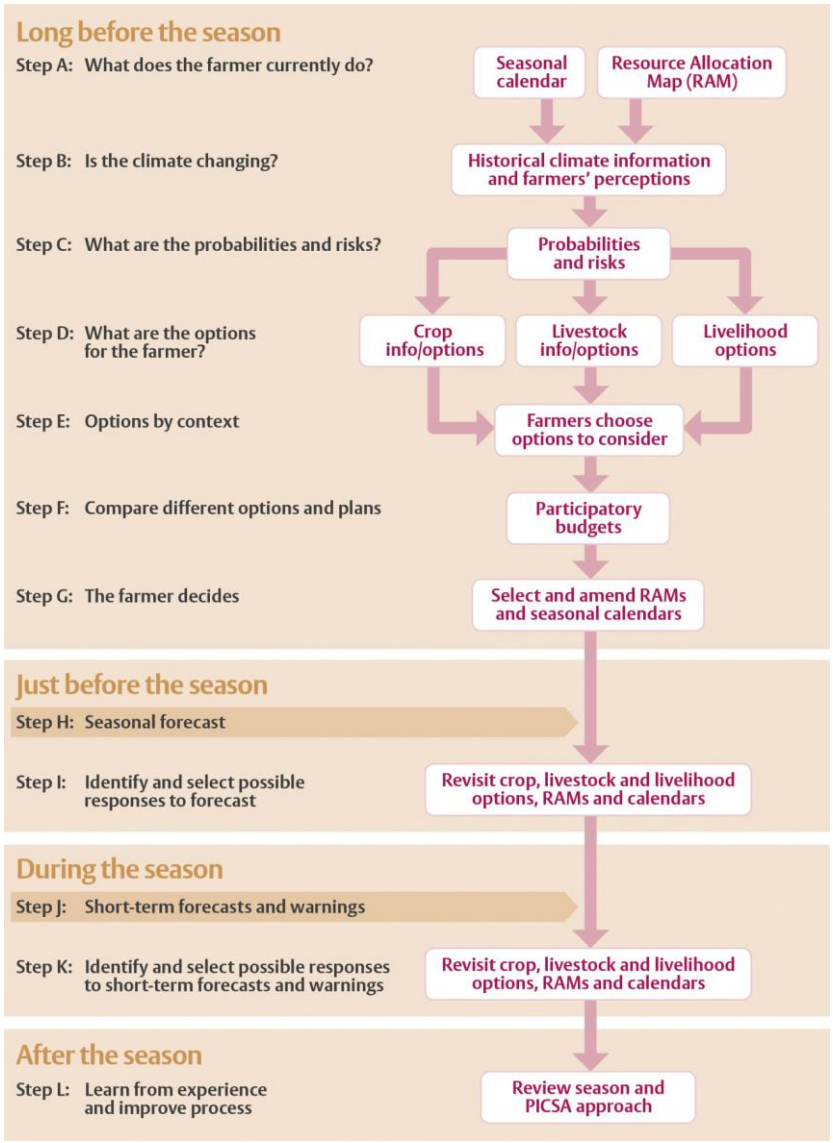

Figure 1. Activity flowchart showing steps to implement the PICSA methodology. (Source: Dorward et al. 2015).

According to Dorward et al. (2015), the PICSA methodology has three key components that define how it should be implemented through a series of meetings with farmers. The following is a description of the key components of PICSA methodology:

a) Providing and considering climate and weather information with farmers including historical records and forecasts.
b) Joint analysis by field staff and farmers of information on crop, livestock and livelihood options and their risks.
c) A set of participatory tools to enable farmers to use this information in planning and decision making for their specific circumstances.

In Malawi, PICSA methodology was introduced in 2015 in selected districts of Balaka, Chikwawa, Dedza, Dowa, Karonga, Mzimba, Nkhata Bay, Nkhotakota, Nsanje, Ntcheu, Salima and Rumphi. So far in Malawi, 20,000 Lead Farmers have been trained nationwide, who later reached out to

over 200,000 smallholder farmers (Government of Malawi 2022a). In Chikwawa, the government of Malawi had been working in partnership with the Department of Climate Change and Meteorological Services (DCCM), World Vision International and WFP to facilitate implementation of the methodology. Through this partnership, the Ministry of Agriculture and Food Security managed to train 62 frontline staff members, where 52 were men and 10 were women. The members of staff facilitated farmer training sessions across the district and reached out to 2,154 male farmers and 2,206 female farmers, totalling 4,360 farmers since 2016 (Government of Malawi 2022a). The approach helped farmers to select early maturing and drought-tolerant crop varieties and practice feed preservation for livestock while some farmers started keeping small stock animals for sale during the lean season (Government of Malawi 2022a). Despite these success stories, a great majority of farmers who received PICSA training were still using old farming practices and continued to experience the effects of weather-related disasters.

3. METHODS OF STUDY

This chapter gives an outline of the research methods that were used to carry out the study. It provides information on the study area, criteria for choosing households that participated in the study and key informant interviews, as well as how the respondents were sampled. The instruments that were used to collect data and procedures followed to carry out the study are also described in this chapter. The chapter further discusses the thematic analysis method which was used to analyse the data. This method was chosen because it is flexible and not attached to any particular theoretical perspective in order to identify themes or patterns in the data that are important in addressing the research questions (Maguire & Delahunt 2017). Braun and Clarke (2016) also noted that this method gives researchers the liberty to examine the diversity of underlying ideas, assumptions and concepts underlying what is stated by the respondents during the interviews.

3.1 Description of the study area

The study was conducted in Chikwawa district which is located in the lower Shire River flood plain in the southern region of Malawi (Fig. 2). The district shares boundaries with Nsanje district in the south, Thyolo district in the east, Blantyre district in the north east, Mwanza district in the north and Mozambique in the west (FAO 2013). Administratively, the district is divided into six Planning Extension Areas (EPA), which are further sub-divided into 124 sections. In 2022, only 52 sections were manned by Agriculture Extension Development Officers (AEDO) while 72 were vacant, representing a 58% vacancy rate (Government of Malawi 2022a). There were 54,520 male-headed households and 65,569 female-headed households giving a total of 120,089 faming households in Chikwawa district as of March 2022 (Government of Malawi 2022a). The major crops grown in the district included maize, rice, sorghum, millet, cotton, beans, pigeon peas and sweet potatoes. Livestock species reared in the district were cattle, goats, sheep, pigs and chicken (Government of Malawi 2022a).

According to a government report of 2022, the district experiences a tropical climate divided into wet and dry seasons (Government of Malawi 2022b). The wet season was reported to start in November and end in April while the dry season could start in May and end in October (Government of Malawi 2022b). The district generally receives unreliable and variable rainfall ranging from 170 mm to 968 mm per annum. Temperatures are generally high, ranging from 19°C in July to 44°C in November, while the annual mean temperature is 37.6°C (Government of Malawi

2022b). The district is prone to natural disasters like floods and prolonged dry spells which are usually coupled with the infestation of pests and diseases (Government of Malawi 2022b).

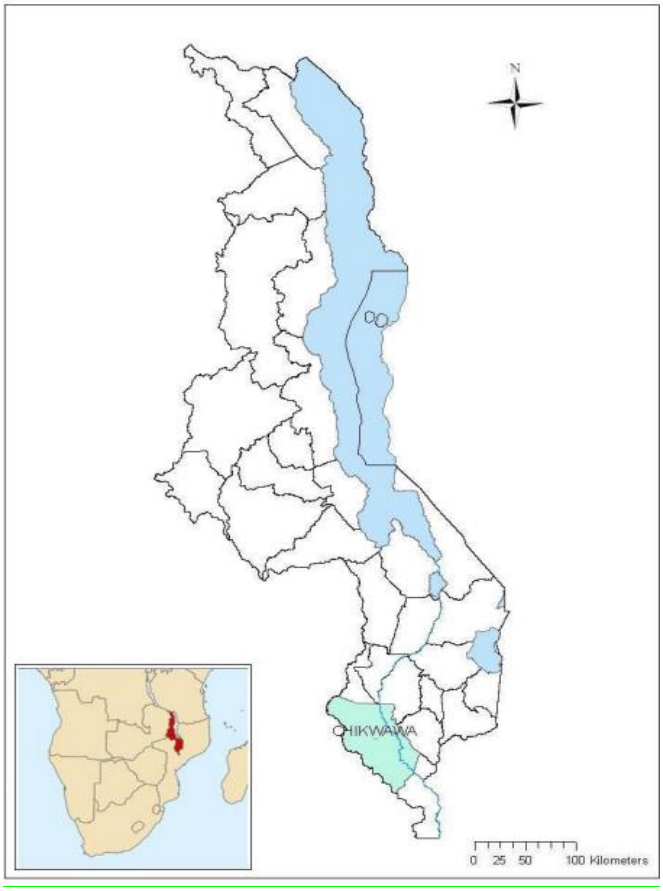

Figure 2. Maps of Southern Africa and Malawi showing the location of Malawi and Chikwawa district respectively. (Source: Sehatzadeh 2011).

3.2 Research design, sampling technique and determination of sample size

An explanatory research design was used for data collection in which face-to-face interviews were conducted with farmers and expert key informants following a questionnaire guide. The explanatory study design was chosen to allow respondents to explain and account for descriptive information by probing them for reasons for adoption of PICSA methodology in Chikwawa district. Explanatory research design allows respondents to provide evidence for supporting or refuting their explanation or prediction (Akhtar, 2016). The data collectors were encouraged to make independent observations around the households and agricultural fields of the respondents to supplement the information collected using open-ended questions.

Purposive and stratified random sampling was used to determine the number of households to be interviewed. Two categories of farmers participated in the household interviews. The first category comprised of farmers who had received training in the PICSA approach. This category was sub-divided into two groups of adopters and non-adopters. The second category of respondents contained farmers who had not received training in PICSA methodology and were not following the concept despite being exposed to it through on-farm demonstrations and field days. Stratified

random sampling ensured the capture of both social and ecological variability of the two groups (Shi 2015).

The number of farmers who participated in the household interviews was only 20 due to resource constraints (time and finance) and was split into two categories as described above. The first category had 15 farmers who received training on the PICSA methodology. This group was sub-divided into two groups of five adopters and 10 non-adopters. The second category of respondents contained five farmers who had not received training in the methodology. Marshall (1996) noted that samples for qualitative research are generally small because qualitative research recognizes the fact that some informants have more information than others and that these people are more likely to provide insight and understanding for the researcher. Marshall (1996) further observed that for a random sample to be selected, the characteristics of the whole population under study should be known, which is rarely possible in a complex qualitative study, making probabilistic sampling to be neither productive nor efficient. Thus, 20 farmers for the household interviews was considered enough to provide adequate and rich information to be used for drawing conclusions and recommendations. The chart in Figure 3 summarizes the criteria which were used to select farmers who participated in the household interviews.

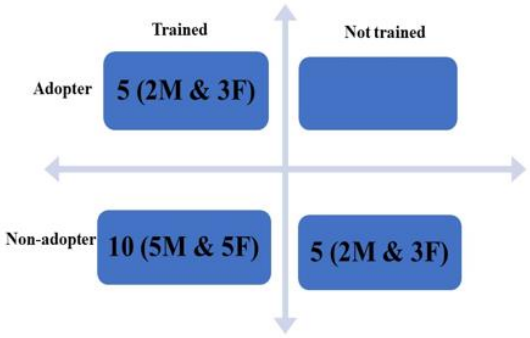

Figure 3. Chart showing categories of farmers who participated in household interviews in the study area

Apart from the household interviews, the study also conducted four key informant interviews (KII) with experts from key implementing partners in Chikwawa district. Key informant interviews are in-depth qualitative interviews of a small number of individuals, identified based on their organization, positions, knowledge and experience regarding the particular topic under study (Elmendorf & Luloff 2006). The purpose of the key informant interviews is to collect rich, varied and textured first-hand information from a wide range of people including community leaders, professionals, or residents who have particular knowledge and understanding, and can provide insight on the nature of problems and give recommendations for solutions (Elmendorf & Luloff 2006). The team of experts which participated in the key informant interviews comprised of the Acting Extension Methodologies Officer from Chikwawa District Agriculture Office; a Community Development Facilitator from the World Vision District Office; a Senior Assistant Meteorologist from the Department of Climate Change and Meteorological Services (DCCM); and a representative of Agriculture Extension Development Coordinators (AEDCs) from Mitole EPA.

3.3 Gender effects

The government of Malawi prioritizes increasing and transforming agricultural production through diversification and enhanced community resilience to climate change that impacts women and vulnerable groups more than other groups (National Planning Commission 2020). Implementation of climate-smart agriculture practices promoted by the PICSA methodology would improve agricultural productivity of vulnerable groups including women who largely contribute the workforce in the agriculture sector (National Planning Commission 2020). This study recruited more women than men for household interviews because there were more female headed than male headed households in Chikwawa district in 2022 (Government of Malawi 2022a).

In Malawi, as in most African countries, women are essential to agricultural productivity as they make up 70% of the agricultural labour force, produce 70% of household food and perform 50-70% of all agricultural tasks (UN Women, UNDP, UNEP & World Bank 2015). A study on the gender gap in agricultural production in Sub-Saharan Africa which focused on causes, costs and solutions of the gaps found that if the gender gap in agricultural productiion was closed in Malawi, the country could increase its crop yield by 7.3% per annum and increase gross domestic product (GDP) by 1.8% (UN Women, UNDP, UNEP & World Bank 2015). Increasing the number of women respondents for the household interviews in this study also helped to understand core issues which affect adoption of the PICSA approach in Chikwawa district. Inclusion of vulnerable groups in the programming of any development of activities would ultimately help in addressing gender disparity issues when planning sustainable agricultural production strategies and programmes in the district.

3.4 Data collection

The study employed various data collection methods for a comprehensive understanding and validation of the findings. Household interviews were conducted in all six Extension Planning Areas (EPAs) of the district by a team of trained enumerators, see Fig. 4 for details on the spatial distribution of the farmers who participated in the household interviews. In addition, four in-depth key informant interviews (KII) with selected experts were conducted. The data gathered from the key informant interviews provided a logical basis for the development of practical and community-based solutions to the issues based on the study.

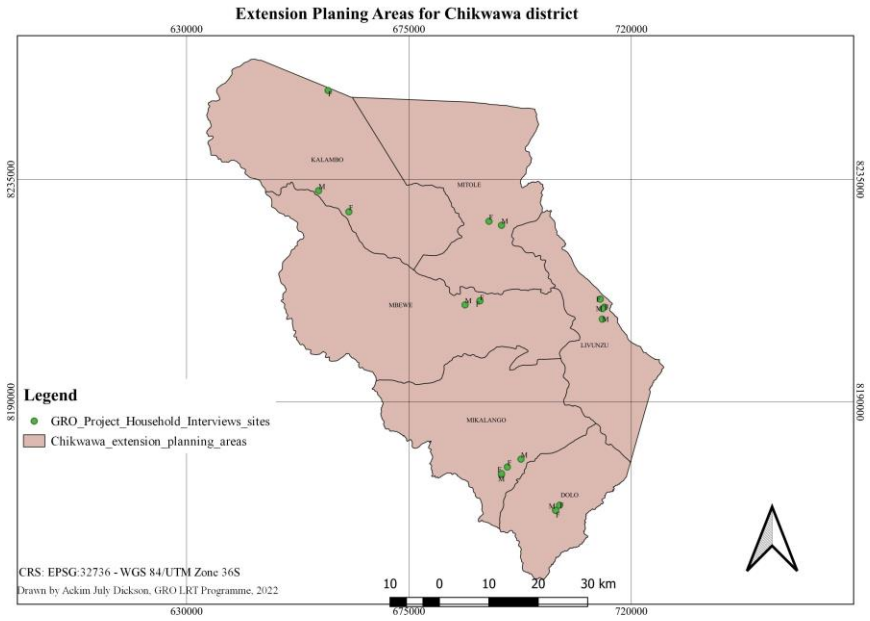

Figure 4. Map of Chikwawa district showing the spatial distribution of farmers who participated in the household interviews.

It should be noted that data collection was conducted by a team of six Agriculture Extension Development Officers. This team of officers was coordinated by a Subject Matter Specialist from the Land Resources Conservation Department (LRCD), Chikwawa District Ariculture Office. The interviewers were first trained before conducting the interviews. Moreover, development of the questionnaires for both household and key informant interviews followed a series of improvements based on the feedback from farmers and the data collection team after pre-testing the questionnaires. This step was very important because it helped the research team to understand if the respondents understood the questions. More importantly, the pretesting session helped the data collection team to refine their probing skills while administering the questionnaire which led to the successful collection of the required data (see appendices 1 and 2).

The key areas that were addressed included the effects of climate change on agricultural production, the impact of the PICSA methodology on agricultural production and farmers' livelihoods, the benefits of PICSA methodology, and challenges and proposed solutions for accelerating the adoption of the PICSA methodology in the district. Lastly, field observations were used as a tool for additional data collection. The enumerators also geo-referenced the houses where the household interviews were conducted using hand-held GPS receivers.

3.5 Data analysis

Qualitative analysis was used to explore the interview data to gain an understanding of the farmers' assessments and the decisions they had taken following their participation in the PICSA methodology. This was done by transcribing and decoding responses from the interviews. The responses were later categorized into main themes that emerged from the study. Maguire and Delahunt (2017) defined thematic analysis as a flexible method of identifying patterns within qualitative data which is not tied to a particular epistemological or theoretical perspective. The themes in this study included: evidence of climate change and/or variability, impact of climate change on agricultural production, sustainable land management practices in the study area,

technologies promoted by PICSA methodology, means of message dissemination under PICSA approach, benefits/reasons for adopting PICSA methodology, challenges affecting adoption of PICSA methodology, and strategies for enhancing adoption process of PICSA methodology.

R-studio was used to analyse quantitative data from the household interviews to generate descriptive statistics such as frequency tables, charts and graphs of demographic data. ArchGIS was used to produce a map of the georeferenced households where the household interviews were conducted.

3.6 Ethical consideration

The farmers who participated in the household interviews were drawn from a list of farmers who had been trained in the PICSA approach in the district since 2016 and another set of randomly selected farmers from the same communities. The researcher had easy access to the list of farmers from Chikwawa District Agriculture Office because of his position of District Land Resources Conservation Officer in the Ministry of Agriculture and Food Security. In order to ensure ethical conduct in this study, the sampled farmers and key informants participating in the interviews were asked for their consent. This was done by explaining to them the purpose of the information to be collected from them. The respondents were assured of their confidentiality and privacy.

As observed by Arifin (2018) on the importance of applying appropriate ethical principles and confidentiality for participants in qualitative research, the household interviews were conducted individually in a private and quiet room at the participant's home without access by outsiders. Only the enumerators were able to match the identity of the participants and voice recordings. Many qualitative researchers have stressed the need for observing ethical principles when conducting research using face-to-face interviews with vulnerable groups and/or communities who may be unable to express their emotions during a sessions (Kang & Hwang 2021). The research team therefore explained to the farmers that the data collected from them would be used for the purpose of this study. On the other hand, the research team asked for permission from the Subject Matter Specialists to disclose their positions to establish credibility of the information provided during the interviews. Kaiser (2009) emphasized that researchers must ascertain in advance whether information providers wish to remain anonymous or receive recognition, and must do their best to meet those preferences. Kaiser (2009) further hinted that researchers must also inform their participants about the potential impacts of their choices, and explain that anonymity may still be compromised despite their best efforts. All the experts who participated in this study agreed that their positions could be disclosed.

4. RESULTS

The results presented in this chapter are based on the data obtained through the household and key informant interviews. Direct quotes taken from interviews are presented in italics to illustrate the actual standpoint of the respondents.

4.1 Socio-economic and demographic characteristics of farmers in the study area

The general characteristics of respondents in the study area are of great importance because they show salient features of the social context of the farming communities in the district. Therefore,

characteristics such as gender, age groups, size of household, level of education and source of income are presented.

4.1.1 Distribution of respondents in household interviews and their age

Table 1 shows how the 20 respondents in the household interviews were distributed by gender as well as spatially across the six EPAs in Chikwawa district. Out of the 20 respondents, 11 were women while nine were men.

Table 1. Distribution of respondents for household interviews in the study area.

Name of EPA	Adopter		Non adopter		Not trained		EPA Totals
	Male	Female	Male	Female	Male	Female	
Kalambo	0	1	1	1	0	0	**3**
Mbewe	0	0	1	1	0	1	**3**
Mitole	1	0	0	1	0	1	**3**
Livunzu	0	1	1	1	1	0	**4**
Mikalango	0	1	1	1	1	0	**4**
Dolo	1	0	1	0	0	1	**3**
District Totals	**2**	**3**	**5**	**5**	**2**	**3**	**20**

Figure 5 shows that the age groups of the respondents were dominated by the 40-45 year age group, representing half of all respondents. The results also suggest that the farming community has few youthful households as evidenced by the presence ofonly one household in the 26-30 age category and none in the 18-25 and 31-35 age categories.

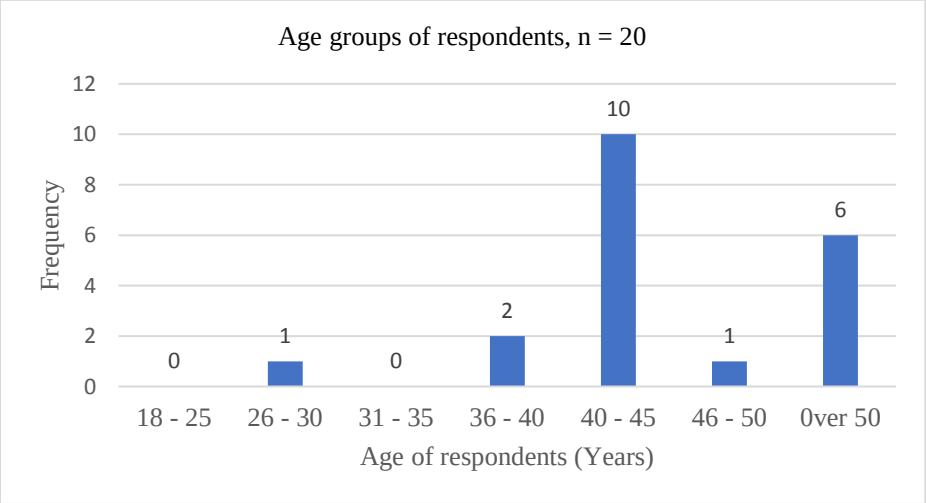

Figure 5. Age categories of respondents in the study sample.

4.1.2 Size of households

The results in Figure 6 show that many sample households had five members and that no household had less than four members. Furthermore, some households had many members ranging from eight

to 10. The results of this study are in tandem with the 2018 Malawi national census findings where Chikwawa was one of the most densely populated districts, with an average of 116 people per square kilometer (National Statistical Office 2019).

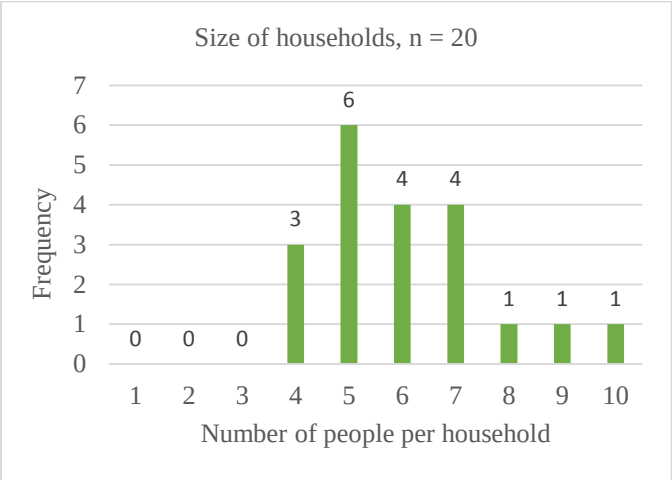

Figure 6. Size of households in the study sample.

The trend for number of children per household was similar to the number of people per household as seen in Figure 7. It was observed that most households had three children followed by families with five children. It is also important to note that some households had many children ranging from seven to eight. These results revealed that the fertility rate of the sampled households was much higher than the average national fertility rate of 4.4 children per household, which was reported by National Statistical Office from a 2015/2016 Malawi Demographic Health Survey (National Statistical Office & ICF 2017).

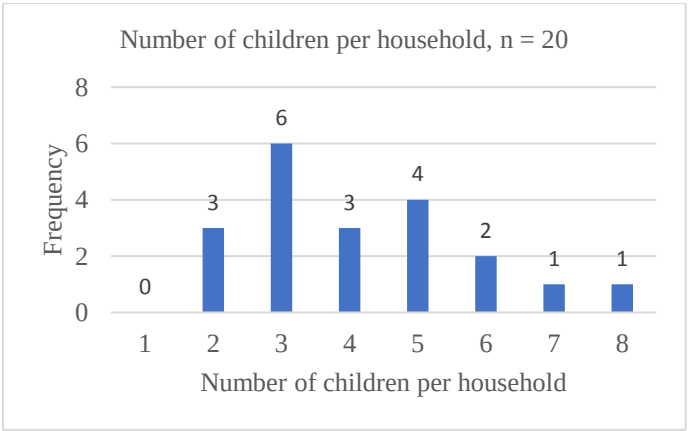

Figure 7. Number of children per household in the study sample.

4.1.3 Education level of the respondents

Figure 8 shows the level of education of the respondents.. In Malawi, the education system starts with primary schooling, which is completed in eight years after passing the Primary School Leaving Certificate of Education (PSLCE) examinations. The next level is secondary education,

which is divided into junior and senior sections. The junior section has two years, that is, 10 years of schooling in total. Completion of the junior section depends on passing the Junior Cerificate of Education (JCE). The last two years of secondary education, or 12 years of schooling in total, ends with passing the Malawi School Certificate of Education (MSCE). Thereafter, one can pursue different courses at tertiary level for a certificate, diploma or degree programme. In this study, the results showed that 10 farmers attended primary education, representing half of the respondents, while seven attained the JCE. The results also showed that only two farmers completed secondary education having obtained the MSCE. Interestingly, none of the respondents attended tertiary education while one farmer did not attend any formal education in his lifetime. These results give the impression that a considerably large percentage of the population in the study area have a low education level.

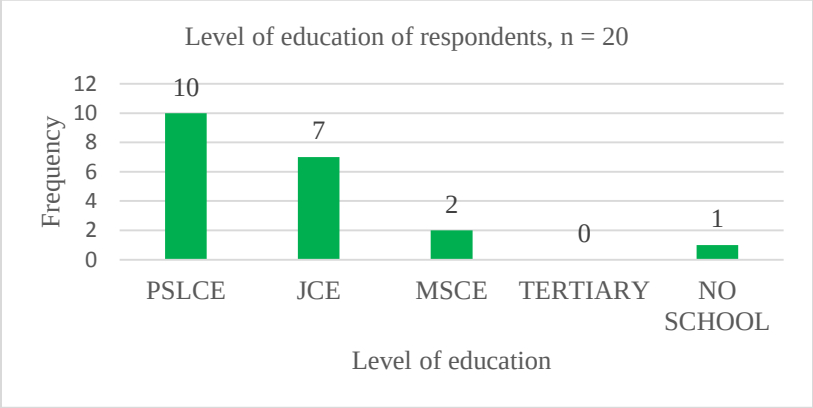

Figure 8. Level of education of the respondents.

4.1.4 Land holding size and type of crops grown in the study area

Figure 9 shows that the land holding size of half of the respondents is between 1.1 and 5 hectares, which is generally enough to produce food and cash crops in Malawi. It is important to note that eight farmers who participated in the household interviews had a land holding size between 0.6 and 1 hectare. The results further show that two farmers had a land holding size of equal to or less than 0.5 hectares, but none had a land holding size greater than 5 hectares.

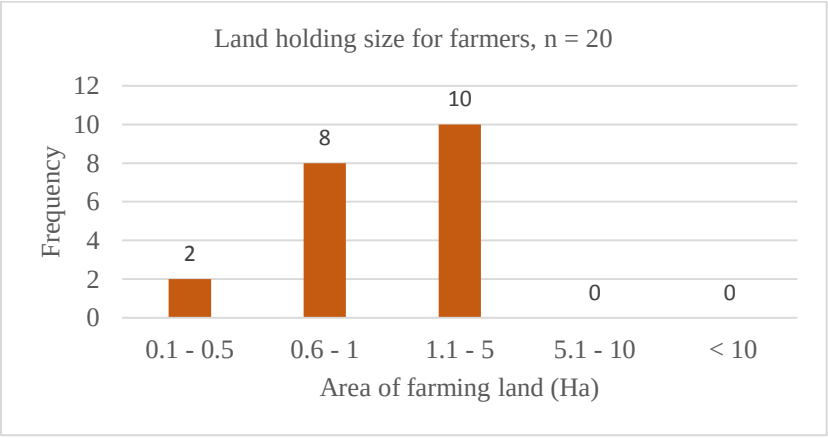

Figure 9. Land holding size of farmers participating in the study.

Figure 10 shows that maize is the dominant crop produced by the interviewed farmers, as 17 farmers indicated that they grow the crop as their staple food. Other important food crops grown in the district include millet, sorghum, rice, beans, sweet potatoes and pigeon peas. Some farmers said they grow cash crops such as cotton and sesame.

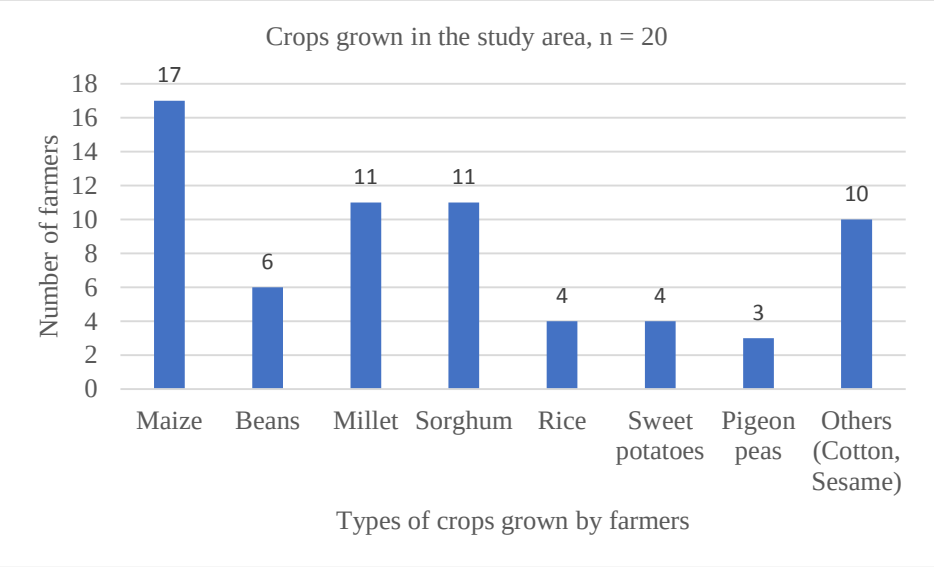

Figure 10. Types of crops grown in the study.

4.1.5 Sources of income

The dominant economic activity of the people in the study was subsistence agriculture, where people grow crops such as maize, rice, beans, sweet potatoes, cotton and sesame, among others, mainly through rain-fed production. Figure 11 shows that all the interviewed farmers engage in agriculture as their primary source of income. Eight farmers indicated that they do casual labour on other people's farms and for companies like Illovo Sugar (Malawi) Limited, Farmer Coorporatives and invest some of the money in Village Savings and Loans (VSL) groups. Other sources of income reported by the household respondents include employment, small-scale businesses and selling charcoal.

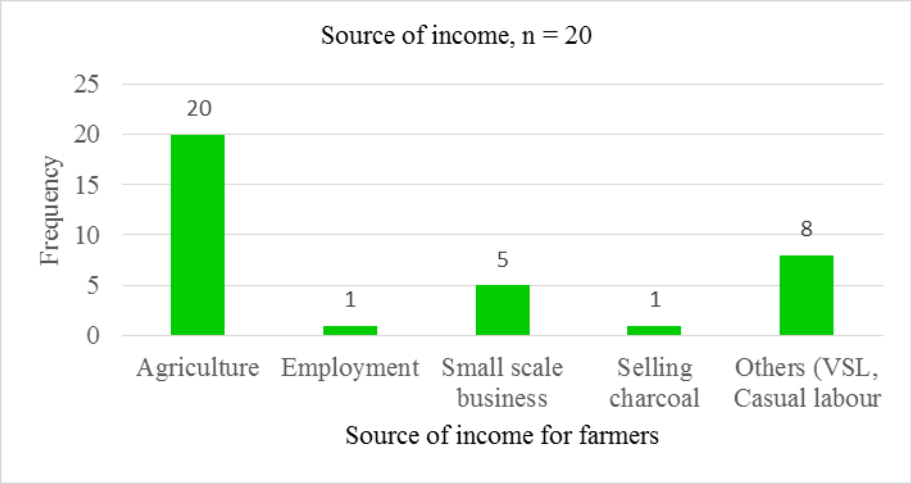

Figure 11. Sources of income for farmers in the study.

4.2 Perception of farmers regarding climate change and its impact on agricultural production

The sampled farmers were asked to express theirs views on the climate trends and their impact on agricultural production. Almost every farmer stated that the climate has been changing over the past 10 years. Several reasons were given as evidence of climate change or variability. The most frequently mentioned evidence of climate change was varying rainfall where farmers said they experienced intense rainfall which usually resulted in flooding and the washing away of crops and household properties. The farmers emphasized that the frequency and magnitude of floods had increased in the district such that some areas that never experienced floods in the past were now badly affected. One of the farmers who grows maize and rice in the eastern banks of Shire River said:

> *When I was young, we used to experience floods in February. Right now, the story has changed because we are experiencing floods anytime and the affected area is very big; this is totally different from past events when only areas close to Shire River were affected by the floods. This year, I lost all my rice because of the heavy floods we had in January. I do not have anything to support my family because I rely on rice as a source of income to buy household essentials and pay school fees for my children.*

Another important aspect of rainfall mentioned by the farmers was the onset of the rainfall season. Many farmers reported that they were usually receiving planting rains in October or early November in the 1990s. However, the first planting rains are no longer predictable as the rains can start in December and sometimes in January which affects the crop calendar and all agriculture-related activities. The Senior Assistant Meteorologist from DCCM corroborated the farmers by stating that average total rainfall amount received per growing season in Chikwawa district has been changing since 1968.

On the other hand, some farmers stated that they experience prolonged dry spells almost every year now as compared to the past 10 years. The dry spells usually last for a minimum of one week, leaving most crops heavily affected. In certain instances, the dry spell can last for two weeks and leave devastating effects to the extent that farmers are forced to plant again. In such circumstances,

farmers usually plant recycled seed whose viability and vigour are not recommended by the Ministry of Agriculture and Food Security. Farmers also cited inadequate drinking water and loss of feed for livestock, wilting of crops and total crop failure as the consequences of dry spells.

The experts mentioned floods, dry spells, late onset and early ceasation of rainfall as evidence of climate change. They said that floods result in soil erosion and the washing away of crops, leading to reduction in crop yields and livestock.

Furthermore, farmers cited pest and disease outbreaks as another sign of climate change and/or variability. They said that the damage caused by pests, Fall Armyworm in particular, is huge and compromises food security. One of the female farmers who participated in the household interviews had this to say on the impact of Fall Armyworm:

> *In recent years, we have experienced strange army worms which are very aggressive in eating our crops in the fields. These worms are so different because they are resistant to traditional remedies which we usually use to kill the ordinary army worms. One has to apply pesticides many times in order to contain them and it is difficult because we cannot manage to buy the pesticides because of high prices on the market. As a result, we loose our crops and remain food insecure and poorer than before. When I was young, our family was able to harvest bumper yields without applying any pesticide; nowadays it is impossible to produce our crops without applying pesticides.*

The farmers also reported instances of heavy winds or cyclones to be a clear sign of climate change. In their naratives, they indicated that the heavy winds that the district experienced in 2019 and early 2022 were exceptional. They were accompanied by intense rainfall and were later reported to be cyclone Idai and cyclone Ana respectively. According to the farmers, they had never before experienced such wind and subsequent floods which damaged people's property and claimed many lives. Farmers were still recovering from the impact of cyclone Ana by the time the household interviews were conducted. One farmer recollected the events that occurred in the community in January 2022:

> *We just noted that the magnitude of the wind on that particular day was not normal; many houses were blown off. The heavy wind was followed by heavy rainfall which washed away everything in the village. We have never seen such type of wind before; I think the climate has really changed; we are experiencing strange events every year.*

Another evidence of climate change and/or variability reported by the interviewees was increased heat and number of hot days. The farmers stated that there are now more hot days per year, especially before the beginning of the rainy season than before. Asked about the actual difference in numbers, the farmers could not provide specific numbers but were quick to say that the degree of "hotness" has also increased. One of the farmers singled out 2019 as the hottest year of his life because he lost two young cows due to the heatwave. The Senior Meteorologist and Acting Extension Methodologies Officer also mentioned that the increased number of hot days had an impact on agricultural production as the heat is usually associated with dry spells.

4.3 Benefits of the PICSA methodology

According to the farmers in Chikwawa district who had adopted the PICSA methodology, the ability to make a decision based on weather forecasts and advisories from the Department of Climate Change and Meteorological Services and the Ministry of Agriculture and Food Security was the most important factor for adoption. They reported that, based on weather forecasts and climate advisories, they were able to choose what crop variety to plant, the appropriate planting period for the crops and what technologies to implement in order to increase crop yields.

Another reason for adoption was reported to be the ability to diversify livelihood options. One of the farmers mentioned that the PICSA methodology enabled her to start keeping small livestock, such as chickens and rabbits. According to this farmer, small livestock are a source of food and income. The farmer emphasized the importance of small livestock during lean seasons when she sells them and buys staple food for her family.

Again, the PICSA methodology encourages farmers to invest the little income they get from agriculture and other sources into Village Savings and Loans. This concept has helped farmers to increase their annual income. Many farmers are now able to buy basic necessities and pay school fees for their children with ease. One of the farmers who has adopted PICSA methodology said that she bought iron sheets for her house using interests from a Village Savings and Loan group. She said she was encouraged to join the VSL group during a PICSA methodology training in her community.

> *I never dreamed of sleeping in a decent house before. We used to sleep in a leaking grass thatched house but that is history now. My children and I are safe during the rainy season. I thank our extension worker for teaching us different methods for agricultural production, including joining the VSL group which is perceived as a loan shark by many people in the village. I wish everyone could join this group because it is a life saver when we do not have any other source of income during crop failure.*

Another important point raised by farmers as a reason for adoption was the level of awareness of the need to implement sustainable land management practices on a catchment basis as promoted by the PICSA methodology. The farmers said that they were now aware that it is important to implement the recommended agricultural practices holistically in order to realise the benefits. One farmer said that he has the duty to make sure that all farmers surrounding his field are following what is advocated by PICSA methodology in order to minimize the effects of floods, dry spells, pests and diseases. The interviewed experts summarized the benefits of PICSA by mentioning the ability of the methodology to offer farmers an opportunity to diversify crop, livestock and livelihood options. According to the experts, diversification of crop, livestock and livelihood options increases their resilience to the effects of climate change. Increased farmers' resilience was also attributed to the implementation of climate-smart agriculture practices. Table 2 summarizes the importance of different technologies promoted by PICSA as reported by the adopter farmers, non-adopter farmers and the experts.

Table 2. Sustainable agricultural and livelihood practices promoted by the PICSA methodology.

ID	Name of agriculture technology or livelihood practice	Importane
1	Early land preparation	• Allows for timely planting and subsequent field activities
2	Planting with first rains	• Gives chance for crops to use adequate rainfall since the rain season can be short • It helps reduce pest infestation as crops planted late are prone to Fall Armyworm attack
3	Planting early maturing varieties	• Allows farmers to harvest even during times of inadequate rainfall or dry spells
4	Planting improved varieties	• The yield per hectare is high compared to local varieties
5	Crop diversification	• Increases resilience of farmers to unpredictable weather conditions • Increases income
6	Conservation Agriculture	• Conserves moisture • Controls soil erosion • Improves soil fertility • Increases crop yields
7	Integrated pest management with emphasis on use of biological measures and other innovations	• Controls pests with lower costs • Environmentally friendly
8	Making hay for livestock to be used in dry season	• There is feed for livestock during the dry season • Hay is easily stored • It is cheap because farmers use green forage, which is readily available during the rainy season
9	Record keeping	• It helps farmers to know if their production is profitable • It helps decision making in subsequent growing seasons
10	Soil and water conservation (agroforestry, manure utilization, check dams, contour ridging, construction of swales, vetiver hedgerow planting)	• Improves soil condition • Reduces/controls soil erosion • Conserves moisture • Improves fertility • Agroforestry trees provide feed for livestock
11	Promotion of other livelihood options like village savings and loans groups, and small scale businesses	• Increases income and resilience of farmers

4.4 Challenges affecting adoption of PICSA methodology

The results from the study revealed many challenges that possibly affect adoption of the methodology in Chikwawa district. Firstly, farmers said that the methodology is not user-friendly to resource-poor farmers who can not afford the basic requirements for production that would result in successful implementation of the methodology. Agricultural farm inputs such as inorganic fertilizer and improved hybrid seeds were mentioned as the most needed requirements for the PICSA methodology to be successful but these are very expensive. All 10 farmers who had not adopted the methodology said they did not have the capacity to buy improved hybrid seeds and

inorganic fertilizer as advised by the agriculture extension workers. As a result, they were forced to follow their old ways of farming despite having attended PICSA methodology training successfully. The willingness of the non-adopter farmers to implement sustainable land management practices suggests that they were concerned with the impact of climate change. None of the experts mentioned, however, that the methodology is not user-friendly to any specific group of farmers in the study area.

Another challenge which was mentioned by the farmers was lack of and/or inadequate follow up visits by extension workers after the training sessions in PICSA methodology. This was lamented by both adopter and non-adopter farmers in the study. Some farmers indicated that they failed to implement some technologies like construction of improved kholas (kraal) and conservation agriculture because of lack of technical knowledge and skills. The AEDC for Mitole EPA and the Acting Extension Methodologies Officer agreed with the farmers' sentiments by stating that their offices have challenges of mobility due to inadequate human and financial resources. A high vacancy rate was mentioned as the biggest challenge to the delivery of extension services to farmers. The experts also mentioned a lack of motorcycles and fuel as other factors contributing to inadequate follow up visits by frontline staff. The AEDC for Mitole EPA attributed this problem to lack of commitment from the Ministry of Agriculture and Food Security to include PICSA methodology as part of its core activities.

Many of the farmers also reported that the Department of Climate Change and Meteorological Services (DCCM) provided generalised weather forecasts for the district, which could mislead farmers in terms of planning what type of crops they should plant and when to plant them. Thus, a lack of area-specific downscaled weather forecasts led to some farmers not adopting PICSA methodology. On the same note, the farmers mentioned that DCCM sometimes provides incorrect weather forecasts resulting in crop failure either due to too much rain or dry spells because the farmers had implemented technologies that did not match the weather conditions.

Furthermore, it was reported that PICSA methodology does not favour farmers who have very limited land for production. The farmers indicated that most of them have limited pieces of land for production and cultivate their crops on rented fields where tenure is not guaranteed. They said that owners of the rented fields often snatch back the land whenever they see some successes registered by the tenants. As a result, the tenants do not see the benefits of implementing sustainable land management practices promoted by the methodology, which often provides benefits in the medium to long term. A farmer who had been cultivating his maize on rented plots had this to say:

> *I successfully attended the training on PICSA methodology. However, I am not implementing the practices that we learned at the training because of lack of interest. I feel like the landlord will take away the land before I can realise the benefits of the methodology. Otherwise, I still feel the methodology is very good in our area where we experience dry spells and floods sometimes.*

Again, farmers reported that seasonal weather forecasts and advisories do not reach many farmers since very few were trained in the PICSA methodology. This makes it difficult for the farmers to implement technologies on a catchment basis. Asked on the means of message dissemination from DCCM and the Ministry of Agriculture and Food Security, the farmers indicated that they usually receive messages through the radio, cell phones (for those who have them), extension workers and

field days. One of the farmers lamented that the Ministry of Agriculture is not doing enough to train many farmers in the district:

> *We are very few of us who attended the training. We cannot manage to reach out to our friends because of lack of mobility and other resources. I believe the impact of PICSA methodology would be seen if everyone was implementing the good practices promoted by the methodology. May you, please, extend our plea to the authorities to train as many farmers as possible and also give us lead farmers the necessary support we deserve.*

4.5 Strategies for accelerating adoption of PICSA methodology

In order to address the challenges that affect adoption of the PICSA methodology, the experts and most farmers cited several strategies to improve the adoption process of the methodology. The most frequently mentioned strategy was timely release of seasonal weather forecasts and advisories by DCCM. The farmers indicated that this is very crucial in agricultural production because the information helps to plan their crop calendar accordingly. Additionally, the farmers indicated that the weather forecasts should be downscaled to local conditions/agro-ecological zones to avoid generalizations which result in poor performance of crops. All the experts also indicated that there is great need for DCCM to release weather forecasts and advisories on time to allow farmers to have adequate time for planning.

As advice, some farmers suggested that DCCM should install more raingauges for improved weather forecasting as well as train local communities to read and keep records of weather information. This suggestion was corroborated by the Senior Assistant Meteorologist from DCCM, who said his department does not have adequate raingauges which could assist in providing accurate information about the amount of rainfall, number of rainy days, and onset and ceasation of the rainfall season. The officer indicated that their department is collaborating with implementing partners like World Vision and WFP to procure more equipment for improved weather forecasting.

Most of the farmers suggested that Ministry of Agriculture and Food Security should explore other avenues for disseminating information about PICSA methodology. The farmers noted that weather forecasts and advisories from DCCM are sent to farmers as text messages, jingles on radios and sometimes through extension workers. According to the farmers, these are not adequate means of information dissemination since some farmers do not have the luxury of owning cell phones and radios. Most of the interviewed farmers said there should be additional means of communication so more farmers would be able to access the weather forecasts and advisories. Examples included use of community structures like Village Development Committees (VDC), Village Civil Protection Committees (VCPC), churches and any meetings organised by development partners or politicians in the communities.

The farmers strongly encouraged the Ministry of Agriculture and Food Security to liase with the Ministry of Education on the possibility of incorporating the PICSA methodology in the school curriculum, especially at the elementary level, so that the pupils would grow up being exposed to the methodology. According to the farmers, the PICSA methodology should be used beyond farming because it incorporates many issues dealing with the livelihood of people. The Agriculture Extension Development Coordinator for Mitole EPA had similar sentiments. He stated that the methodology should be incorporated in all development programmes including agriculture, fearing

that the methodology would not reach many farmers when the project phases out. The Community Development Facilitator from World Vision had similar views where she suggested inclusion of the PICSA methodology in any activity at household level to improve farmers' livelihood.

Some farmers hinted that authorities should allocate more time for the training sessions on PICSA methodology. They said that extension workers always rush through the materials which requires a lot of time to comprehend and implement. As a result some steps are not as clear as needed and this compromises the implementation process of the methodology. The farmers gave examples of topics that they feel should be given adequate time, such as participatory budgeting and analysis of historical climate information, where focus should be put on the probabilities and risks of growing different crops. Experts from the Ministry of Agriculture and Food Security, and World Vision, had the same suggestion of providing adequate time during training sessions for farmers to gain a better understanding of the critical steps of the methodology. According to the experts, this could lead to more effective implementation of all technologies promoted by the methodology.

The fifth strategy suggested by the farmers was for the Ministry of Agriculture and Food Security to promote the establishliment of many demonstration plots and conducting many field days so that surrounding communities would have access to and could implement the various technologies and livelihood activities promoted by the methodology. The Community Development Facilitator from World Vision corroborated the farmers' opinion by mentioning the establishment of demonstration plots as community learning centres for the methodology.

Furthermore, it was strongly advised by the farmers that the Lead Farmers should have regular refresher training and be supported with necessary resources (bicycles, stationery and lunch allowances) for them to train fellow farmers in the community. Where possible, the number of Lead Farmers should be increased to ease the workload of the few Lead Farmers present in the district. This point was supported by experts from the Ministry of Agriculture and Food Security, and World Vision, who said that there are very few members of staff and they cannot cover the whole district. Therefore, it is important to keep on training more Lead Farmers who have the potential to accelerate adoption of the methodology, given they receive adequate training.

The farmers also suggested the formation of PICSA clusters where farmers could meet easily and share experiences on best practices which are working in their localities and suggest solutions on the challenges they face while implementing the methodology. Increased farmer-to-farmer engagement would, according to some farmers, encourage slower learning and less interested farmers to adopt the methodology. They said this should be facilitated by the extension workers and make sure that they make follow-up visits regulary. The Acting Extension Methodologies Officer and the AEDC also hinted that frequent engagement between frontline staff and farmers through existing structures could increase the rate of adoption of the methodology.

Again, the Agriculture Extension Development Coordinator for Mitole EPA, suggested that the Ministry of Agriculture and Food Security should instutionalise PICSA methodology in its programmes. Thus, the ministry should include the methodology in planning and allocate adequate financial resources for its implementation. The AEDC opined that planning and financing the methodology would ensure its sustainability when development partners pull out of the programme.

Finally, the farmers suggested that there should be mass awareness campaigns on the importance of PICSA methodology. Most of the interviewed households indicated that all possible platforms accessible by farmers should be used to disseminate PICSA information. Examples of platforms included community radio, national television channels, school meetings and social media. One of the farmers emphasized that these awareness campaign meetings should target school children because they hold the future of economic development of the country:

> *PICSA methodology is a very good tool for development. As we all know, children grasp information easily compared to us grown up people. Awareness campaigns on this methodology should therefore focus on primary school children. This is the generation which will turn things around; they will grow up knowing the importance of incorporating the methodology in their activities. I hope issues of food insecurity will be history if this plan is implemented.*

In addition to the suggestions made by the farmers on the dissemination of information, the Acting Extension Methodologies Officer pointed out that the methodology should embrace ICT as another means of reaching many farmers in the district. He said that the Ministry of Agriculture and implementing partners should take advantage of the growing interest among stakeholders and farmers on the use of social media as a means of communication.

5. DISCUSSION

The overall objective of this study was to identify factors that affect the adoption of PICSA methodology for adapting and mitigating the effects of climate variability and/or change in Chikwawa district, Malawi. In order to achieve this goal, the study had three specific research questions that guided data collection and analysis. This section discusses the results of the study in relation to similar studies to answer the research questions.

It is important to note that this study only conducted 20 household interviews and four key informant interviews due to limitations of time and financial resources. As such, the results discussed in this chapter are based on the opinions of these respondents only and may not provide a full picture of the issues affecting adoption of PICSA methodology in Chikwawa district.

5.1 What are the socio-economic factors affecting adoption of PICSA methodology in Chikwawa district?

5.1.1 Level of education of the respondents

The results of the study suggest that there are many factors that may affect the adoption process of the PICSA methodology. First and foremost, socio-economic factors have huge potential to influence a particular farmer to adopt sustainable agricultural practices. It is interesting to note that 10 out of the 20 farmers who participated in the household interviews dropped out of school at elementary level. This was followed by a group of farmers who attended secondary education for two years only while two of them managed to finish secondary education. Again, none of the interviewed farmers attended tertiary education and one of them did not attend any formal education at all. Theses findings suggest that it might be difficult for the farmers to comprehend complicated technologies advocated by Ministry of Agriculture and Food Security such as PICSA methodology.

It should be noted that one of the pillars of the PICSA methodology is joint analysis of information on crops, livelihood and livestock options and their risks, by field staff and the farmers. This is done by going through 12 steps of the methodology in a series of meetings, one after another without skipping any step. The most crucial part of the methodology is the first part which involves understanding and interpreting historical climate information using probabilistic mathematical models. The extension workers use different tools to help the farmers understand and interpret the data/information from the Department of Climate Change and Meteorological Services.

After analyzing the historical climatic information, farmers are also required to calculate risks associated with the climatic information in relation to crop and livestock enterprises, including various livelihood options at their disposal. All these processes require farmers to have the ability to understand concepts quickly and the importance of education cannot be overemphasized in this case. The results from this study indicate that Malawi could have fallen short of the United Nations' expectation, which declared the years between 2005 and 2014 to be the Decade of Education for Sustainable Development, the goal of which was to utilise education as a means of integrating the principles of sustainable development with human values and perspectives in order to create a sustainable society (UNESCO 2005). This was followed by the Incheon Declaration that seeks to transform people through education, recognizing education's important role as a main driver of achieving all proposed Sustainable Development Goals (SDGs) by 2030 (UNESCO 2016).

Nzunda et al. (2013) found a negative regression coefficient of education of the household heads interviewed in a study assessing the socio-economic drivers of land use and vegetation cover changes in and around Kagoma Forest Reserve in Tanzania. The researchers found that an increase in the level of education reduced the possibility of households causing environmental degradation, because they were exposed to knowledge of wise use of natural resources, including the implementation of good agricultural practices (Nzunda et al. 2013). Thus, educated farmers had an advantage over less educated ones in understanding the benefits of natural resources management, which fostered adoption. It is therefore imperative to seriously consider the best ways of delivering the concept of PICSA methodology in Chikwawa where the education levels of farmers are relatively low. Howe (2009) argued that there is an urgent need for a comprehensive, quantitative and critical assessment of the role of education in order to determine how educational policies may be carried out in the most cost-effective manner to aid the implementation of environmental conservation strategies.

5.1.2 Landholding size and tenure

Another socio-economic factor which may play an important role in the adoption process of PICSA methodology relates to land ownership and the landholding size of the household. The results suggest that many farmers have small pieces of land, mostly below one hectare. The size of the land keep on decreasing as the number of members in the household is increasing. The family is forced to share the small pieces of land with their children whenever the children want to be independent. As observed from the results, the households are quite big, where some have nine or ten members. As a result, the farmers are forced to cultivate their crops on rented pieces of land. In most cases, rented land is not good for long-term investment as the owners tend to take their land back whenever the tenants are harvesting better yields because they have implemented sustainable land management practices. Examples of such practices include agroforestry and conservation agriculture, the benefits of which are only realised after a good number of years.

Although the technologies are good, farmers are afraid to make such long term investments because of the uncertainty connected to the tenure of the land.

In a study of the adoption of climate-smart agriculture technologies in Tanzania, Kurgat et al. (2020) found a positive relationship between the adoption of crop diversification and agroforestry with land ownership and size. Their study therefore suggested that authorities should put more focus on improving land tenure rights alongside enhancement of women's empowerement in household decision making in order to increase the rate of adoption of climate-smart agriculture programs in Tanzania. In another study, Autio et al. (2021) found that land tenure restrictions in Kenya had an influence in limiting the adoption of certain practices and technologies, such as crop rotation and agroforestry. The results of this study align with the findings of Autio et al. (2021) and Kugart et al. (2020), where the farmers' willingness to invest in certain sustainable land management practices and livelihood options promoted by PICSA methodology was influenced by land tenure and size of the land.

5.1.3 Sources of income

The findings of the study show that agriculture is the main source of income for all the households in the study area while some farmers also venture into other livelihood options for additional sources of income, such as small scale businesses, Village Savings and Loans, casual labour and the sale of charcoal and firewood. Only one farmer indicated employment as an additional source of income. As most of the farmers have limited pieces of land for production and the types of crops they plant (e.g. maize, sorghum, millet, sweet potatoes, beans and rice) were basically for food, sale of the harvest can lead to food insecurity at an early stage before the lean period starts. Very few of the farmers stated that they grow cash crops, such as cotton and sesame, as a source of income. However, the sizes of the land per household are too small to realize meaningful benefits from producing these cash crops.

It is regrettable and, at the same time, not surprising that many farmers who were trained in PICSA in Chikwawa were failing to adopt the methodology because of lack of adequate resources to implement the technologies, practices and livelihood options. Kifle et al. (2022) found that households in the central highlands of Ethiopia with higher on-farm and off-farm income were more likely to adopt conservation agriculture by 33.6% and 39% respectively than those with low on-farm and off-farm income. Those findings are similar to the results of this study as some farmers indicated that lack of resources, such as adequate land for production and money to buy essential agricultural inputs advocated by the PICSA methodology, affected their willingness to adopt the recommended practices and technologies.

5.1.4 Inadequate and inconsistent extension services

Inadequate, or lack of, follow-up visits by extension workers defeats the core purpose of their existence in the Ministry of Agriculture and Food Security. This challenge could be attributed to the high vacancy rate of extension workers in Chikwawa district, inadequate financial resources and mobility as stated by the Agriculture Extension Development Coordinator for Mitole EPA and the Acting Extension Methodologies Officer for the district. The officers agreed with farmers' demands for more Lead Farmer training sessions to ease the workload of the few extension workers and Lead Farmers.

As advocated by the Ministry of Agriculture and Food Security, it is important to make follow-up visits to farmers if the various sustainable agriculture practices are to be adopted. For instance, some farmers in the study area indicated that they failed to implement certain technologies, such as construction of improved kholas (kraal) and conservation agriculture, because of a lack of technical knowledge and skills. The Decentralised Agricultural Extension Services System (DAESS) in the Ministry of Agriculture and Food Security was revised to address emerging issues like these following a number of study and review findings, the implementation of various projects, and the policy direction in promoting agricultural development as guided by Malawi Vision 2063 (Government of Malawi 2021). The guidelines specifically seek to enhance collaboration and coordination of service providers in agricultural extension and advisory services in order to encourage harmonisation and integration in service provision. The guidelines also intend to promote interaction, engagement, dialogue and innovations with farmers and stakeholders to take collective action on issues of common interest (Government of Malawi 2021).

Dayamba et al. (2018) argued that it is worth considering whether PICSA is increasing the workload of already stretched extension agents because it was designed to complement the basic functions and roles of the extension workers (Dorward et al. 2015). Dyamba et al. (2018) further noted that the high farmer-to-extension worker ratio raises the debate of the efficiency and effectiveness of face-to-face service delivery in comparison to relying on facilities provided by Information and Communications Technology (ICT) in a context where extension services are under strain. Similarly, Ncoyin et al. (2022) observed that lack of effective agricultural extension services was the most critical constraint to coping with and adaptating to climate change. While it is important to incorporate ICT in disseminating information to farmers as proposed by the Acting Extension Methodologies Officer, the findings of this study suggest that it is important to continue with the face-to-face engagement with farmers, taking into consideration that some farmers do not have the capacity to access extension services and climate information through ICT.

5.2 What are the farmers' perceptions of the importance of the PICSA methodology in Chikwawa district?

5.2.1 Improved decision-making in agricultural production and livelihood activities

The Participatory Integrated Climate Services for Agriculture (PICSA) methodology has registered many success stories in countries where it has been implemented, ranging from increased crop yields to positive impacts on the livelihoods of communities (Vargas & Omuto 2016). Various reasons have been cited by farmers for adopting the methodology in agricultural production. This study documented a number of benefits of the PICSA methodology. First and foremost, the farmers singled out the ability to make decisions based on weather forecasts and advisories from the Department of Climate Change and Meteorological Services as the most important factor for adoption. The decision making process, according to the farmers, is the most critical step in PICSA methodology because the district faces multiple problems related to climate change or variability, such as flash floods and dry spells. The farmers said they are now able to choose what crop variety to plant, the appropriate planting period for the crops and what technologies to implement in order to increase crop yields based on weather forecasts and advisories. Therefore, more accurate and timely delivery of seasonal weather forecasts and advisories would really improve agricultural production and the livelihoods of farmers in Chikwawa district.

Dayamba et al. (2019) found that implementation of the PICSA methodology in Senegal and Mali stimulated a range of innovations by farmers in addressing the effects of climate change. It was

reported in that study, regarding the assessment of the use of the PICSA approach by farmers to manage climate risk, that all men and about 95% of women from Senegal judged the approach as very useful while women in Mali made several changes in their agricultural production (Dayamba et al. 2019). Some of the technologies triggered by PICSA implementation included manure utilization, choice of crop varieties, adapting sowing dates, adapting production plans to available resources (reducing crop land size) and applying stones to contour lines to reduce soil erosion. Despite the methodology being complex, most of the farmers who participated in this study also mentioned that the methodology is generally useful. Furthermore, research on the effects of PICSA for farmers in Africa by Clarkson et al. (2022) showed overwhelmingly positive effects on decision making in agricultural production and livelihood options.

Clarkson et al. (2022) reported that PICSA had important personal and social impacts for farmers in the continents of Africa, Asia, South and North America. About 91-98% of the farmers in the study indicated that their confidence in planning and decision making had increased after PICSA training. The farmers further reported that their social standing had improved within their households and communities because of adopting the PICSA approach. All the experts that participated in this study also stated that the PICSA methodology had improved farmers' decision making processes regarding the best practices and livelihood activities to be implemented based on weather forecasts. This is a clear indication that the methodology could be a good option for adaptation in the era of climate change.

5.2.2 Diversification of crop, livestock and livelihood options

The results suggested that both adopters and non-adopters agreed that PICSA methodology is a measure to adapt to the effects of climate variability and/or change because of its principle of diversifying crops, livestock and livelihood activities. The adopter farmers demonstrated that the methodology is changing their lives socially because of increased income levels through improved crop production, small scale businesses, rearing of small livestock and participation in Village Savings and Loans groups. Through implementation of PICSA methodology, the Community Development Facilitator for World Vision Malawi reported that one of the trained farmers had totally transformed the household from hunger-stricken to self-reliant courtesy of PICSA methodology. That household was documented as a success story for the PICSA methodology describing that the farmer has a decent house, a grocery shop, seven goats, six ducks, eight chickens and 12 pigeons.

Similar results have been reported by many studies regarding the benefits of crop and/or livestock diversification in combating effects of climate change. Clarkson et al. (2022) documented several positive cases of livelihood diversification in many countries where farmers were investing in new crops or planting a different variety of crop and/or changing the management of crops (soil and water management, timing of planting). The farmers combined crop production with livestock enterprises (increasing scale, changing feed and veterinary practices), starting a new livestock enterprise and adapting wider livelihood strategies.

Sardar et al. (2020) emphasized the importance of livelihood diversification options in Pakistan due to population growth and climate variability in order to enhance household resilience against environmental shocks and climate change. Estimates from the same study examining the role of livelihood diversification as a part of climate-smart agriculture strategy showed that farmers who adopted crop, livestock and off-farm diversification as an adaptation strategy to mitigate the

impacts of climate change earned 9.3% more income than non-adopter farmers (Sardar et al. 2020). Likewise, cocoa farmers in Ghana opted for income diversification through non-farm activities as an adaptation strategy to climate change having noted that the changing rainfall regime negatively affected the production of cocoa and other crops (Kosoe & Ahmed 2022). These results clearly show that the diversification of crops, livestock and off-farm livelihood activities have a great potential to increase the farmers' resilience to the effects of climate change as long as they are implemented following recommended standards.

5.2.3 Improved productivity through sustainable land management technologies

The results showed that all the adopters reported improved crop production compared to the time before adopting PICSA methodology. The successes ranged from better crop and animal resilience to dry spells to increased crop yields per unit area, including improved land conditions for production. These benefits were attributed to the implementation of a number of sustainable land management and livestock interventions. For instance, adopter farmers stated that they apply manure in their fields and practice conservation agriculture, in-situ rainwater harvesting through construction of planting pits and swales, agroforestry, construction of marker ridges, planting of vetiver hedgerows, construction of check dams as well as planting with the first rains. The farmers further reported that, because of PICSA training, they acquired the knowledge and skills to make hay bales for livestock to be used during the dry season.

It is worth noting that most of the technologies mentioned by the farmers are already promoted by the Ministry of Agriculture and Food Security in Malawi. The difference is in the efficiency and effectiveness of the technologies because they are now carefully chosen and implemented based on the seasonal weather forecasts and advisories from the Department of Climate Change and Meteorological Services. Furthermore, the farmers reported the need to always keep records because they help in deciding what enterprise is profitable in their context. The National Land Resources Management Policy and Strategy promotes efficient, diversified and sustainable use of land-based resources both for agriculture and other uses to ensure sustainable socio-economic development (Government of Malawi 2000). One of the objectives of the Malawi National Agriculture Policy is to improve agricultural productivity through programmes that mitigate land degradation investments in climate-smart agriculture and sustainable land and water management (Government of Malawi 2016). Examples of the interventions include integrated soil fertility management, agroforestry and conservation agriculture. The availability of policies that promote sustainable land management practices is an opportunity for PICSA methodology to compliment government efforts to combat the effects of climate change as this is the original design of the approach (Dorward et al. 2015).

In Ghana, farmers were motivated by PICSA methodology to implement soil and water conservation technologies as the main activities to improve their adaptability to local climate and increase their production (Dayamba et al. 2018). This motivated a development partner, USAID, to support farmers who were implementing sustainable land management interventions in Senegal through the Global Climate Change project while their friends in Mali were connected to an agricultural inputs loan project that helped farmers obtain seeds and fertiliser to increase production (Dayamba et al. 2018). Thus, systematic implementation of sustainable land management can unlock other opportunities that might increase farmers' resilience to climate change.

CIAT and World Bank (2018) documented sustainable land management practices in Africa, including Malawi, that could potentially restore soil nutrients, water and microbial activities to soil health. The practices included conservation agriculture, agroforestry, improved fertilizer and manure utilization. These are some of the agricultural practices promoted by the Ministry of Agriculture and Food Security that remain central in addressing the challenges of land degradation and decreased agricultural productivity which have been exercerbated by climate change in Malawi (Government of Malawi 2018a). PICSA methodology therefore stands a better chance of improving the implementation process of these technologies and transforming the livelihoods of resource-poor farmers in Chikwawa district.

5.3 What measures and practices should be put in place to enhance adoption of PICSA methodology in Chikwawa district?

Much as the PICSA methodology has offered many benefits to farmers (Dorward et al. 2015), there are several factors that should be taken into consideration when advocating implementation of the methodology. The findings of this study revieled some weakness in the extension service delivery in Chikwawa district that may have contributed to low adoption of the PICSA methodology. It was noted from from both adopter and non-adopter farmers that extension workers do not meet farmers regularly to assist them with technical information and skills for implementing sustainable agricultural practices and livelihood activities. The farmers indicated that the time provided for training sessions is not adequate as some topics require more time for the farmers to fully comprehend. It was also noted that only a few Lead Farmers had been trained in PICSA methodology, which redusced the possibilities to reach out to many farmers in the district. Furthermore, both farmers and Subject Matter Specialists pointed out that lack of resources, such as motorbikes for extension workers or bicycles for Lead Farmers, stationery and fuel, affect delivery of extension services in Chikwawa district. Both farmers and experts suggested timely and improved provision of the key resources mentioned above as one of the priority areas to be addressed in order to increase extension worker/farmer-to-famer engagement when implementing PICSA methodology.

With respect to the issues of extension service delivery, both farmers and experts said that the Department of Climate Change and Meteorological Services in Malawi often provides generalised weather forecast information and advisories. According to most of the interviewed farmers and all four experts, the provision of such generalised information may lead to the implementation of inappropriate practices and livelihood options, thereby affecting production. It was reported by both farmers and experts, that DCCM provides the weather forecasts late when farmers have already started land preparation for the season. The District Senior Assistant Meteorologist from DCCM confirmed this problem by stating that the department does not have enough raingauges to be installed in all strategic areas. He said the problem makes it difficult for the department to provide accurate weather forecasts and advisories to its client, including farmers. These sentiments are in total agreement with Srinivasan et al. (2019) who stressed that credible climate information is an important starting point for effective climate services and risk management decisions. This observation is consistent with opinions of both adopter and non-adopter farmers in the study area who said that incorrect and late delivery of weather forecasts compromises their planning and implementation of agriculture and livelihood activities and thus renders the weather forecasts and advisories ineffective.

Dayamba et al. (2018) had similar fears that the lack of historical climate records due to poor coverage in terms of climate information recording equipment might hamper the implementation of the PICSA approach in some localities. The farmers and the experts in this study therefore demanded timely release of seasonal weather forecasts and accompanied advisories. The farmers said that the timely release of critical weather information could greatly improve decision making on the types and varieties of crops to be planted, when to plant them and what technologies should be implemented in order to improve agricultural production. Dayamba et al. (2018) agreed that there should be initiatives that would improve data availability by filling spatial and temporal gaps in climate observations by combining gauge data with satellite proxies.

An additional strategy suggested by the farmers and experts to improve the adoption of PICSA methodology was to increase awareness amongst farmers and the general public of the importance of climate-smart agriculture practices and livelihood activities advocated by the methodology. This was emphasized by farmers having noted that PICSA methodology targets farmers only, which, according to them, is problematic because the concept has other components that are beneficial beyond the boundaries of agriculture. Thus, the farmers suggested mass awareness campaigns on PICSA methodology through meetings, the formation of PICSA clusters, by mounting demonstrations, and conducting field days and learning visits.

The experts and farmers also suggested that the government of Malawi should incorporate the concept of PICSA methodology in the primary and secondary school curriculum. According to the farmers, teaching the methodology at an early stage of learning is the best strategy that would transform the agriculture sector and the livelihoods of future generations.

6. CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

The aim of this study was to identify socio-economic factors that affect the adoption of the PICSA methodology in Chikwawa district, Malawi. The findings suggest there are a number of factors that contribute to the low adoption of PICSA methodology. These include low level of education in most households, low income levels and small size land holdings as a result of population increase.

The second objective of the study was to assess farmers' perceptions of the impact of PICSA methodology in managing the effects of climate change in Chikwawa district. The study established that farmers are aware of the impact of climate change on agricultural production and their livelihoods. The farmers listed a number of factors as evidence of climate variability and/or change. Examples of these factors included an intense and erratic rainfall regime, increased occurrence and magnitude of floods, persistent seasonal dry spells and infestation of pests like Fall Armyworms and diseases. It was stressed that the weather-related disasters have devastating effects on crop production and their lives in general. As such, implementation of PICSA methodology was cited as an adapatation measure to the effects of climate change.

Some of the benefits of implementing the technologies and practices promoted by PICSA methodology included: informed decision making on the best enterprises to pursue, increased resilience to the effects of climate change because of diversification of crop, livestock and livelihood activities, and improved productivity because of various sustainable land management

and livelihood activities offered by the methodology. This suggests that farmers see the value in implementing the methodology while their socio-economic conditions can impede its adoption.

Several strategies for increasing adoption of the PICSA methodology were put forward by both the farmers and Subject Matter Specialists interviewed in this research. These included improving the coordination and delivery of extension services by all stakeholders, intensifying awareness campaigns using various possible means, incorporating the PICSA methodology in the school curriculum and programmes of Ministry of Agriculture and Food Security, and increasing the coverage of equipment for recording climatic information for accurate and efficient delivery of seasonal weather forecasts and advisories.

In conclusion, Participatory Integrated Climate Services for Agriculture (PICSA) has great potential to be an effective option for adapting and mitigating the effects of climate change in the agriculture sector in Malawi. Implementation of the methodology can faclitate change in farmers' planning because of the underpinning principles of farmer empowerement in decision making and respecting the farmers' opinions to implement practices and technologies that suit their conditions.

6.2 Recommendations

Having discussed the factors affecting the adoption, benefits and strategies for enhancing adoption of PICSA methodology in Chikwawa district, the study has the following recommendations to make:

a) The PICSA methodology should not be implemented in isolation. Other sectors should work in close collaboration with the Ministry of Agriculture and Food Security in order for the methodology to work effectively. Critical areas to be addressed while implementing the PICSA methodology include the need to increase farmers' education level to aid easy understanding of the concept and associated messages, incorporating the concept in the school curriculum for sustainability, and addressing issues of population increase and poverty to improve farmers' access to inputs required for implementing the various technologies and practices promoted by the methodology.

b) The Department of Climate Change and Meteorological Services should fast-track the procurement and installation of weather recording equipment in order to improve its service delivery. Improved weather forecasting information is crucial for the implementation of the PICSA methodology. Complex information should be simplified and packaged in a way so that farmers are able to easily understand the critical steps of the methodology.

c) There were fears that PICSA methodology could never be sustained in Malawi because it is financed by development partners for a certain period of time. The Ministry of Agriculture and Food Security should therefore include PICSA methodology as one of its core programmes requiring financing on a yearly basis for sustainability.

d) There is need for a well-functioning extension service for effective implementation of the methodology. The Ministry of Agriculture and Food Security should therefore strive to fill all vacant positions and provide the necessary training and resources to improve extension service delivery.

e) While this study has provided certain insights into the issues affecting the adoption of PICSA, there is need for a larger study to fully understand the reasons for low adoption of

PISCA in Malawi. This study had a only a small number of participants but it still brought out a number of issues affecting adoption of the methodology. A larger-scale study could therefore unearth further information that could help authorities take the necessary actions to improve implementation of the methodology.

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APPENDICES

Appendix 1: Household interview questionnaire

Household interview questions on adoption of PICSA methodology: challenges and opportunities in Chikwawa district southern Malawi

INTRODUCTION

My name is……., I am one of the data collectors in this study. The study is intended to assess factors that affect and determine adoption of Participatory Integrated Climate Services for Agrculture in Chikwawa district. Your answers to the questions are absolutely confidential. The results published in the study cannot be traced back to you; you will remain anonymous at all time and your participation is voluntary. You are at liberty to remain silent if you do not want to answer any or some of the questions and you can stop the interview at any time. However, your honest answers to these questions will help us to better understand the opportunities and challenges surrounding adoption of PICSA methodology in Chikwawa district. The information will help policy makers and all stakeholders to appreciate the core issues underlying adoption of the methodology in the district. The results from this study will guide the stakeholders to make well informed decisions on the best practices and strategies to promote and improve PICSA methodology in the district. I am therefore grateful for your participation in this study. Kindly answer the questions to the best of your knowledge.

Part I: General information

1. Date ……

2. GPS coordinates: N……..…….……E……..…….……. Elevation (m) …….....

3. Age: (a) 18 - 25 (b) 26 - 30 (c) 31- 35 (d) 36 - 40 (e) 41- 45 (f) 46 – 50 (g) 51 – 55 (h) > 55

4. How many people live in this household? Male……..….. Female…… Total…….…..

5. How many children are in this household? Male……. Female…….. Total…..…..….

6. Are you indigenous to this area? (a) Yes (b) No

7. If no, what was the reason for immigrating to the area?
   (a) Agriculture (b) Small business entrepreneurship (c) Employment (f) Marriage

   (g) Others, please specify…….……..

8. Level of education
   (a) Primary/PSLCE (b) JCE (c) MSCE (d) Tertiary (e) None

9. What is your source of income?

   (a) Agriculture (b) Employment (c) Formal business (d) Selling charcoal or firewood

   (b) (e) Others, please specify…….……..

10. What crops do you cultivate on your farm? (a) Maize (b) Beans (c) Millet (d) Sorghum

(e) Rice (f) Sweet potatoes (g) Pigeon peas (h) Others, please specify……..……

11. What is the estimated size of your farm excluding communal land?

(a) 0.1 - 0.5Ha (b) 0.6-1Ha (c) 1.1-5.0 Ha (d) 5.1-10 Ha (e) < 10Ha

16. Of your total cultivated land, how much land (Ha) is allocated to

ID	Type of crop	Area (Ha)
1	Maize	
2	Beans	
3	Pigeon peas	
4	Cow peas	
5	Sorghum	
6	Millet	
7	Rice	
8	Other, please specify	

Part II: Effects of climate change on agricultural production and impact of PICSA

13. What is your opinion on the trend of climate in the district? Do you feel like the climate has been changing? Please explain your answer.

14. How has the climate affected your agricultural production and livelihood over the past 10 years?

15. What other challenges do you face in agricultural production?

16. Are there any sustainable land management technologies practiced on your farm? If yes, can you tell me what they are?

17. Have you ever heard about PICSA before? (a) Yes (b) No

18. If yes, how did you learn about PICSA?

19. Why did you/did you not adopt PICSA methodology?

20. Do you think PICSA provides any benefits in agricultural production? Please explain your answer

21. Are there challenges associated with PICSA methodology? If yes, what are they?

22. How do you deal with the challenges mentioned in question 21 above?

23. What is your suggestion on the best ways of improving implementation of PICSA methodology?

Part III: Miscellaneous

24. Do you have additional issues to put forward pertaining to the points discussed above?

……
……
……

25. Do you have any final comments, if any, regarding the information provided in this interview?

……
……
……

End of questions

Thank you very much for your participation in this survey. Your answers will be extremely useful for this study on adoption of PICSA methodology in Chikwawa district. Once again, be assured that all the answers you have provided in this survey will be kept strictly confidential and will never be revealed to any other person outside our research group.

Appendix 2: Key informant interview questionnaire

KEY INFORMANT INTERVIEW QUESTIONS ON ADOPTION OF PICSA METHODOLOGY: CHALLENGES AND OPPORTUNITIES IN CHIKWAWA DISTRICT SOUTHERN MALAWI

INTRODUCTION

My name is……., I am one of the data collectors in this study. The study is intended to assess factors that affect and determine adoption of Participatory Integrated Climate Services for Agrculture in Chikwawa district. Your answers to the questions are absolutely confidential and participation is voluntary. However, your position may be disclosed in the report for the sake of credibility of the information you will provide. You are at liberty to remain silent if you do not want to answer any or some of the questions and you can stop the interview at any time. Your honest answers to these questions will help us to better understand the opportunities and challenges surrounding adoption of PICSA methodology in Chikwawa district. The information will help policy makers and all stakeholders to appreciate the core issues underlying adoption of the methodology in the district. The results from this study will guide the stakeholders to make well informed decisions on the best practices and strategies to promote and improve PICSA methodology in the district. I am therefore grateful for your participation in this study. Kindly answer the questions to the best of your knowledge.

Part I: General information

25. Date : ……..…….

26. Name of respondent:……..……Sex..……..…….…...…

27. Position of respondent:...…….…….……

28. Summary of duties of the respondent:
    ……
    ……

Part II: Climate change, PICSA and agricultural production in Chikwawa district

29. What is your expert opinion on the impact of climate change on agricultural production and livelihoods of farmers in Chikwawa district?
    ……
    ……

30. Could you elaborate the benefits of PISCA approach in addressing the challenges posed by climate change on agricultural production in the district
    ……
    ……

31. What kind of information do farmers want to get from extension workers regarding PICSA methodology?
    ……

32. Who are the partners implementing PICSA methodology in the district?

……
……

33. What role do the partners mentioned in question 8 above play in implementing PICSA methodology in the district?

……
……

34. What are the success stories registered from implementing PICSA methodology in Chikwawa district?.....

……

35. What are the notable challenges that you and the institution face while implementing PICSA methodology in the district?

……
……

36. What should be changed in order improve adoption of PICSA methodology in Chikwawa district?

……
……

37. How would you compare PICSA to the other approaches used in delivering extension services to farmers

……
……

Part III: Miscellaneous

38. Do you have additional information to put forward pertaining to the points discussed above?

……
……

39. Do you have any final comments, if any, regarding the information provided in this interview?

……
……

End of questions

Thank you very much for your participation in this interview. Your answers will be extremely useful for this study on adoption of PICSA methodology in the district. Once again, be assured that all the answers you have provided in this survey will be kept strictly confidential and will never be revealed to any other person outside our research group.