# EXTENT OF FARMERS' PARTICIPATION IN AGRICULTURAL DEVELOPMENT PROJECTS, PERCEIVED PROJECT SUSTAINABILITY AND THEIR EFFECTS ON POVERTY SITUATION IN KAKAMEGA COUNTY, KENYA.

**BY**

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**MASENO UNIVERSITY**

## DECLARATION

**Declaration by the Student**

This thesis is my original research work and has not been presented for a degree or award in any other University.

Signature ……..……..…… Date …….

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**Approval by the University Supervisors**

We confirm that the work reported in this thesis was carried out by the candidate under our supervision and has been submitted for examination with our approval as the University Supervisors.

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## DEDICATION

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## ABSTRACT

In recent years the agriculture sector has been highly affected by increasing climate variability and enhanced exposure to extreme weather events. These changes have reduced productivity and led to greater instability in production in the agricultural sector and consequently resulted to increased poverty among the people who primarily rely on rain-fed agriculture for their livelihoods. The government of Kenya and other international development organizations therefore invested massive resources into agricultural development projects due to their contribution towards food security and poverty reduction. However, despite billions of dollars spent on agriculture projects, most of these projects are partially active or the efforts have ultimately ended in halt or failure. Furthermore, farmers' participation in their own projects has not yet attained the acceptable levels that qualify to imply full participation and high levels of poverty still persists among the rural households. This study aimed at determining the extent of farmers' participation in agricultural development projects, perceived project sustainability and their effects on poverty situation in Kakamega County. The study sought to determine socio-demographic and institutional factors influencing extent of farmers' participation in agricultural development projects, determine socio-economic and institutional determinants of perceived sustainability of agricultural development projects and determine the effect of extent of farmers' participation and perceived project sustainability on poverty situation in Kakamega County. Cochran's formula for unknown heterogeneous population size was used to determine 384 respondents. Using cross-sectional research design, structured questionnaires were used to obtain primary data from 384 farmers both project participants and non-participants. Interview schedules were also conducted on 12 sub-county agriculture officers as key informants. Systematic sampling technique was employed to select farmers from the sampling frame of all farmers provided at every sub county. From the Tobit regression model analysis, it was established that extent of farmers' participation in agricultural development projects was positively influenced by the type of project funders and the number of climate smart practices offered by the projects whereas it was negatively influenced by the frequency of extension visits by other extension service providers, distance to the market and legal land ownership status. The ordered probit results demonstrated that the perceived sustainability of the projects was positively influenced by the number of practices adopted from the project, longevity of farmers' participation and training while it was negatively influenced by legal land ownership status, farming experience and adoption cost. The stepwise regression results revealed that extent of farmers' participation in projects had a significant positive effect on the poverty situation of farmers at 1 % level of significance while farmers' perception on sustainability of agricultural projects did not have a significant effect. The study recommends up scaling of agricultural development projects to non-benefiting communities through partnerships between the national government and international agencies funding agriculture in order to offer a wide variety of new climate smart agricultural practices and also enhance high farmer participation in terms of both longevity and high climate smart practice adoption. The projects should also be designed under a bottom-up approach that allows prior assessment of the needs and capabilities of the local farmers. This assists in the development of climate smart agriculture practices and training that is tailored to suit farmers' different needs and capabilities. In addition they should also explore opportunities for cost-sharing among farmers through collective action or by providing subsidies backed by local institutions that will continue to offer quality training, extension services and other forms of support beyond the project period.

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## ACRONYMS AND ABBREVIATIONS

ATE: Average Treatment Effect

ATT: Average Treatment Effect on the Treated

ATU: Average Treatment Effect on the Untreated

CBOs: Community-Based Organizations

CIP: Crop Intensification Program

CSA: Climate Smart Agriculture

CSAP: Agricultural development projects

DFID: Department for International Development

GoK: Government of Kenya

IFAD: International Fund for Agriculture Development.

IPCC: Intergovernmental Panel on Climate Change

KCSAP: Kenya Climate Smart Agriculture Project

KNBS: Kenya National Bureau of Statistics

KPSI: Key Project Sustainability Indicator

MoA: Ministry of Agriculture

MoALF: Ministry of Agriculture, Livestock and Fisheries

NGOs: Non-Governmental Organizations

PSM: Propensity Score Matching

SSA: Sub-Saharan Africa

UNCF: United Nations Children's Fund

UNDESA: United Nations Department of Economic and Social Affairs

USAID: United States Agency for International Development

VIF: Variance Inflation Factor

WFP: World Food Programme

## DEFINITION OF TERMS

**Project Sustainability:** The IFAD Strategic Framework 2007-2010 (IFAD, 2007) defines project sustainability as ensuring that the institutions supported through projects and the benefits realized are maintained and continue after the end of the project.

In this study it refers to the maintenance and continuity of the practices and benefits realized from the agricultural projects for as long as the problem exists among the beneficiaries even after the end of the project.

**Perceived Sustainability** in this study refers farmers' perceptions of the projects' actions towards maintenance and continuity of economic, social and environmental benefits by the present and the future beneficiaries even after cessation of the projects.

**Participation** refers to involvement of individuals and groups in development processes with the aim of ensuring self-reliance and better standard of living.

In this study it refers to the direct involvement of farmers in agricultural development projects, which aims to build farmers' capabilities to have access to project benefits and opportunities towards self-reliance and an improved quality of life.

**Poverty** is a situation where people's level of income is adequate for survival but fall below the community average, they cannot have what the larger community regard as the minimum necessary for decency, and they cannot wholly escape.

In this study poverty refers to a situation where rural people's level of income is adequate for survival but falls below the Kenyan national rural poverty line of less $1.05 per day.

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# CHAPTER ONE

# INTRODUCTION

## 1.1 Background Information

Agriculture contributes a significant part of gross domestic product (GDP) in many economies in the world with 2.5 billion people worldwide depending on agriculture for their livelihoods (Food and Agriculture Organization [FAO], 2016). In Kenya, it contributes to 51 percent of Kenya's GDP (26 percent directly and 25 percent indirectly), accounts for 60 percent of employment and 65 percent of exports (World Bank, 2018).

However, in recent years the agriculture sector has been highly affected by increasing climate variability and enhanced exposure to extreme weather events (FAO, 2020). There has been changing rainfall patterns, drought, flooding, and the geographical redistribution of pests and diseases. In addition, the vast amounts of $CO_2$ absorbed by the oceans causes acidification, influencing the health of oceans and those whose livelihoods and nutrition depend on them (FAO, 2018a). These changes have reduced productivity and led to greater instability in production in the agricultural sector (Climate, Energy and Tenure Division, 2011). This consequently results to increased poverty among the people who primarily rely on rain-fed agriculture for their livelihoods (Intergovernmental Panel on Climate Change [IPCC], 2014 and GoK, 2017).

A transformation of the agricultural sector was therefore urgently needed to respond to climate change and sustainably increase agricultural productivity and incomes. It is against this background that climate smart agriculture(CSA) intervention based on three pillars of sustainably increase agricultural productivity and incomes, adapt and build resilience of people and agri-food systems to climate change and reducing and/or removing greenhouse gas

emissions (GHGs) where possible was implemented by many countries worldwide (FAO,2021).

CSA interventions have been successfully implemented around the world (FAO, 2021). For instance, Food and Agriculture Organization of the United Nations (FAO) has been working to support countries in transitioning to climate-smart agriculture in a number of ways. In Sri Lanka FAO's Save and Grow project supports the transition to more productive and resilient smallholder farm systems and aims to reduce greenhouse gas emissions in rice production systems. In Mali, the 2019 Climate-Smart Agriculture Investment Plan (CSAIP) supported by the World Bank foregrounds climate concerns and prioritizes CSA interventions that offer feasible and robust solutions (FAO, 2021).The State Department of Agriculture in Kenya also introduced the FAO's Mitigation of Climate Change in Agriculture (MICCA) programme, Kenya Adaptation to Climate Change in Arid and Semi-Arid lands (KACCAL), Kenya Climate Smart Agriculture Project among others.

However, according to FAO, 2021, the case studies confirmed that CSA faces challenges such as implementation requires a site-specific approach such that what may be considered as a climate-smart practice in one location may not be considered as such in another location, given local circumstances (including agricultural and socio-economic circumstances) under climate change. This necessitated this study on extent of farmers' participation in agricultural development projects, perceived project sustainability and their effects on poverty situation in Kakamega County, Kenya. Findings on extent of farmers' participation in completed agricultural development projects, farmers perceptions on sustainability of the projects and the effect of extent of farmers' participation and perceived project sustainability on poverty situation in Kakamega county context may build a more diverse and robust evidence base for CSA projects that project implementers within the country may draw on and take a

comprehensive look at how to achieve better results with the designing and promotion of climate smart agriculture projects

The State Department of Agriculture and other international development organizations in Kenya had already put in place many initiatives that addressed some elements of climate smart agriculture since 2001, although very few of the initiatives called those elements by climate smart agriculture terms (Ministry of Agriculture [MoA], 2010). These initiatives include National Accelerated Agricultural Inputs Programme (NAAIP), Njaa Marufuku Kenya, The National Agriculture and Livestock Extension Programme (NALEP) Arid Lands Resource Management Project (ALRMP), Kenya Agricultural Productivity Programme (KAPP), Agriculture Sector Development Support Programme (ASDSP), ASAL Based Livestock and Rural Livelihood Support Project, Heifer International Kenya, Aquaculture Development Project, Fisheries Resource Management Project among others (MOA, 2008). These projects were mainly aimed towards promotion of integrated farming approaches that would sustainably increase productivity and increase resilience in order to enhance achievement of national food security in the midst of climate change (Ministry of Agriculture Livestock Fisheries [MoALF], 2017).

As shown in Table 1, massive resources were poured into these agricultural projects in form of initiating projects, financial support and technical support to boost agriculture productivity, combat food security and reduce poverty. However, while the trend with implementation of the projects has been showing significant improvement, the trend with sustainability has been rather disappointing. Bilateral Aid agencies and notable donors Such as USAID, WFP, UNICEF and World Bank have been raising concerns over the unsustainability of projects they mostly fund in developing countries (Kerubo and Annastacia, 2021). According to Operation Evaluation Department (OED) of World Bank, Kenya appears to be the poorest amongst East African countries in project sustainability. Kenya attained an overall sustainability rating of

49% between the years 2000-2014 while Tanzania and Uganda were rated at 70.1% and 59.5% respectively with Ghana rated at 64.7% beyond east Africa in the same period (World Bank, 2003). In Kakamega County, Send a cow a Non-Governmental Organization supporting poor communities supported 5 groups with 16 dairy goats in 2009 and currently the number of goats have reduced to 25% after 8 years in the funded groups. Livestock Development Programme (LDP) also introduced 9 dairy cows and 2 bulls 15 years ago to a few groups that cannot be currently traced (Olang, 2016).

Furthermore, poverty still remains a major problem in many developing countries. About 48% of Africa's population live in extreme poverty, on less than $1.25 per day (World Bank, 2015). According to the Kenya Household Budget Survey (KHBS) in 2015/16 poverty rates are considerably higher in rural areas at 40% compared to peri urban or core-urban areas at 28-29% (Diwakar & Shepherd, 2018). In Kakamega County, poverty still persists with 51% of the proportion of people living below the poverty line (MoALF, 2017).

Farmers' participation is an important factor for sustainable agricultural development in rural areas (IFAD, 2012). Without farmer participation, there would be no partnerships, no program and obviously no development (Aref *et al.,* 2011). Farmers' participatory practice has not yet been cultured properly in the African countries. According to Community development society, 2001 People's participation in their own projects had not yet attained the acceptable levels that qualify to imply full participation. The poor sustainability levels of Kenyan projects has been linked to low participation of farmers in agricultural development programmes. The lack of effective structures for people's participation has been a major constraint upon more widespread agricultural development (Ouma, 2016).

There has been a concerted effort by different scholars to investigate sustainability of agricultural projects. Warinda et al., 2019 conducted a study on Sustainable development in East Africa: Impact evaluation of regional agricultural development projects in Burundi,

Kenya, Rwanda, Tanzania, and Uganda. This studies failed to show how sustainability of the projects was measured and did not examine factors influencing sustainability of the projects.

In Kenya, (Kerubo and Annastacia, 2021; Mairura, 2019; Kaimenyi, 2019; Onkoba, 2016; Olang, 2016; Sang, 2015; Mutiso, 2015; Wabwoba and Wakhungu, 2013; Mutimba, 2013) sought to investigate determinants of sustainability of community based projects or donor funded projects. Nonetheless, these studies failed to assess the extent of farmers' participation in the projects despite the fact that without participation, there would obviously be no viable projects in rural areas, they did not assess farmers' perception of sustainability of the agricultural projects as it is the case in this study, failed to present a clear measurement for sustainability of the projects and only focused on factors that affected sustainability of the projects where sustainability was treated as a binary variable in some of the studies.

In Kakamega County, Kerubo and Annastacia, (2021) and Olang, (2016) carried out their studies entitled "Factors influencing sustainability of community food security projects in Kakamega County, Kenya" and "Determinants of sustainability of donor funded dairy projects: a case of Malava sub- county, Kenya". Olang, 2016 study was limited to dairy farmers in Malava Sub-County in Kakamega County. Furthermore, no clear measurement of sustainability of the projects was presented and no model was run in determination of the significant factors, only descriptive and inferential statistics were used to draw conclusions.

Kerubo and Annastacia, 2021 improved on Olang, 2016 work by conducting the study in the whole county and running a multivariate regression analysis. However, the study limited its independent variables to institutional factors (project management capacity, government policies, resource support and project monitoring) and suggested further research on other factors affecting sustainability of community food security projects in Kakamega County. It also did not present a clear measurement of sustainability of the projects and also failed to assess extent of farmers' participation in the projects.

**Table 1: Agricultural Development Projects/Programs in Kenya.**

| Programme | Year initiated | Duration | Total Budget (Ksh) |
|---|---|---|---|
| National Agriculture and Livestock Extension Programme (NALEP) | 2000 | 5years | 1.098 billion |
| Kenya Agricultural Productivity Programme (KAPP) | 2004 | 12 years | 3.1 billion |
| Kenya Special Programme for Food Security(Njaa Marufuku Kenya) | July 2003 | 1.5 years | 75 million |
| National Accelerated Agricultural Inputs Programme (NAAIP) | 2007 | 5 years | 4.020 billion |
| Agricultural Sector Support Programme (ASP) | 1st July 2001 | 5 years | 1.009 billion |
| Small Holder Dairy Project | 1997 | 9 years | 421.5 Million |
| Smallholder Dairy Commercialization Programme | 2006 | 6 years | 1.5 billion |
| Arid Lands Resource Management Project (ALRMP) | 1996 | 13years | 5.9 billion |
| East African Dairy Development EADD) I and II (Heifer International) | 2008 | 11 years | 9.3 billion |
| Aquaculture Development | 2002 | 6 years | 121.8 million |
| Fish Inspection and Quality Assurance | 2005 | 2years | 62.5 million |
| Lake Victoria Environment Management Program | 2003 | 3 years | 115.6 million |

Adopted from MOA, 2008

### 1.2 Statement of the Problem

Over the years the governments of Kenya, the county government of Kakamega and other international development organizations have poured massive resources in agricultural development projects to boost agriculture productivity, combat food insecurity and reduce poverty situation in Kakamega County. However, despite billions of dollars spent on agricultural development projects, most of these donor aided development projects are partially active or the efforts have ultimately ended in halt or failure depriving the funding agencies the benefits and returns foreseen through the projects (Aref, 2011). Furthermore, the poverty situation in Kakamega County are still high with approximately 51 % of people living below the poverty line as compared to the national level of about 46% (MoALF, 2017).

Minimal studies have been conducted in Kakamega County to determine the sustainability levels of agricultural development projects and the factors affecting sustainability of these projects despite the raised concerns. Furthermore, the few preceding studies failed to capture the important aspect of farmers' participation despite the fact that poor sustainability levels of projects largely emanates from low participation of farmers in agricultural development programmes (Ouma, 2016). These studies also failed to determine the effect of farmers' participation and sustainability of the projects on poverty situation overlooking the fact that poverty reduction is a key objective for setting up the projects. This study intents to fill these gaps by determining the extent of farmer's participation in agricultural development projects and its determinants , perceived project sustainability and its determinants and lastly the effects of extent of farmers' participation and perceived project sustainability on poverty situation in Kakamega County.

## 1.3 Objectives of the Study

### 1.3.1 General Objective

To determine the extent of farmers' participation in agricultural development projects, perceived project sustainability and their effects on poverty situation in Kakamega County.

### 1.3.2 Specific Objectives

i. To determine socio-demographic and institutional factors influencing extent of farmers' participation in agricultural development projects in Kakamega County.
ii. To determine socio-economic and institutional determinants of perceived sustainability of agricultural development projects in Kakamega County.
iii. To determine the effect of extent of farmers' participation and perceived sustainability of agricultural development projects on poverty situation in Kakamega County.

## 1.4 Research Questions

i. Which socio-demographic and institutional factors influence extent of farmers' participation in agricultural development projects in Kakamega County?

ii. Which socio-economic and institutional factors affect the perceived sustainability of agricultural development projects in Kakamega County?

iii. What is the effect of extent of farmers' participation and perceived sustainability of agricultural development projects on poverty situation in Kakamega County?

## 1.5 Justification of the Study

Food insecurity and poverty still persists despite the huge costs incurred on implementation of agricultural projects in Kakamega County. Approximately 51 % of people in the county live below the poverty line as compared to the national level of about 46% (MoALF, 2017).

This study adds to the existing knowledge on agricultural development projects and significantly informs governmental and non-governmental agencies of the crucial areas to focus on in order to enhance sustainable agriculture development through project implementations.

Economic planners are expected to use the findings of this study to formulate sound policies that can help in increasing farmers' participation in agricultural development projects and consequently enhance projects sustainability.

This findings of this study are expected to aid in the achievement of the first and thirteenth Sustainable Development Goals (SDG) of poverty eradication and taking urgent action to combat climate change and its impacts respectively

## 1.6 Scope of the Study

To evaluate extent of farmers' participation in agricultural development projects, project perceived sustainability and their effects on poverty situation, the study was carried out in all the 12 sub-counties in Kakamega County. It targeted farmers who had participated in

completed agricultural development projects between 2000 and 2020 and those who had never participated and in any agricultural development projects. The study was conducted from February, 2021 to April, 2021.

### 1.7 Limitations of the study

Collecting data from farmers with experience of past interviewers' fatigue was threatening as they would be passive in their responses. However, to mitigate this, efforts were made to create effective rapport and being as informal as possible.

Low literacy levels of the respondents. This was mitigated by the researcher administering the questionnaire personally, reading and translating the questions to the respondents where necessary.

### 1.8 Assumptions of the Study

The key assumptions on which this study was based on include; availability of documented information, willing and truthful respondents, respondents had a prior experience or/and information about completed agricultural development projects over the years.

# CHAPTER TWO

# LITERATURE REVIEW

## 2.1 Introduction

This chapter presents reviews of related work from previous studies on three main subthemes derived from the specific objectives. It compares the type of models used in other empirical work together with different types of variables that were employed. It also reviews the theoretical framework and the conceptual framework concerning extent of farmers' participation, the perceived sustainability agricultural development projects and their effect on poverty situation.

## 2.2 Empirical Literature Review

### 2.2.1 Socio-demographic and institutional factors influencing extent of farmers' participation in agricultural development projects.

Aref (2011) conducted a study on 'Farmers' participation in agricultural development: The case of Fars province, Iran'. The findings of this study revealed that majority of rural farmers want to participate and involve in agricultural development planning and policy, but the government support was lacking. Farmers' participation in agricultural planning and evaluation decision making was not considered as agricultural policy decision making was mostly made by government organizations. Lack of resources such as financial resource and new techniques, lack of local organizational support to provide adequate facilities and agricultural requirements and lack of capacity of local agricultural organizations were cited as the most barriers towards farmers' participation. Aref (2011) study examined farmers' participation in agricultural development in general. This study intents to improve on it by choosing one form of agricultural development (agricultural development projects) and determining extent of farmers' participation in the projects.

Nahayo *et al.,* (2017); Jamilu *et al.,* (2015); Etwire *et al.,* (2013) and Nxumalo and Oladele, (2013) examined "factors influencing farmers' participation in agriculture projects/programmes" in the context of developing countries. Using binary probit or logit model where the only consideration was the dependent variable is a dichotomous variable which is 1 when a farmer participates in agriculture project and 0 if otherwise. The empirical analysis results by Nxumalo and Oladele, (2013); Etwire *et al.,* (2013) and Jamilu *et al.,* (2015) were in agreement that lack of funds and access agriculture extension service significantly determined farmer's participation in agriculture projects. However, Nxumalo and Oladele, (2013) further found out that attitude, effectiveness of land care, age, gender, livestock enterprise, crop enterprise and income were significant determinants of participation; Jamilu *et al.,* (2015) further found out that household size, farm size, level of education and membership to cooperative were other significant factors influencing farmers' participation in the project; Etwire *et al.,* (2013) found number of years in school was an additional significant determinant while Nahayo *et al.,* (2017) on the other hand found out that other significant determinants of farmers' participation in programs were farming experience, non-farm income, , market access, land acquisition means and agro-ecological conditions. These studies focused on assessing factors influencing farmer's decision to participate but failed consider the extent of their participation in the projects which is crucial when determining farmers' level of empowerment by the projects. This study intents to improve on their studies by determining extent of farmers' participation in the projects in terms of longevity of participation in the projects and number of practices adopted from the projects. It will then determine the factors influencing their extent of participation where a censored Tobit regression model will be run instead of the probit or logit model as the dependent variable is no longer a bivariate value but now possesses two outcomes: either equal to zero or positive numbers.

Ogunlade *et al.,* (2016) analyzed the level of participation of farmers in group activities in Kwara State, Nigeria. The study examined the effect of selected socio-economic characteristic of the farmers on their level of participation. The researcher used a likert scale to determine the level of participation in group activities where respondents were asked to rank various statements. The results revealed that the level of participation of farmers in group activities were appreciable but could be improved on. The multiple regression analysis established that income, farm size, access to training, access to credit, extension contact and membership of farmers' association all positively influenced participation of farmers in group activities. This study intents to determine the extent of farmers' participation in the agricultural development projects and not the groups formed under the projects.

Tologbonse *et al.,* (2016) examined socio economic and institutional factors influencing women level of participation in Women in Agriculture (WIA) Programme, Nigeria. Participation was measured by the number of agriculture activities or programmes the participant were engaged in during the farming season under study that is 1 if a respondent participated in one programme only and 6 if a participant engaged in all six programmes. Using multiple regression model it was established that age, education, marital status, agriculture extension access and market access were determinants of participation level. Tologbonse *et al.,* (2016) efforts of going a step further in measurement of participation must be commended. However, he failed to put 0 participation into account. A censored Tobit regression would have then been a more appropriate model to determine factors influencing level of participation in the programme. Furthermore, intuitively one can be a participant of a programme and opt out before adopting any practices thus capturing their extent of participation would have also been important. In addition his study was gender biased focusing on women only and thus projects that hope to empower both male and female cannot sufficiently rely on his findings.

Ouma (2016) observed that the participation of the local community in the activities of Kimira-Oluch smallholder farm improvement project (KOSFIP), Homa Bay County was considerably low, thereby threatening the realization of the project goal. His study therefore sought to examine how project design; mode of resources contribution; types of implementation approaches; community capacity building strategies influences community participation in implementation the project. The study findings revealed that; the project design principles were adequate and provided the local community with an avenue to be effectively involved in all stages of implementation. Mode of resource contribution had not enhanced community participation and acceptability of the project. Lack of ownership, acceptability and low level of community participation could be largely attributed to lack of cohesion among the farmers, resulting from ineffective community capacity building strategies. Ouma (2018) study only assessed the influence of institutional related factors (project design; mode of resources contribution; types of implementation approaches; community capacity building strategies) and failed to factor in any socio demographic or socio economic factors.

Ngavara *et al.,* (2021) examined factors influencing extent of farmers' participation in the livestock development programmes. Tobit regression model was used where level of participation was measured in terms of herd size. House hold farm income, labour, farming activities undertaken, expenditure on stock feed, frequency on extension visits and training in rearing cattle were found to be significant factors influencing extent of participation. Ngavara *et al.,* (2021) improved on previous studies by assessing determinants of extent of farmers' participation. However, the study was restricted to livestock development programmes. This study intents to improve on it by increasing the scope of the study by incorporating crop and fisheries development programmes in the study.

### 2.2.2. Socio-economic and institutional determinants of perceived sustainability of agricultural development projects.

Mutimba (2013) investigated factors influencing sustainability of donor funded projects in Kilifi County. He reported that donor role, community participation, management practices and government strategies were significant influencers of sustainability of donor funded projects. Wabwoba and Wakhungu (2013) findings on the other hand showed community participation and funding were the crucial factors affecting sustainability of community food security projects in Kiambu County. These studies were limited to donor funded projects and community food security projects in Kilifi and Kiambu County, hence the study findings cannot be generalized to other counties. Further studies need to be conducted on donor funded community food security projects in other counties. In addition the studies did not factor in the influence of socio economic factors on sustainability of the projects.

Simane and Zaitchik, (2014) studied 'The Sustainability of Community-Based Adaptation (CBA) Projects in the Blue Nile Highlands of Ethiopia'. Sustainability was considered for social, institutional, technical, financial, and environmental dimensions, with second-order indicators or factors defined for each dimension. According to this analysis, CBA efforts of two thirds of the Community Based organizations (CBOs) studied were found to be unsustainable in all dimensions and CBA efforts of the remaining CBOs were found to be at risk of unsustainability. A number of barriers to CBA sustainability were identified, including inadequacies in community participation, training of local community members, local government commitment, farmer capacity, and bureaucratic efficiency.

Sustainability of each activity was evaluated on the basis of participation rates and effectiveness of implementation relative to expectation, either measured where possible or reported by farmers on a five point scale. It was then quantified for each activity and assigned a sustainability score. These scores were then averaged with equal weights within each

dimension and the aggregate sustainability of CBA at each CBO evaluated at a weighted average calculated across all five dimensions. An overall sustainability classification was then calculated on the basis of dimension sustainability scores as follows; Sustained CBA: 70% score (or more) in aggregate across all five dimensions and a 70% score (or more) in each dimension; Sustained but at risk CBA: 50% score (or more) in aggregate across all dimensions (individual dimensions can be below 50%); and Unsustained CBA**:** fails to obtain a 50% score in aggregated form.

Simane and Zaitchik, (2014) study categorized sustainability into different levels an approach adopted by this study as well but this study only incorporated the main measures of sustainability (social, economic and environmental measures). However, Simane and Zaitchik, (2014) study did not present any model when determining barriers to CBA sustainability. This study intents to improve on this by running an ordered probit model.

Sang (2015) investigated the determinants of sustainability of World Bank funded projects in Kenya. Principal component analysis was carried out using factor analysis method to establish the most critical factors among the ones identified to influence sustainability of the projects. Logit regression analysis was used to determine the various factors influencing sustainability of the projects in Kenya. The results established that institutional and technical factors were significant and thus determine project sustainability while economic and political factors were found to be insignificant at 5 percent level. Sang (2015) study used a very small sample size of only 51 respondents, failed to clarify the specific factors that influenced sustainability of the projects under each category and failed to incorporate the environmental aspect of measuring sustainability which is crucial. There is also need to determine sustainability of projects under one sector (agricultural development projects) with different donor funders as opposed to a generalized view on project sustainability under different sectors (energy, water, education, health, agriculture) funded by one donor.

Mutiso (2015) and Mutunga (2015) examined factors influencing sustainability of agriculture projects in Machakos County. Using linear regression model Mutiso (2015) established that credit access, input supply factors, training of farmers and adoption of technologies were significant determinants of sustainability of the projects. Mutunga (2015) on the other hand noted demographic factors, financial stability and capacity building of project beneficiaries were significant determinants of sustainability of fish farming projects. However, these studies only utilized descriptive statistics relying on respondents ratings on whether a certain factor had an influence on sustainability. This study intends to improve on this studies by introducing project sustainability measures from economic, environmental and social dimensions before running an ordered probit regression model to determine the factors influencing sustainability of the agricultural projects.

Olang (2016) investigated factors influencing sustainability of donor funded dairy projects in Kakamega County. He reported climate change, land scape and terrain, rate of technology, technology available for adoption, type and satisfaction of extension services as the determinants of sustainability of the dairy projects. Despite the fact that it is among the few studies on sustainability of agriculture projects in Kakamega County, it was conducted in only one Sub County in Kakamega County and focused on the dairy value chain only. Furthermore, no model was run in determination of the significant factors, only descriptive and inferential statistics were used to draw conclusions from respondents' likert scale ratings on how certain factor had an influence on sustainability. This study intents to go a step further and run an ordered probit regression model to determine the factors influencing sustainability of the agricultural projects.

Muluh *et al.,* (2019) assessed the determinants, challenges and prospects for sustaining development projects in the North West Region (NWR) of Cameroon: A case of the Investment Fund for Communal and Agricultural Micro-projects (FIMAC I) scheme. The binary logistic

regression results reveal that although there is a significant change in the level of incomes for the FIMAC I project beneficiaries, its sustainability (mirrored through continuity) is dependent upon a myriad of socio-economic factors including family size, length of stay in the community, gender, education and the status of the beneficiary. Less transparent loan application process and the lack of collateral security were the main challenges faced by project beneficiaries. Project sustainability was treated as a binary variable 1 for sustainable and 0 otherwise. This study intents to go a step further and measure projects sustainability levels rather than just classifying them as sustainable. In addition the study was conducted in Cameroon which may have a different environmental, political, economic and social setting thus a need to carry out a study on the sustainability of agricultural projects in Kenya still exists.

Kerubo and Annastacia, (2021) study investigated 'Factors influencing sustainability of community food security projects in Kakamega County, Kenya. Multivariate regression analysis was used to assess the relationship between independent variables (project management capacity, government policies, resource support and project monitoring) and (sustainability of community food security projects in Kakamega county Kenya) dependent variable. The study concludes that project management capacity and government policies influence sustainability of community food security projects in Kakamega County. The study was limited to institutional related factors (project management capacity, government policies, resource support and project monitoring) and suggests research on other factors affecting sustainability of community food security projects in Kakamega county a gap that this study intents to fill by incorporating socio economic factors.

Ngavara *et al.,* (2021) ordered probit model results on factors influencing farmers' decision to continue utilizing livestock development scheme practices revealed that gender, herd size, expenditure on stock feed and frequency of extension had a bearing on the extent of willingness to continue practices from the Scheme. Sustainability of the scheme tended to decrease with an

increase in herd size, access to veterinary services and a higher frequency of extension visits while it tended to improve with increases in expenditure on stock feed. This study intents to utilize a similar approach as Ngavara *et al.,* (2021). However, the study was limited to sustainability of livestock development programmes only.

### 2.2.3 Effect of extent of farmers' participation and perceived project sustainability on poverty situation.

**Effect of extent of farmers' participation in agricultural projects on poverty situation.**

Solomon and Ketema (2015) assessed the impact of Irrigation Technologies on Rural Households' Poverty Status in North-Western Ethiopia. Foster, Greer and Thobecke (FGT) index results showed that in terms of incidence, depth, and severity of poverty, users of different irrigation technologies were better off compared to the non-users. The PSM results also illustrated that on average, the per capita consumption expenditure of irrigation user households had significantly increased by 21 percent indicating that irrigation had the potential to reduce poverty.

Olusegun *et al.,* (2015) evaluated the ex post impact of Root and Tubers Expansion Program (RTEP) on poverty in rural Nigeria. FGT poverty measures established that poverty incidence were higher among non-beneficiaries than beneficiaries by about 23%. Net crop income per hectare increased by about $198-211, reducing poverty by about 5 to 20%.

Marechera *et al.,* (2019) evaluated the Impact of DroughtTEGO maize hybrids on poverty situation among small-scale maize farmers in Kenya. The PSM results showed that adoption of the maize varieties led to significant increase in maize income by 82%, total income by 75%, and reduced the depth of poverty by 46-point margins. This study failed to present poverty measures which is crucial in poverty analysis studies.

In another study on Agriculture commercialization, poverty situation and pro-poor growth: Evidence from commercial agriculture development project (CADP) in Nigeria. Etuk and

Ayuk (2021) established that FGT poverty indices were higher for the non-beneficiaries than beneficiaries and that CADP participants' income increased by $1,239.09 and were better off in terms of their welfare compared to non-participants. The average treatment effect on the treated (ATT) findings also showed an income difference indicator of 446,073 which was significant at the 5% level implying that CADP had a positive impact on the incomes of beneficiaries compared to non-beneficiaries.

Most of these preceding studies assessed the impact of the projects/ project interventions on poverty situation. It was established that the average annual per capita consumption expenditure of project participants was higher than that of non-participants confirming that project participation had an effect on poverty situation. This study adopted a similar approach but also went a step further to fill the gap on determination of the effect of extent of farmers' participation in agricultural development projects on poverty situation. In addition, most of these studies cannot be fully relied on for policy formulation in Kenya due to differences in the agro-ecological zones. Marechera *et al.,* (2019) study that was conducted in Kenya failed to present poverty measures which are crucial in poverty analysis studies.

**Effect of perceived projects' sustainability on poverty situation.**

According to Sibande *et al.,* 2007, the Malawi government introduced a large-scale farm subsidy program since the year 2005/6 agricultural season to improve maize production, productivity, food security and household income from crop sales. Despite the implementation of the programme, food insecurity and poverty were still rampant among smallholder farmers raising doubts about the effectiveness and sustainability of the programme. This is also backed up by Bradshaw (2007) who argues that despite all the development plans, poverty is rampant, raising the issue of sustainability of the poverty situation interventions.

Kumari (2014) conducted a study on poverty alleviation and long-term sustainability of microfinance project. This research attempted to assess the strengths of poverty alleviation initiatives taken by foreign donors in Sri Lanka. Descriptive analysis, double difference method, and the regression analysis were the analytical tools used in data analysis. According to the results of the double difference analysis and the descriptive analysis microfinance facility provided by the Matale Regional Economic Advancement Project (MREAP) had significantly influenced the income levels of the beneficiaries. In general, microfinance had a positive influence on poverty alleviation of beneficiaries. However, the study failed to present any results on effect of long-term sustainability of microfinance project on poverty alleviation and points out that monitoring of long term sustainability of the activities initiated during the project period after the termination of the project was a vital factor that should receive due attention from relevant authorities.

Minimal studies that analytically assesses the effect of extent of farmers' participation and perceived projects' sustainability on poverty situation exists. Most studies assessed the effect of agricultural projects/project technologies on poverty situation but none attempted to link extent of farmers' participation and project sustainability with poverty. This study attempts to fill this gap by determining the effect extent of farmers' participation and perceived project sustainability on poverty situation by running a stepwise regression analysis.

## 2.3 Theoretical Framework

### 2.3.1 Diffusion of Innovation Theory

Diffusion of Innovation (DOI) Theory was developed by E.M. Rogers in 1962. It explain how, over time, an idea or product gains momentum and diffuses (or spreads) through a specific population or social system. The spreading out of innovation is a process by which, through certain channels, novelty is communicated among the members of a social system over time (Rogers, 1995). Consequently, it is a process that spreads innovation out from its discovery or

creation source to the user or its adapter, a process that occurs in the society as a group process (Rogers, 2003). Adoption of an innovation does not happen simultaneously in a social system; rather it is a process whereby some people are more apt to adopt the innovation than others. The level of adoption is usually measurable on the basis of the number of the members who adopt the innovation system in a given period, and who are classified in different categories: innovators, early adopters, early majority, late majority and the backwardness.

In relation to this study, agricultural projects occasionally offer new practices and technologies to farmers. In order for the new practices to spread out, farmers have to at least participate in the projects in order to spread the information on the innovations among other members of the community. This ensures that the innovation spreads out from its source (projects) to the user or its adapter. However, participation and adoption of an innovation does not happen simultaneously in a social system; rather it is a process whereby some farmers tend to participate and adopt the innovation than others thus extent of farmers' participation in different projects differs from time to time.

### 2.3.2 The Resource Dependence Theory (RDT)

The study adopted The Resource Dependence Theory (RDT) which was first introduced by Pfeffer & Salancik in 1978. RDT characterizes the organizations as an open system, dependent on contingencies in the external environment (Pfeffer & Salancik, 1978; 2003). According to this theory, organizations survive to the extent that they are effective. Their effectiveness derives from management of demands particularly demands of interest groups upon which the organizations depend for resources and support. Organizations are never in complete control of all components necessary for their operations and are embedded in an environment comprised of other organizations. They depend on those other organizations for the many resources they themselves require (Pfeffer & Salancik, 2003). Dependence on "critical" and

important resources influences the organizational decisions and actions which can be explained depending on the particular dependency situation (Werner, 2008).

In line with this study, for governmental and non-governmental organizations projects to attain sustainability they need to meet the demands of the donors and the project beneficiaries who they depend on for support and resources that they do not have control over. Thus for projects to achieve sustainability, all stakeholders should be involved during decision making, conception and implementation of community based agricultural projects so that their demands are met and in return the projects obtain support and resources needed for their effectiveness and survival in the long run.

## 2.4 Conceptual Framework

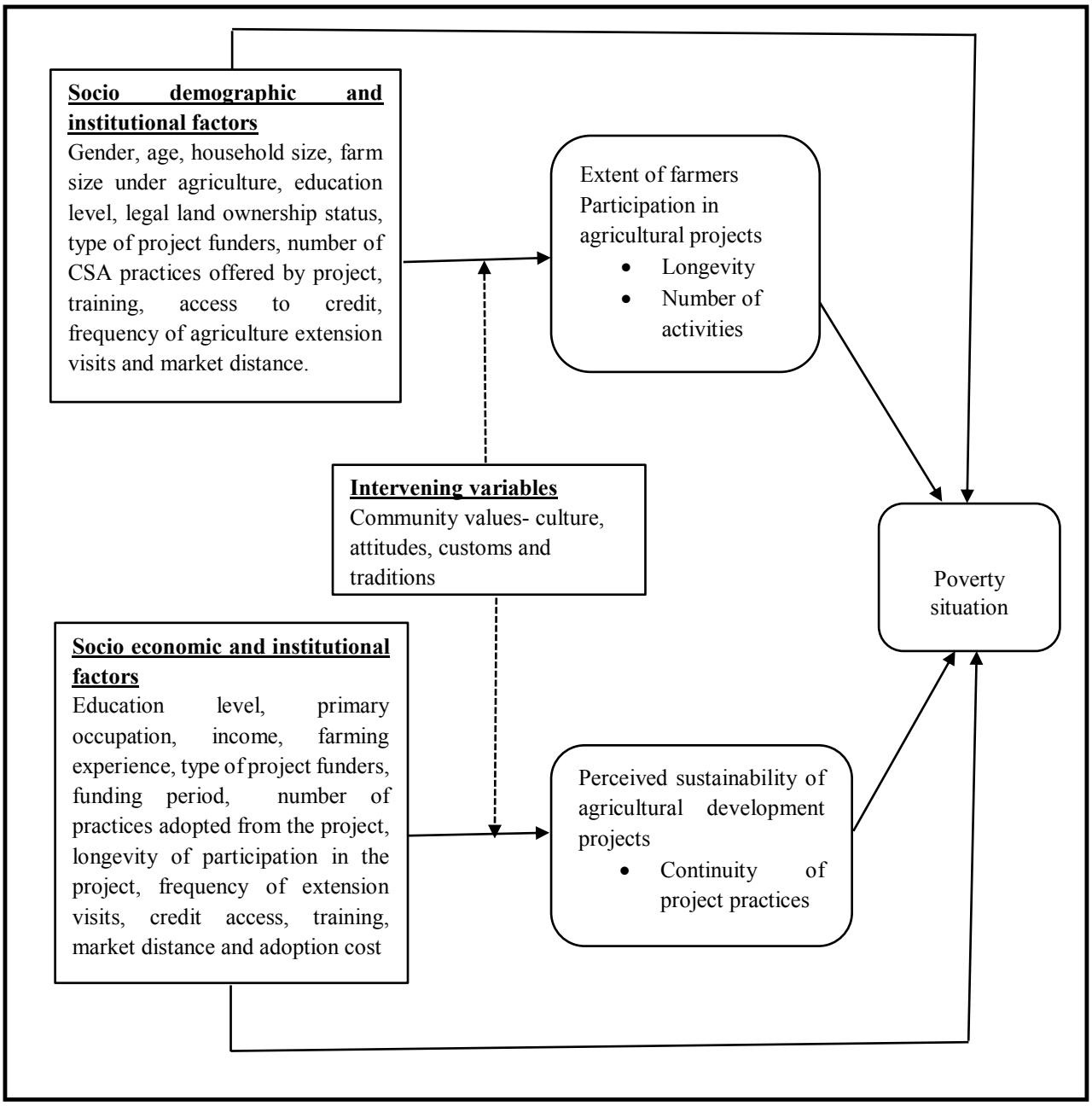


**Figure 1: Conceptual framework**

One set of the independent variables was socio-demographic and institutional factors influencing extent of farmers' participation in agricultural development projects; the effect of gender, age, household size, farm size under agriculture, education level, legal land ownership status, type of project funders, number of CSA practices adopted, training, access to credit, frequency of agriculture extension visits and market distance on longevity of farmers'

participation in agricultural development project and number of practices adopted from the project by the farmer.

Another set of independent variables was socio-economic and institutional factors affecting perceived sustainability of agricultural development projects. To be specific, the effect of education level, primary occupation, income, farming experience, type of project funders, funding period, number of practices adopted from the project, longevity of participation in the project, frequency of extension visits, credit access, training, market distance and adoption cost on sustainability of agricultural development projects. Borrowing from Simane and Zaitchik (2014), the dependent variable perceived sustainability of agricultural development projects was measured at three different levels, namely unsustainable, sustainable and very sustainable. The effect of extent of farmers' participation and perceived project sustainability on poverty situation in Kakamega County was determined by running a stepwise regression analysis where the monthly consumption expenditure levels were used as a proxy for the poverty situation.

# CHAPTER THREE

# RESEARCH METHODOLOGY

## 3.1 Introduction

This chapter presents the methodology that was followed in conducting the research. It comprises of description of the study area, research design, the target population, sample size and sampling procedure, data collection instruments, sources of data, validity and reliability of research instruments, ethical considerations and data analysis techniques.

## 3.2 Study Area

This study was conducted in Kakamega County because it is one of the counties that has benefited most from completed agricultural development projects due to its high vulnerability to climate hazards yet it still has a high proportion of people living below the poverty line at 51% as compared to the national level of 46 % (Mo ALF, 2017).

According to (MoALF, 2017), Kakamega County covers an area of 3,050.3 $km^{2.}$ It boarders Nandi County to the east, Busia and Siaya Counties to the west, Bungoma and Trans Nzoia Counties to the north, Vihiga County to the south and Uasin Gishu County to the north-east. Administratively; it has 12 sub-counties Ikolomani, Lurambi, Malava, Navakholo, Shinyalu, Lugari and Likuyani sub counties which covers the central and northern parts of the county and Matungu, Mumias East, Mumias West, Butere and Khwisero in the southern part of the county. It consists of 433,207 households with the population of 1,861,332 people (Kenya Population and Housing Census, 2019). The rainfall amounts of the county range from about 1200 mm to 2000mm per annum. The soils are deeply weathered, poor to moderate in their nutrient content and partly acidic. The central and northern parts of the county practice intensive maize, tea, beans, and horticultural production mainly on small medium and small scale while the main economic activities practiced by farmers in the southern part include sugarcane production,

maize, sweet potatoes, ground nuts and cassava production(MoALF, 2017). Some of the completed agricultural development projects cutting across all the sub-counties include; National Accelerated Agricultural Inputs Programme (NAAIP), Njaa Marufuku Kenya, The National Agriculture and Livestock Extension Programme (NALEP), Kenya Agricultural Productivity Programme (KAPP), Anglican Development Services (ADS) Kenya, Agriculture Sector Development Support Programme (ASDSP).

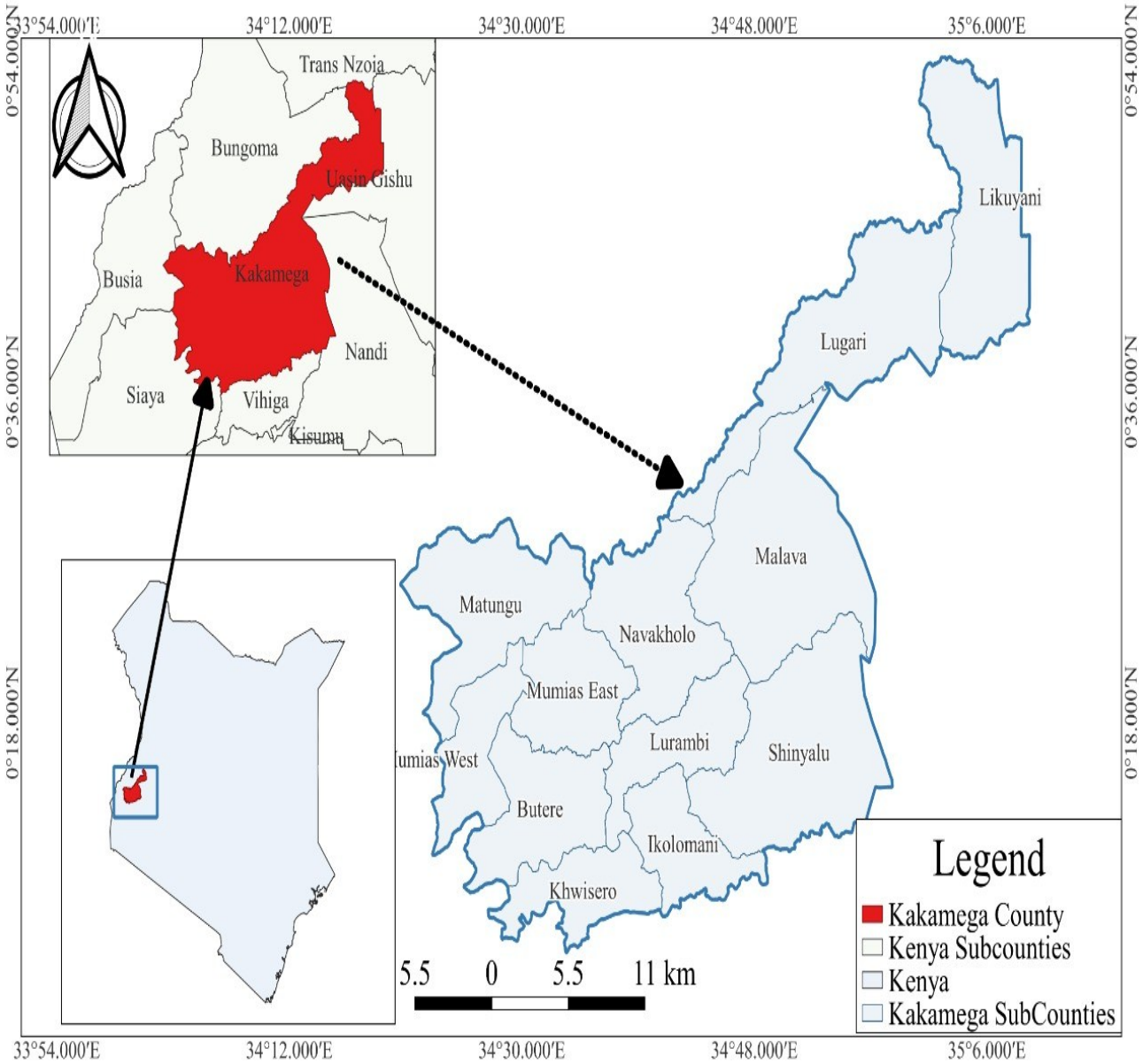


**Figure 2: Map showing Sub counties in Kakamega County**

Source: Independent Electoral and Boundaries commission (2012)

### 3.3 Research Design

This study used cross-sectional research design to collect data. Cross-sectional design allows data collection at one specific point in time from selected individuals (Kothari, 2004). This design was relevant to this study as it enabled the researcher to gather data from a pool of participants with varied characteristics from each sub-county at one point in time within a short period of time.

### 3.4 Target Population

The target population comprised of all farmers in Kakamega County. Sub-county Agriculture Officers (SCAOs) were also targeted as key informants.

### 3.5 Sample Size and Sampling procedure

#### 3.5.1 Sample size

The Cochran's formula was adopted to yield a representative sample size since it allows one to calculate an ideal sample size for a large unknown heterogeneous population size with an unknown proportion of the attribute present in the population (Chaokromthong & Sintao, 2021)

Cochran formulae is $n_o = \frac{Z^2 pq}{e^2}$ (Cochran, 1977) (3.1)

Where; $n_o$ is the sample size, z is the selected critical value of desired confidence level, p is the estimated proportion present in the population, q= 1-p and e is the desired level of precision. A maximum variability of 50% was used, (p = 0.5) and taking 95% confidence level, the calculation for required sample size was as follows:

$$\boldsymbol{n_o} = \frac{\mathbf{1.96^2(0.5)(0.5)}}{\mathbf{(0.05)^2}} = 384.16 = 384 \quad (3.2)$$

A minimum of 384 respondents was therefore adopted as the sample size for the study.

#### 3.5.2 Sampling Procedure

The Sub County Agriculture Officers (SCAOs) at the Ministry of Agriculture, Livestock and Fisheries were visited to obtain the most recent sampling frame of farmers in the sub county.

From the provided list systematic sampling was conducted to select farmers both project participants and non- participants whereby after the first farmer in the list every fifth farmer was selected. According to White (2018) a 25% to 30% range for control group is a good compromise, however minimal losses in statistical power occur when the control size is shrunk to 40%. This study therefore adopted 37.5% control group size i.e. 144 project non- participants exposing 62.5% of the sample to the treatment (240 project participants). To achieve the sample size, 20 project participants and 12 project non-participants were to be selected from each of the 12 sub-counties in Kakamega County. Every selected farmer was then called to confirm their location and whether they had ever participated in an agricultural project or not. They were later visited for administration of the questionnaires. A total of 20 project participants and 12 project non-participants selected sums up to a total of 32 respondents from each sub-county and 384 farmers in the whole county. In addition, one sub county agriculture officer was selected from the twelve sub-counties as key informants adding up to a total of 12 key informants.

### 3.6 Data Collection Instruments

Questionnaires and interview schedules were used to collect data. Questionnaires were divided into three sections based on the three objectives and were administered to farmers to collect primary data (refer to appendix II, III). Interview schedules were administered to sub county agriculture officers to gather in-depth insights on the three objectives (refer to appendix IV).

### 3.7 Types and Sources of Data

The study was mainly based on primary data obtained from the sample population using questionnaires and interview schedules. Information on gender, age, household size, farm size under agriculture, education level, legal land ownership status, type of project funders, number of CSA practices offered by the projects, training, access to credit, frequency of agriculture extension visits and market distance was gathered to determine socio-demographic and

institutional factors influencing extent of farmers' participation in agricultural development projects.

Information on education level, primary occupation, income, farming experience, type of project funders, funding period, number of practices adopted from the project, longevity of participation in the project, frequency of extension visits, credit access, training, market distance and adoption cost was also obtained in order to assess their effect on perceived sustainability of agricultural development projects.

Information on the respondents' monthly consumption expenditure was captured to determine the effect of extent of farmers' participation in agricultural development projects on poverty situation and the effect of perceived sustainability of agricultural development projects on poverty situation in Kakamega County.

Interview schedules were conducted for the Sub-county agriculture officers who were the key informants to capture information on socio-demographic, socio-economic and institutional factors that influence extent of farmers' participation in the agricultural projects and perceived sustainability of the projects in Kakamega County.

### 3.8 Validity and Reliability of Research instruments

To ensure validity, survey questions were generated based on the literature reviewed. The questionnaires and interview questions were presented to experts within and outside the university to seek expert opinion. They were then pretested on a pilot survey. According to Perneger *et al.,* (2015) a default sample size of 30 respondents is recommended for pre-tests of instrument items. Therefore, a pilot survey was carried out in Mumias West Sub-County on the Mumias central ward agriculture officer and 30 selected farmers. The selected farmers under the selected projects were excluded during data collection. Amendments were later made to make the questions clearer to respondents and after two weeks, the pilot survey was repeated on Mumias North ward agriculture officer and 30 selected farmers. Internal reliability of the

research instruments was measured using Cronbachs alpha co-efficient drawn in SPSS package. The reliability co-efficient was to be >0.7, for the instruments to be considered acceptable and reliable (Taber, 2018).To measure external reliability that is the effect of the projects on poverty situation the inter rater reliability analysis test was carried out in SPSS using intra class correlation coefficients (ICC's). The correlation co-efficient was to be >0.8, for the instruments to be considered reliable (Liljequist *et al.,* 2019).

### 3.9 Ethical Considerations

The researcher ensured that an informed consent from the respondent was taken prior to the study. Participants were enlightened about the purpose of the research, the funders of the research, how findings were to be used and the potential impacts of the research project. Permission was sought to ensure respondents voluntarily participate in the study giving assurance to maintain utmost confidentiality about the respondent's information obtained. Identifying information was not made available or accessed by anyone except the research project coordinator. The researcher also ensured that every participant remained unknown to the research team. The safety of the participants was highly prioritized thus no one was subjected to physical or emotional torture or invasion of privacy in quest to seek answers. Only relevant components to the project were assessed. The research was kept as simple as possible focusing on the intentions of the research.

### 3.10 Data Analysis Techniques

#### 3.10.1 Socio-demographic and institutional factors influencing extent of farmers' participation in agricultural development projects.

For this study, extent of farmers' participation was measured in terms of how long the farmer had participated in the agricultural development projects (longevity of participation) and the number of agricultural practices adopted from the project by the farmer.

First, descriptive statistics on mean and standard deviation for longevity of participation and number of practices adopted from the project were analyzed to show extent of farmers' participation in agricultural development projects. The censored Tobit regression model was then run to determine the factors influencing extent of farmers' participation. Since, the dependent variables longevity of participation and number of practices have two outcomes: either equal to 0 months of participation/practices adopted or less than a month of participation censored at 0 and positive values for months of participation and practices adopted. The response variable was censored in the lower tail of the distribution that is censored at zero. According to Odah *et al.,* 2018, Tobit regression model is given by:

$$y_{it=\beta^T X_{it}+\ \alpha_i+ e_{it}} = 1,2.3 \dots \dots \dots \dots \dots n \quad (3.3)$$

$$y_{it=}\ \ y^*_{it}\ if\ y^*_{it}\ \leq 0 \quad (3.4)$$

$$y_{it=}\ \ y^*_{it}\ if\ \ y^*_{it}\ > 0 \quad (3.5)$$

Where $y_{it}$ is the observed variable of interest, and $y^*_{it}$ is the latent variable. $\alpha_i$ and $e_{it}$ are the random effects and the error term respectively and are independent of $X_{i1,\ X_{i2},\dots\dots\dots,X_{iT}}$ which were gender, age, education level, household size, farm size under agriculture, legal land ownership status, type of project funders, number of practices offered by the project, training, access to credit, frequency of agriculture extension visits and market distance. $\beta$ Estimates the maximum likelihood estimation.

### 3.10.2 Socio-economic and institutional determinants of perceived sustainability of agricultural development projects.

The Triple Bottom Line (TBL) accounting measure of degree of sustainability that was introduced by John Elkington in mid 1990s was used in this study (Elkington, 1994). The TBL accounting framework goes beyond the traditional measures of profits and return on investment (economic measures) and incorporates environmental and social dimensions. It allows measuring of the effects of a particular project in a specific location or across large geographic.

There is no universal standard method for calculating the TBL neither is there a universally accepted standard for the measures that comprise each of the three TBL categories. This allows a user to adapt the general framework to the needs of different entities. The level of the entity or type of project and the geographic scope drives the decisions about what measures to be included. Subject matter experts and data availability also determines the set of measures included for TBL calculations (Slaper & Hall, 2011).

For this study 5 key project sustainability indicators (KPSI) were included in each of the three components of sustainability framework borrowing from Chen *et al.,* 2019 (Refer to appendix 1). Borrowing from Sheppard and Meitner (2005) the project participants were then required to evaluate the importance of each key project sustainability indicator by ranking and weighing each key project sustainability indicators on a five-point likert scale where 1- strongly disagree and 5- strongly agree. Farmers' response had to show some degree of variation for them to be included in the project sustainability index (Ajidasile *et al.,* 2015; Terano *et al.,* 2015). The mean score and weights of each key project sustainability indicator were then calculated in IBM SPSS version 25. The weight was calculated by mean score of each factor from the questionnaire survey as follows;

$$W_i = \frac{M_i}{\sum_{i=1}^{n} M_i} \quad , \quad 0 \leq W \leq 1 \quad \text{(Chen } et\ al.,\ 2019) \qquad (3.6)$$

Where $W_i$ = Weighting, $M_i$= Mean score of each KPSI

The means of each KPSI were then transformed in IBM SPSS version 25, and the overall mean integrated to three discrete categories of sustainability index where 1. Unsustainable 0-1.66 (≤33%) 2. Sustainable 1.67- 3.33 (34-67%) and 3. Very Sustainable 3.34 -5.00 (68-100%) to develop the overall Project Sustainability Index (PSI).

After development of PSI, the ordered probit regression was then run to analyze how socio-economic and institutional factors affect perceived sustainability of agricultural projects. According to (Greene, 2003), the Ordered Probit model is expressed as:

$y_i^* = \chi'\beta + \varepsilon_i \qquad \varepsilon_i \sim N(0,1) \quad i = 1 \ldots \ldots, N$ (3.7)

Where; $y_i^*$ is the latent variable measuring degree of sustainability of $i^{th}$ projects only known when it crosses thresholds, $\chi'$ is the vector of observed non-random independent variables (education level, farm size, legal land ownership status, farming experience, primary occupation, type of project funders, funding period, number of practices adopted from the project, longevity of participation in the project, frequency of extension visits, credit access, training, market distance and adoption cost), $\beta$ is the vector of unknown parameters of the regression to be estimated and $\varepsilon_i$ is the vector of error term which is assumed to be normally distributed with zero mean and unit variance (Greene, 2003).

$y_i$, which is the observed ordinal variable, thus takes on the following values:

$$y_i = j \; if \; u_{j-1} < y_i^* \leq u_j \quad (3.8)$$

Where; j = 1(unsustainable) or 2(sustainable) or 3(very sustainable). For instance;

$$y_i = 2 \; if \; u_{2-1} < y_i^* \leq u_2 \quad (3.9)$$

Where; 2= sustainable, $u_{2-1}$= unsustainable threshold (1.66), $u_2$= sustainable threshold (3.33).

The study was also concerned with how much change in the predictors translate into the probability of observing a particular ordinal outcome. Therefore probabilities of each ordinal outcome were considered as follows;

$$P_{ij} = P(y_i = j) = P(u_{j-1} < y_i^* \leq u_j) \quad (3.10)$$

**3.10.3 Effect of extent of farmers' participation and perceived project sustainability on poverty situation.**

First of all the Foster–Greer–Thorbecke (FGT) index was used to measure poverty. The FGT index was appropriate for this study because unlike the Squared poverty gap index, the Sen Index, the Sen-Shorrocks-Thon index and the Watts Index, the FGT class of poverty measures can be disaggregated for population sub-groups and the contribution of each sub-group to national poverty can be calculated (Khandker & Haughton, 2005).

According to Khandker & Haughton, 2005, the FGT poverty measure is given as follows:

$$\mathrm{FGT}_{\alpha} = \frac{1}{N}\sum_{i=1}^{H}\left(\frac{z-y_i}{z}\right)^{\alpha} \quad (3.11)$$

Where; $N$ is the sample size, $z$ is the poverty line, $y$ is per capita monthly income for the $i^{th}$ person, and α is the poverty aversion parameter. The national rural poverty line of Ksh 3252 per month as per the Kenyan National Bureau of Statistics (KNBS) official poverty statistics for 2015/16 was used. This is equivalent to an average of $1.05 per day using the 2016 dollar rates of 101.50.

When α= 0, Pα is the proportion of people that is poor or the headcount index; when α = 1, Pα is the poverty gap index, a measure of the aggregate expenditure shortfall of the poor from the poverty line and when α = 2, Pα is a measure of severity of poverty and reveals the degree of inequality among the poor.

Secondly, before determining the effect of extent of farmers' participation and perceived projects' sustainability on poverty situation in Kakamega County, the researcher found it fit to first evaluate the effect of the agricultural projects on poverty situation as most preceding studies had mostly focused on it. Propensity Score Matching (PSM) was used to determine the effect of agricultural development projects on poverty situation. Propensity scores were estimated using the logit regression model where the dependent variable was participation in agricultural development projects. If farmer had participated (treated unit) took the value 1 and 0 if farmer had never participated in any agriculture project (control unit). According to Rosenbaum and Rubin, (1983), the cumulative logistic probability function is specified as;

$$P_i = F(Z_i) = \mathrm{F}(\alpha + \beta_i X_{ti}) = \left(\frac{\mathbf{1}}{\mathbf{1}+\boldsymbol{e}^{(\alpha+\beta_i X_{ti})}}\right) \quad (3.12)$$

Where; $e$ is the base of natural logarithms (2.718), $X_{ti}$ represents the regressors (gender, age, farm size, highest education level, marital status, household size, legal land ownership status, primary occupation, farming experience, credit access, agriculture extension services access

and farm income) for the $i^{th}$ individual, $P_i$ is the probability that $i^{th}$ individual will make a certain choice (participate) with the given explanatory variables. $\alpha$ & $\beta_t$ are parameters to be estimated.

After running the logit model, propensity scores of each observation were matched, where treatment and control units with similar values on the propensity score were paired, and all unmatched units discarded (Rubin, 2001). The common support region was then identified by discarding the propensity scores values below the maximum of the minimum scores and above the minimum of the maximums scores between the treatment and control groups (Diaz and Handa, 2006). Effect of projects was then estimated with matched sample and standard errors calculated. The average difference in outcomes between treated units and their matched control units was the estimated effect of the agricultural development projects on poverty situation (Thavaneswaran *et al.,* 2008; Stuart, 2011).

Lastly, the effect of extent of farmers' participation and perceived project sustainability on poverty situation in Kakamega County was determined by running the stepwise regression model. Stepwise regression model was preferred because unlike the ordinary least squares regression where all variables are evaluated at the same time, in stepwise regression variables are either included or excluded from the model one at a time. This study employed the forward selection stepwise regression approach which starts with the assumption that there are no regressors in the model except the intercept. The process is then followed by inserting the regressors into the model one at a time to find the optimal subset in the model. The largest simple correlation to the response variable (y) is considered into the equation; the second regressor to be considered into the model also has a high partial correlation towards y after adjusting the effect of the first regressor entered into the model. After adding certain number of regressors into the model in the forward procedure, their effects may largely interact and therefore some regressors whose contribution reduces most significantly are gradually dropped

out from the model. The process is repeated until a new variable does not sufficiently improve the fit of the model to justify its inclusion. (Noryani *et al.,* 2019; Olusegun *et al.,* 2015)

The stepwise regression full model was expressed as;

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \beta_8 X_9 + \beta_{10} X_{10} + \varepsilon$$

Where; $Y$ = Monthly consumption expenditure as a proxy for poverty situation, $\beta_0$= constant variable, $X_1$ = Extent of farmers' participation (Longevity), $X_2$ = Perceived project sustainability, $X_3$ = Farm size, $X_4$ = gender $X_5$ =Age, $X_6$ = Education level, $X_7$ = Household size, $X_8$ =Primary occupation, $X_9$ =Access to credit services, $X_{10}$ = off-farm income, $\varepsilon$ =Error term.

# CHAPTER FOUR

# RESEARCH FINDINGS

## 4.1 Overview

This chapter presents descriptive results of farmers' demographic, socio-economic and institutional characteristics. It also presents empirical results of censored Tobit regression models, ordered probit model, the propensity score matching results on the effect of agricultural projects on poverty situation and lastly the stepwise regression results on the effect of extent of farmers' participation and perceived projects' sustainability on poverty situation in Kakamega County. In the results presentations, comparisons are made between agricultural project participants and non-participants. 100% response rate was achieved since the questionnaires were personally distributed by the researcher.

## 4.2 Reliability test

Cronbach's alpha test was separately conducted on the five point likert scale for economic, environmental and social indicators of project sustainability and the average of the three cronbach's alpha coefficient calculated. An alpha coefficient of 0.711 > 0.7 was obtained indicating that the instruments for data collection were good and reliable.

**Table 2: Instrument internal reliability test**

| Construct | Cronbach's Alpha | Number of items |
|---|---|---|
| Economic indicators | 0.670 | 5 |
| Environmental indicators | 0.786 | 5 |
| Social indicators | 0.677 | 5 |
| Average measure | 0.711 | 15 |

To test for external reliability the inter rater intraclass reliability test was carried on the incomes of project participants and non- participants when the projects were active and when the

projects had ended. An intraclass correlation coefficient of 0.88 > 0.80 was found also indicating that the instruments for data collection were reliable.

**Table 3: Instrument external reliability test**

| Variable | Intraclass correlation | 95% Confidence Interval | | Sig. |
|---|---|---|---|---|
| | | Lower bound | Upper bound | |
| Single measure | 0.784[a] | 0.706 | 9.160 | 0.000 |
| Average measure | 0.879[c] | 0.828 | 9.160 | 0.000 |

### 4.3 Descriptive Results

#### 4.3.1 Farmers socio-demographic and socio-economic characteristics

Table 4 presents the summary statistics for the categorical socio-demographic and socio-economic characteristics of the respondents. The selected sample was stratified into 240 (62.5%) climate smart project participants and 144 (37.5%) non- participants bringing the total number of respondents to 384 from the 12 sub counties in Kakamega County.

In terms of gender of the farmer, the results showed that about 60% of the respondents were male while 40% were female. The presence of many males in the selected sample could be explained by the fact that according to the cultural and social settings of African people men are more likely to access and control land resources which are fundamental in agriculture, thus will have great influence on the household participation in the project activities.

With regards to highest education level, about 51% of the respondents had attained primary education followed by secondary education at 34 %. Only 9 % of the farmers had attained tertiary education and 7 % had no formal education. Generally this implies that a good proportion of the farmers had attained formal education and had sufficient capacity to read, understand and apply farm principles thus capable of adopting new climate smart practices and technologies. The *chi-square* test was statistically insignificant, indicating that there was no significant difference in the highest education levels of participants and non-participants.

For legal land ownership status of farmers land, the results indicated that 79% of the respondents had title deeds to their lands and were the sole owners of their land whereas 21 % indicated that they did not possess title deeds to the land that they farmed on. The land had been leased or belonged to the family. The *chi-square* test was statistically significant at 10% level, indicating a significant difference in the legal land ownership status of participants and non-participants.

**Table 4: Descriptive statistics of categorical socio-demographic and economic variables.**

| Variable | | Non-Participants Count (%) | Participants Count (%) | Total Count (%) | Chi Square |
|---|---|---|---|---|---|
| Gender of the farmer | Female | 60 (15.6) | 94 (24.5) | 154(40.1) | 0.628 |
| | Male | 84 (21.9 | 146 (38.0) | 230 (59.9) | |
| Highest Education level of the farmer | Non- formal | 13 (3.4) | 13 (3.4) | 26(6.8) | 0.276 |
| | Primary | 71 (18.5 | 123 (32.0) | 194(50.5) | |
| | Secondary | 44 (11.5) | 86 (22.4) | 130(33.9) | |
| | Tertiary | 16 (4.2) | 18 (4.7) | 34(8.9) | |
| Marital status of the farmer | Single | 0 (0.0) | 1 (0.3) | 1 (0.3) | 0.429 |
| | Married | 142 (37.0) | 238(62.0) | 380 (99.0) | |
| | Widowed | 2 (0.5) | 1 (0.3) | 3 (0.8) | |
| Legal land Ownership Status | Sole Ownership | 120 (31.3) | 185(48.2) | 305 (79.4) | |
| | Family land | 22 (5.7) | 54(14.1) | 76 (19.8) | 0.080* |
| | Joint Ownership | 0 (0.0) | 1 (0.3) | 1 (0.3) | |
| | Leased | 2 (0.5) | 0 (0.0) | 2 (0.5) | |
| Primary Occupation of the farmer | Off-farm income | 4 (1.0) | 2 (0.5) | 6 (1.6) | 0.137 |
| | Farm Income | 140(36.5 | 238(62.0) | 378 (98.4) | |

***, ** and * denote 1%, 5% and 10% respectively. Frequencies provided with percentage values in parenthesis.

The primary occupation for majority of the respondents was farming as farm income was the main source of income at 98 % and non-farm income at 2 %. This shows that most of the respondents were full time farmers while only a small proportion of the salaried and business people participated in farming. Participating in off-farm income generating activities lowers the ability of farmers to interact with extension providers which makes them less knowledgeable on intended interventions such as agricultural development projects.

Table 5 presents summary statistics for the continuous socio-demographic and socio-economic characteristics of the respondents. T-tests were carried out to determine mean differences between project participants and non-participants.

The mean age of the respondents was 52.31 years. This shows that majority of the sampled farmers were past their youthful age. The t-value indicates that there was no significant mean difference based on project participation with a mean of 52 years for both participants and non-participants. This could be explained by the fact that the study was interested in participants and non-participants of projects that had been completed some years back and thus the older people were more likely to have been selected.

**Table 5: Descriptive statistics of continuous socio-demographic and economic variables**

| **Variable +** | **Non-participants Mean (SD)** | **Participants Mean (SD)** | **Total Mean (SD)** | **t-value** |
|---|---|---|---|---|
| Age of the farmer (in years) | 52.02 (10.53) | 52.48(11.04) | 52.31(10.84) | 0.689 |
| Household size of the farmer | 5.95 (2.22) | 6.27(2.30) | 6.15 (2.27) | 0.189 |
| Farm size (in acres) | 1.83(1.55) | 1.75(1.50) | 1.78(1.51) | 0.651 |
| Farming experience (in years) | 21.01(9.21) | 21.06(9.91) | 21.04(9.64) | 0.957 |
| Income (in shillings) | 5.28 (2.60) | 5.79(2.20) | 5.59(2.37) | 0.034** |
| Frequency of Extension services | 0.53(0.50) | 2.16(1.06) | 1.55(1.19) | 0.000*** |

***, ** and * denote 1%, 5% and 10% respectively. Provided are mean values with standard deviations in parenthesis

On average, participants had a farm size of 1.75 acres with a household size of 7 people relative to non-participants who had a farm size of 1.83 acres and household size of 6 people. The farm size mean of 1.78 acres confirms that majority of the respondents were smallholder farmers. The results also imply that, smallholder farmers with smaller pieces of land and with many household members were more willing to participate in agricultural projects as compared to those with relatively larger pieces of land. This could be due to the fact that larger households could sufficiently provide labour which was not catered for by the projects on their small piece of land without incurring extra expenses. The t- value indicates no significant mean difference in farm size and household size of both groups.

The average years of farming experience of the respondents was 21.04 years. There was no significant mean difference based on project participation with a mean of 21 years for both participants and non-participants. This means that farmers were highly experienced. Experienced farmers are likely to better understand the importance of agricultural project interventions and hence easily adopt the new climate smart agriculture practices and technologies in order to increase productivity.

The results also indicate that project participants had a mean of 2.16 as the frequency of extension visits compared to non-participants mean of 0.53 times. There was a significant difference in their means at 1 % level of significance. This indicates that majority of the non-participants barely received any visits from extension officers as compared to participants who were visited at least twice. In this case being a member of a project proved beneficial as there were more interactions with the extension officers.

With regards to income findings reveal that the mean annual income of the respondents was between 40,000 and 50,000 (5.59). Although the mean annual income for both participants and non- participants was between 40,000 and 50000 the mean income of participants (5.79) had slightly higher values as compared to non-participants (5.28). This was further confirmed by

the t-test value of 0.003 showing that there was a significant difference in their incomes at 5% significance level.

### 4.3.2 Institutional characteristics

Table 6 presents summary statistics for the institutional characteristics of the sample. Generally from the results, there was limited access to agriculture credit among the sampled farmers, 76% of the respondents indicate that they had never had access to credit for farming. Chi-square test results indicate that the proportion of participants who accessed agriculture credit (13%) was significantly greater (at 5% level) than that of non-participants (11%). This could be explained by the fact that in most cases financial institutions that have credit facilities for farmers usually partner with agriculture projects to provide credit services. Farmers who require credit and are project participants are therefore more likely to easily access credit as compared to non-participants.

**Table 6: Descriptive statistics of institutional variables**

| Variable | | Non-Participants Count (%) | Participants Count (%) | Total Count (%) | Chi square |
|---|---|---|---|---|---|
| Access to agriculture Credit | No | 101 (26.3) | 190(49.5) | 291(75.8) | 0.046** |
| | Yes | 43 (11.2) | 50 (13.0) | 93(24.2) | |
| Training on CSAP | No | 65(16.90) | 16(4.2) | 81(21.1) | 0.000*** |
| | Yes | 79(20.6) | 224(58.3) | 303 (78.9) | |
| Access to agriculture Extension | No | 81( 21.1) | 6(1.6) | 87(22.7) | 0.000*** |
| | Yes | 63(16.4) | 234(60.9) | 297(77.3) | |
| Market distance influence | No | 104 (27.1) | 158(41.1) | 262(68.2) | 0.193 |
| | Yes | 40 (10.4) | 82(21.4) | 122(31.8) | |

***, ** and * denote 1%, 5% and 10% respectively. Frequencies provided with percentage values in parenthesis.

Table 6 results also show that 79% of the respondents received training on climate smart practices while 21 % did not. However a larger percentage of project participants (58%)

received training as compared to non- participants (21%). This indicates that project participants had more training as compared to their non-participants counterparts. The *chi-square* test results which were statistically significant at 1% level of significance further confirmed that.

More than half of the respondents (77%) had access to agriculture extension services while 23 % did not. The *chi-square* test at 1% level of significance, further indicated that project participants had more access to extension services (61%) compared to non-participants (16 %). Membership to project was thus beneficial to farmers in this aspect.

From Table 6 results, 68 % of the sampled farmers indicated that distance to the market did not have any influence on their decision regarding project participation. This could imply that farmers already had ready market for their products or they were more interested in acquiring knowledge on practices that would improve their productivity. However, 32% indicated that distance to the market was a determining factor for them to participate in the project. The *chi-square* test results were statistically insignificant meaning that project participation was not dependent on distance to the market.

### 4.4. Test for Multicollinearity

Before conducting the Tobit and Ordered Probit regression analysis, existence of multicollinearity problem on the selected independent variables was checked. The Variance Inflation Factor (VIF) which measures the intensity of multicollinearity in continuous explanatory variables in an ordinary least square (OLS) regression analysis was used while a Pearson's contingency coefficient test (CC), a *chi-square* based measure of association for categorical data was used for discrete explanatory variables**.**

$$VIF = \frac{1}{1-R_i^2} \qquad (4.1)$$

Where: $R_i^2$ = the coefficient of correlation among explanatory variables.

$$CC = \sqrt{\frac{X^2}{N+X^2}} \quad (4.2)$$

Where: CC = Coefficient of contingency

$X^2$ = *Chi-square* random variable

N = Total sample size.

From Table 7 results, the VIFs values were less than ten indicating that there was no substantial association between the continuous independent variables; hence the data had no serious problems of multicollinearity.

**Table 7: Variance Inflation Factor test results.**

| Variable | VIF |
|---|---|
| Age of the farmer | 1.92 |
| Household size | 1.08 |
| Farm size( in acres) | 1.19 |
| Farming experience(in years) | 2.07 |
| Number of practices offered by project | 1.07 |
| Frequency of extension services | 1.03 |
| Mean VIF | 1.39 |

The Pearson's contingent coefficients results for the categorical variables in Table 8 show that all the contingent coefficients were less than 1. This illustrates that there was no serious association among categorical variables.

**Table 8: Pearson's Contingency coefficient test results**

| | Gender | Educ. Level | Land Status | Primary occup. | Credit access | Training | Market distance | Sub county |
|---|---|---|---|---|---|---|---|---|
| Gender | 1.000 | | | | | | | |
| Education level | -0.004 | 1.000 | | | | | | |
| Legal land status | 0.381 | 0.170 | 1.000 | | | | | |
| Primary occupation | 0.203 | -0.135 | -0.565 | 1.000 | | | | |
| Credit access | 0.033 | 0.062 | 0.103 | -0.066 | 1.0000 | | | |
| Training | -0.776 | 0.030 | 0.067 | 0.159 | 0.027 | 1.0000 | | |
| Distance to market | 0.020 | 0.009 | 0.099 | -0.031 | 0.128 | 0.016 | 1.0000 | |
| Sub county | -0.151 | -0.045 | 0.078 | -0.080 | 0.140 | -0.061 | -0.013 | 1.000 |

### 4.5. Socio-demographic and institutional factors influencing extent of farmers' participation in agricultural development projects.

#### 4.4.1: Extent of farmers' participation in agricultural projects

Extent of farmers' participation was measured in terms of how long the farmer had been a participant of the agricultural development project (longevity of participation) and the number of practices that the farmer had adopted from the project out of the total number of practices offered by the agricultural development projects.

**Table 9: Descriptive statistics of extent of farmers' participation in agricultural projects**

| | N | Min | Max | Mean | Std. Dev. |
|---|---|---|---|---|---|
| Longevity of participation in months | 240 | 0 | 20 | 4.71 | 1.840 |
| Ratio of number of practices adopted by farmer over total number of practices offered by the projects | 240 | .25 | 1.00 | .7284 | .19566 |

From Table 9, descriptive statistics results on extent of farmers' participation in terms of longevity reveal that the highest number of months that the farmer participated in the projects was 20 months (1 year 8 months) while the minimum was 0 for the non-participants. On average farmers participated in the projects for a period of about 5 months. This confirms the low participation levels of farmers in agricultural development projects as most of the projects under study were running for a period of 5 years and above as shown in Table 2. These results are backed up by Ouma, 2016 who affirmed that people's participation in their own projects had not yet attained the acceptable levels that qualify to imply full participation

With regards to extent of farmers' participation in terms of number of practices adopted from the project, results in Table 9 show a mean ratio of 0.73 indicating that out of the total number of practices offered by the projects farmers adopted at least 73% of the practices. This illustrates high level of farmers' willingness to adopt project interventions. This could be explained by

the fact that partnering with developmental agencies increases benefits accessible to farmers leading to higher adoption and utilization of agricultural practices (Amudavi, 2007)

To determine the socio-demographic and institutional factors influencing extent of farmers' participation in agricultural development projects the censored Tobit regression model was estimated. A Prob> $chi^2$= 0.000 was found indicating that the independent variables in the Tobit model reliably predicted the dependent variable.

Among the selected socio-demographic and institutional characteristics, The Tobit regression model analysis in Table 10 revealed that type of project funders, number of agricultural practices offered by the project, frequency of extension visits from other providers and distance to the market were the main variables that had a significant influence on longevity of farmers' participation in agricultural development projects.

On the other hand, legal land ownership status, type of project funder, number of agricultural practices offered by the project and distance to the market had a significant influence on the number of climate smart practices adopted by the farmer.

It was noted that type of project funder, number of agricultural practices offered by the project and distance to the market influenced extent of farmers' participation in agricultural development projects both in terms of longevity and number of practices adopted by the farmer.

Type of project funder (National government or International agencies) marginal effects of output indicate that, at 1% level of significance, the longevity of participation in projects funded by international agencies (German Cooperation) was lower compared to projects funded by the national government of Kenya by about 18 months.

Type of project funder (National government or International agencies) marginal effects of output also indicate that at 10 % level of significance, the number of practices adopted by the

farmers from international agencies (Swedish Government) were more compared to the national government of Kenya by about 37%.

**Table 10: Tobit regression estimates of factors influencing longevity of participation and number of practices adopted from the projects.**

| Variable | Longevity (in months) | | | Number of practices adopted | | |
|---|---|---|---|---|---|---|
| | Coef. | SE | dy/dx | Coef. | SE | dy/dx |
| Gender of the farmer | -1.528 | 3.300 | -1.528 | -0.121 | 0.142 | -0.121 |
| Age of the farmer | 0.061 | 0.153 | 0.061 | 0.008 | 0.007 | 0.008 |
| Non formal education | 4.570 | 6.670 | 4.570 | -0.239 | 0.287 | -0.239 |
| Secondary education | 2.021 | 3.377 | 2.021 | -0.116 | 0.145 | -0.116 |
| Tertiary education | -6.054 | 5.878 | -6.054 | 0.290 | 0.253 | 0.290 |
| Household size | 0.457 | 0.698 | 0.457 | 0.015 | 0.030 | 0.015 |
| Farm size under agriculture | 0.377 | 1.088 | 0.377 | 0.005 | 0.047 | 0.005 |
| Legal land status dummies; | | | | | | |
| Family land | -5.242 | 3.809 | -5.242 | -0.423*** | 0.164 | -0.423*** |
| Project funders dummies; | | | | | | |
| Anglican Church of Kenya | 5.081 | 12.250 | 5.081 | 0.127 | 0.528 | 0.127 |
| German cooperation | -17.954*** | 6.439 | -17.954*** | -0.091 | 0.278 | -0.091 |
| Swedish Government | -2.208 | 4.974 | -2.208 | 0.367* | 0.214 | 0.367* |
| Number of practices offered by project | 2.116** | 0.993 | 2.116** | 0.452*** | 0.043 | 0.452*** |
| Access to agriculture credit | -1.412 | 3.881 | -1.412 | -0.013 | 0.167 | -0.013 |
| Training on agricultural practices | 0.0680 | 6.381 | 0.068 | 0.377 | 0.274 | 0.377 |
| Frequency of extension visits from other providers | -2.751* | 1.539 | -2.751* | 0.017 | 0.066 | 0.017 |
| Distance to the market | -6.333* | 3.596 | -6.333* | -0.330** | 0.155 | -0.330** |
| Sub County dummies included | Yes | Yes | Yes | Yes | Yes | Yes |
| Constant | 45.555 | 12.956 | | 1.1467 | 0.556 | |
| | Log=1071.31 LRchi$^2$(27) = 69.20 | | | Log =-321.73 LRchi$^2$(27) = 172.81 | | |
| | Pseudo $R^2$ = 0.031 Prob> chi$^2$= 0.000 | | | Pseudo $R^2$ = 0.211 Prob> chi$^2$= 0.000 | | |
| | N = 240 | | | N = 240 | | |

***, **, *** is significant at 10%, 5% and 1% respectively**.

Number of agricultural practices offered by the project had a positive effect on both longevity of participation and number of practices adopted by the farmer at 5 % and 1% level of significance respectively. The marginal effect results shows that introduction of one additional agricultural practice by the project led to an increase in the length of participation by 2 months

while it also led to a 45% increase in the number of practices adopted by the farmer from the project.

Distance to the market negatively influenced longevity of farmers' participation and number of practices adopted by the farmer at 10% and 5% level of significance respectively. A unit increase in the distance to the market decreased the length of farmers' participation in the projects by about 3 months while it also decreased chances of adoption of an additional agricultural practice by 33 %.

Longevity of participation in agricultural development projects was further negatively influenced by frequency of extension services from other providers at 10 % level of significance. The marginal effects illustrate that for one unit increase in the frequency of extension services from other providers the longevity of farmers' participation in projects decreased by about 3 months.

Finally, legal land ownership status significantly influenced the number practices adopted from agricultural projects at 1 % level of significance. The marginal effect results in the model indicate that the number of practices adopted by farmers who did not have title deeds to the land they cultivated on (family land) were less compared to farmers who had title deeds to their land (sole owners) by about 42%.

### 4.6 Socio economic and institutional determinants of perceived sustainability of agricultural development projects.

This subsection first gives results on farmers' perception on sustainability of agricultural development projects before determining the socio economic and institutional factors affecting perceived sustainability of agricultural development projects.

### 4.6.1 Perceived sustainability of agricultural development projects

Project participants were asked to rank and weigh various factors encompassed within the economic, environmental and social indicators of project sustainability using a five-point likert scale (strongly disagree=1, disagree=2, undecided=3, agree=4, and strongly agree=5).

As shown in Table 11, among five factors that were used as project economic indicators. The economic indicator with the highest mean (4.47) was project helped farmers to improve their farm productivity while project reduced cost of production had the lowest mean of 2.31. This implies that most project participants (97%) agreed that participating in the project had helped them in improving their productivity level. However, on the other hand 74 % of the participants disagreed that the project had made efforts to help in reduction of cost of production.

Concerning environmental indicators, projects efforts towards addressing soil protection had the highest mean of 4.28 while efforts towards effective emission management system had the lowest mean of 3.00. 90 % of the project participants were in agreement that the project had addressed soil protection measures. On effective emission management system only 20% were in agreement that the project had addressed it. 24 % of the project participants disagreed while 55% of the participants were undecided whether it had made an effort in addressing effective emission management system. This could imply that the project had not created adequate awareness on effective emission management system.

Lastly, on social indicators, project meeting farmers' demands and provision of great services was rated highly with a mean of 3.97 while protecting people cultural heritage had the least mean of 2.91.

**Table 11: Sustainability Indicators.**

| | Mean | Std. Dev. | Strongly Disagree | Disagree | Undecided | Agree | Strongly Agree |
|---|---|---|---|---|---|---|---|
| **Economic Indicators** | | | (%) | (%) | (%) | (%) | (%) |
| The project; | | | | | | | |
| Improved productivity | 4.47 | 0.78 | 2.9 | 0.0 | 0.0 | 40.8 | 56.3 |
| Improved production efficiency | 4.39 | 0.88 | 2.5 | 3.3 | 1.3 | 38.3 | 54.6 |
| Increased profitability/ income | 4.33 | 0.89 | 2.5 | 3.3 | 3.3 | 40.0 | 50.8 |
| Reduced cost of production | 2.31 | 0.99 | 14.2 | 59.6 | 12 9 | 7.9 | 5.4 |
| increased quality of products | 3.98 | 1.09 | 2.1 | 12.5 | 9.6 | 36.7 | 39.2 |
| **Environmental Indicators** | | | | | | | |
| The project had programmes on; | | | | | | | |
| Water protection | 4.10 | 0.90 | 3.3 | 3.8 | 4.6 | 56.3 | 32.1 |
| Land use efficiencies | 4.24 | 0.97 | 4.6 | 2.5 | 2.5 | 45.0 | 45.4 |
| Soil protection | 4.28 | 0.99 | 5.5 | 1.3 | 2.9 | 40.8 | 49.6 |
| Forest protection | 3.89 | 0.81 | 1.3 | 3.3 | 21.3 | 53.8 | 20.4 |
| Effective emission management | 3.00 | 0.87 | 3.3 | 20.8 | 55.4 | 13.8 | 6.7 |
| **Social Indicators** | | | | | | | |
| The project; | | | | | | | |
| Met demand and provide great services to members e.g trainings | 3.97 | 0.84 | 4.2 | 1.7 | 6.7 | 67.9 | 19.6 |
| Ensured close partnerships between members | 3.88 | 0.89 | 3.3 | 3.3 | 15.8 | 56.7 | 20.8 |
| Led to improvement in service standards e.g. access to credit services, extension | 3.80 | 0.82 | 2.1 | 3.8 | 21.7 | 56.7 | 15.8 |
| Ensured accountability and transparency among stakeholders | 3.28 | 0.77 | 1.3 | 11.3 | 50.4 | 32.9 | 4.2 |
| Protected cultural heritage | 2.91 | 0.94 | 6.3 | 24.6 | 46.3 | 17.5 | 5.4 |

**1= Strongly Disagree, 2=Disagree, 3=Undecided, 4=Agree, 5=Strongly Agree**

Upon transforming the means of all the selected key project sustainability indicators shown in Table 11 to develop the overall project sustainability index (PSI), results in Figure 4 indicate that majority (60.4%) of the project participants were of the perception that the projects were very Sustainable (overall mean falling between 3.34 -5.00). 34.2% felt that that the projects were sustainable (overall mean between 1.67- 3.33) while only 5.4 % of the participants ranked the projects as unsustainable (overall mean between 0-1.66). From the results, (94 %) of project

participants believed that the impact of the completed agricultural development projects could still be traced up to date as farmers still utilize the agricultural projects interventions.

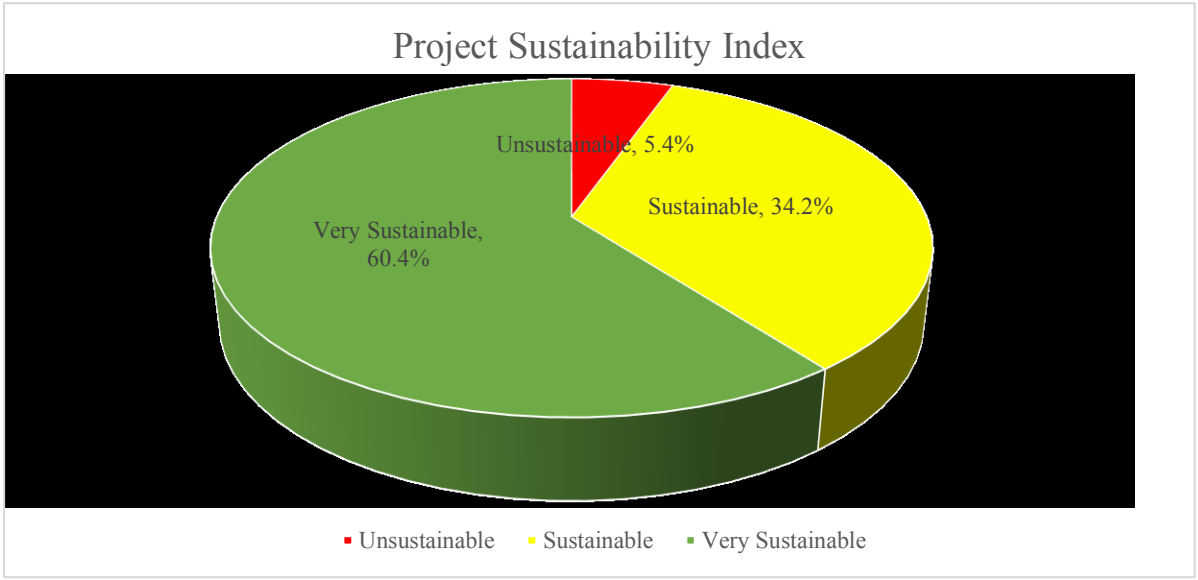


**Figure 3: Project Sustainability Index**

In addition, a separate finding was carried out involving both project participants and non-participants. The respondents were asked a Yes/No question on whether they still utilize the agricultural projects interventions after the projects ended. Figure 5 results show that 94% of the respondent stated that they were still utilizing the projects interventions thus according to them the projects were sustainable while only 6% stated that the projects were unsustainable.


**Figure 4: Project Sustainability**

### 4.6.2 Socio economic and institutional determinants of perceived sustainability of agricultural development projects.

The ordered probit model was satisfactory given its statistical significance (Prob> $chi^2$ =0.000) with pseudo $R^2$ of 0.3003 and log likelihood of −138.51 as presented in Table 12. According to McFadden, (2021) Unlike $R^2$ index, the values of pseudo $R^2$ tend to be considerably lower than those of the $R^2$ index and a pseudo $R^2$ between 0.2-0.4 represent excellent fit.

Looking at the individual coefficients, legal land ownership status, farming experience, number of practices adopted from the project, longevity of participation, training and adoption cost were all significant determinants of perceived sustainability of agricultural development projects. Perceived project sustainability varied directly with number of practices adopted from the project, longevity of project participation and training while legal land ownership status, farming experience and adoption cost were perceived project sustainability decreasing factors. However, coefficients cannot directly reveal the effects of the explanatory variables on each of the three different levels of sustainability therefore marginal effects measured by dy/dx were evaluated at the different corresponding levels of perceived sustainability.

With regards to legal land ownership status, the marginal effects at 5% level of significance reveal that an increase in farmers who do not have title deeds for their farms (family land) as compared to farmers who own title deeds (sole owners) decreased the probability of a project being very sustainable by 15% while it increased the probability of the projects being sustainable and unsustainable by 10% and 4% respectively.

Farming experience decreased probability of projects being very sustainable by 0.5 % while it increased the probability of the project being sustainable and unsustainable by 0.3 % and 0.1 % respectively at 10 % level of significance.

The marginal effects also indicate that at 1% significance level a unit increase in the number of practices adopted by a farmer increased the chances of a project being very sustainable by

6% while it decreased the chances of the projects being sustainable and unsustainable by 4% and 2% respectively.

**Table 12: Ordered probit regression estimates.**

| | Coef. | Unsustainable (≤33%) dy/dx | Sustainable (34-67%) dy/dx | Very Sustainable (68-100%) dy/dx |
|---|---|---|---|---|
| Highest Education level of farmer | 0.130 | -0.010 | -0.023 | 0.033 |
| Farm size (in acres) | 0.062 | -0.005 | -0.011 | 0.016 |
| Legal land Ownership dummies; | | | | |
| Family land | -0.571** | 0.043** | 0.101** | -0.152** |
| Farming Experience( in years) | -0.018* | 0.001* | 0.003* | -0.005* |
| Primary Occupation dummies; | | | | |
| Off farm occupation | -0.556 | 0.042 | 0.098 | -0.140 |
| Project funders dummies; | | | | |
| Anglican Church of Kenya | -0.460 | 0.035 | 0.081 | -0.115 |
| German Cooperation | -0.554 | 0.042 | 0.098 | -0.140 |
| Swedish Government | -0.109 | 0.008 | 0.019 | -0.027 |
| Funding period(in years) | -0.099 | 0.007 | 0.018 | -0.025 |
| Number of practices adopted | 0.246*** | -0.019*** | -0.044*** | 0.062*** |
| Longevity of participation (in months) | 0.007* | -0.001* | -0.001* | 0.002* |
| Frequency of extension visits | -0.042 | 0.003 | 0.007 | -0.018 |
| Credit access | -0.007 | 0.000 | 0.001 | -0.002 |
| Training on CSA practices | 0.696* | -0.053* | -0.123* | 0.176* |
| Distance to the market ( in km) | -0.246 | 0.019 | 0.044 | -0.062 |
| Adoption cost | -0.392** | 0.030** | 0.069** | -0.099** |
| Sub County dummies included | Yes | Yes | Yes | Yes |
| Log likelihood= -138.513 | | | LRchi$^2$(27)= 118.88 | N =239 |
| Pseudo $R^2$ = 0.3003 | | | Prob> chi$^2$ =0.000 | |

***, **, *** is significant at 10%, 5% and 1% respectively.**

Regarding longevity of participation in the projects, at 10 % level of significance an additional month of project participation increased the likelihood of the projects being very sustainable by 0.2% while it decreased the likelihood of the projects being sustainable and unsustainable by 0.1% respectively.

At 10 % level of significance training increased the chances of the project being very sustainable by 18% whereas it decreased the chances of the projects being sustainable and unsustainable by 12% and 5% respectively.

Adoption cost of climate smart practices also significantly affected perceived sustainability of agricultural development projects at 5 % significance level. An increase in the unit cost of adopting agricultural practices decreased the probability of the projects being very sustainable by 10% while it increased the probability of the projects being sustainable and unsustainable by 7% and 3% respectively.

### 4.7 Effect of extent of farmers' participation and perceived projects' sustainability on poverty situation.

The first step was to measure the poverty situation among project participants and non-participants in Kakamega County. Table 13 made comparisons of the poverty indices (headcount, depth and severity) of agricultural project participants and non-participants. The poverty indices were computed using the Foster-Greer-Thorbecke (FGT) poverty measure where farmers' monthly consumption expenditure level and the national rural poverty line of Ksh 3252 per month (US$ 1.05 per day) was used.

**Table 13: Poverty measures among project participants and non-participants.**

| Poverty indices | Participants | Non-participants |
|---|---|---|
| Headcount | 0.083 | 0.153 |
| Depth | 0.013 | 0.027 |
| Severity | 0.004 | 0.008 |
| Poverty line using 2015/16 KNBS national rural poverty line (per month) | 3252 | 3252 |

Source: Authors computation using FGT measures; 2015/16 KNBS national rural poverty line of 3252 per month.

The results in Table 13 revealed that 8.3% of project participants were identified as poor compared to 15.3% of project non-participants who were identified as poor. The proportion of people that was poor was higher for non-participants of agricultural projects than the participants (by 7 %). The poverty gap index was 1.3 % for participants and 2.7% for non-participants indicating that for the poor non-participants to be lifted from poverty, they would have to increase their current monthly consumption expenditure level by 2.7%, while poor

farmers from the participant group needed only 1.3% increment in their current monthly consumption expenditure level to move above the poverty line. The depth and severity indices of poverty were also higher among non-participants by 1.4% than the participants at 0.4 % respectively. This shows a high degree of income shortfall below the poverty line and a high degree of inequality among the poor. The poverty severity index was 0.004 to CSAP participants while 0.008 to non-participants demonstrating higher inequality among the poor non-participants.

Secondly the researcher went a step further to determine the effect of agricultural development projects on poverty situation for comparison purposes with most preceding studies before examining the effect of extent of farmers' participation and project perceived sustainability on poverty situation. First of all the logistic regression model was run under PS match 2 command to determine factors affecting farmers' participation in agricultural development projects while estimating the propensity scores at the same time. The logistic regression model result revealed that farmers' decisions to participate in agricultural development projects was influenced by legal land ownership status, access to credit, access to agriculture extension services and farm income.

Legal land ownership had a positive effect on participation in agricultural development projects. At 10 % level of significance farmers with title deeds to their lands were more likely (by 77%) to participate in agricultural development projects as compared to those who did not have title deeds to their lands. Similarly, ease of access to an additional credit and agriculture extension service increased likelihood of participating in agricultural projects by 99% and 55% respectively at 1 % level of significance. A unit increase in farmers' farm income also increased the chances of participation in the projects by 15% at 1% significance level.

**Table 14: Logit regression results of determinants of participation in agricultural projects.**

| | Coefficient | Std. Error | Z-value |
|---|---|---|---|
| Gender of farmer | 0.111 | 0.317 | 0.35 |
| Age of the farmer | -0.002 | 0.021 | -0.10 |
| Farm size at CSA adoption (in acres) | -0.141 | 0.131 | -1.08 |
| Highest Education level dummies; | | | |
| Primary | Reference | Reference | Reference |
| Non formal | -0.397 | 0.628 | -0.63 |
| Secondary | -0.058 | 0.340 | -0.17 |
| Tertiary | -0.414 | 0.510 | -0.81 |
| Marital status of the farmer | -1.064 | 0.755 | -1.41 |
| Household size of the farmer | 0.080 | 0.073 | 1.10 |
| Legal land ownership status dummies; | | | |
| Sole land ownership | Reference | Reference | Reference |
| Family land | 0.770* | 0.434 | 1.77 |
| Primary Occupation of the farmer dummies; | Reference | Reference | Reference |
| Farm income | | | |
| Non-farm income | 1.805 | 1.240 | 1.46 |
| Farming Experience( in years) | 0.001 | 0.330 | 0.05 |
| Agriculture Credit access | 0.994*** | 0.181 | -3.02 |
| Agriculture extension services access | 4.551*** | 0.530 | 8.58 |
| Farm income | 0.151*** | 0.076 | 1.99 |
| Sub County dummies included | Yes | Yes | Yes |
| Cons | -1.205 | 2.840 | -0.42 |
| Log likelihood = -158.295 | $LRchi^2(26)$= 191.49 | | N =384 |
| Pseudo $R^2$ = 0.377 | $Prob>chi^2$=0.000 | | |

***, **, *** is significant at 10%, 5% and 1% respectively.**

The second step then was matching the estimated propensity score for monthly consumption expenditure of project participants and non-participants by imposing a common support condition.

As shown in Table 15, the estimated propensity scores varied between 1000 and 50,000 (mean = 8453.33) for treatment households and between 0 and 20,000 (mean = 6406.25) for control farmers. The common support assumption was thus satisfied in the region of [1,000, 20,000], with a loss of eleven households (one control farmer and ten treated farmers). Households whose estimated propensity scores were less than 1,000 and larger than 20,000 were not considered for the matching exercise.

**Table 15: Distribution of estimated propensity scores.**

| Group | Obs. | Mean | Std. Err. | Std. Dev. | Min | Max | t-value |
|---|---|---|---|---|---|---|---|
| Total Farmers | 384 | 7685.677 | 309.530 | 6065.511 | 0 | 50,000 | 0.001 |
| Treatment Farmers | 240 | 8453.333 | 460.967 | 7141.250 | 1000 | 50,000 | |
| Control Farmers | 144 | 6406.250 | 272.145 | 3265.741 | 0 | 20,000 | |
| Difference | | -2047.083 | 631.572 | | | | |

The difference mean value in Table 15 shows that the farmers in the control group spend 2,047 Kenya shillings less than those in the treatment group. The difference is also statistically significant at 1 %. This suggests that agricultural development projects increased total farmer monthly consumption expenditure.

Transforming monthly consumption expenditure using natural logarithm in order to correctly interpret in percentages the difference was still significant at 1% as shown in Table 16.

**Table 16: Distribution of estimated propensity scores using natural logarithms.**

| Group | Obs. | Mean | Std. Err. | Std. Dev. | t-value |
|---|---|---|---|---|---|
| Total Farmers | 383 | 8.663 | 0.027 | 0.535 | 0.001 |
| Treatment Farmers | 240 | 8.855 | 0.036 | 0.561 | |
| Control Farmers | 143 | 8.784 | 0.039 | 0.467 | |
| Difference | | -0.192 | 0.056 | | |

The results in Table 16 illustrate that on average participating in agricultural development project increased total farmers monthly consumption expenditure by 19%.

Figure 6 presents the histogram of the estimated propensity scores for participants and non-participants. A visual inspection of the estimated propensity scores for the two groups indicates the existence of a substantial overlap in the density distribution of the estimated propensity scores in terms of monthly consumption expenditure for both groups. This is shown in the intersection region of the common support graph and thus satisfies the common support condition. The propensity scores distribution for the project non-participants is shown by the

bottom half of the graph while the upper half shows propensity scores distribution for the project participants.

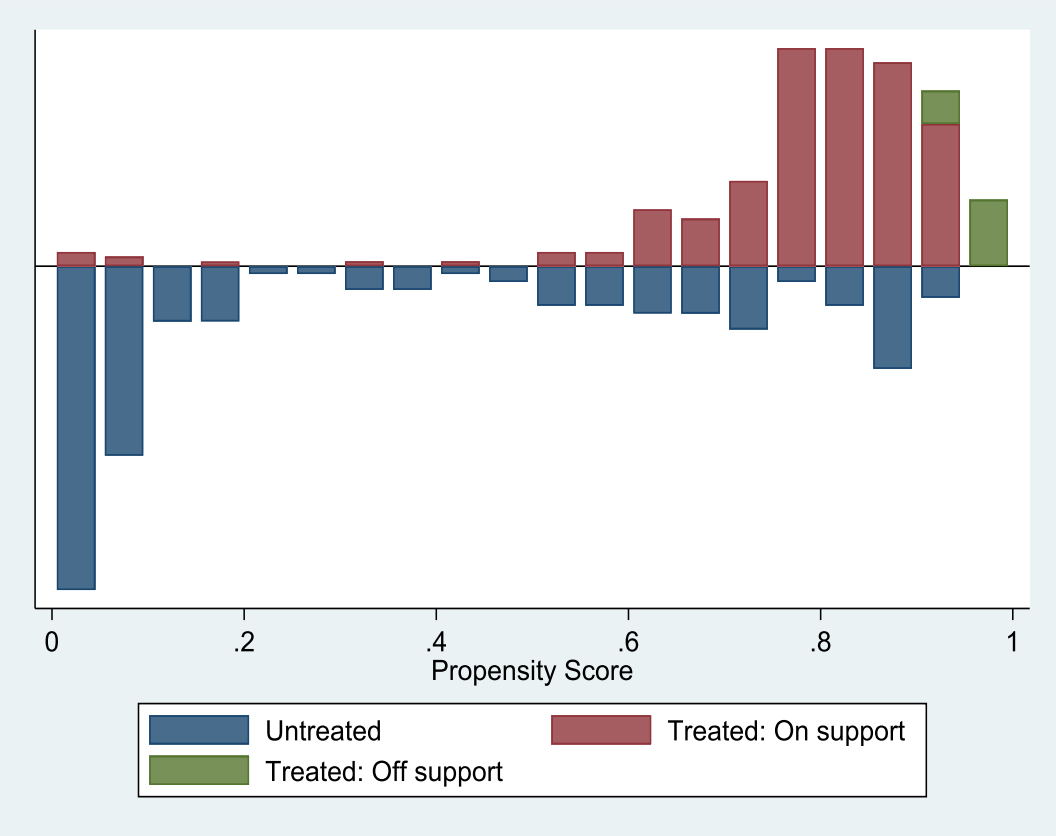


**Figure 5: Propensity score distribution and common support for propensity score estimation.**

Treated: On support illustrates the observations in the project participation group which have a suitable comparison.

Treated: Off support shows the observations in the project participation group which do not have a suitable comparison.

Table 17 reports the average treatment effect on the treated (ATT) estimates. ATT estimates show the effect of participation in agricultural development projects on poverty situation of the participants using monthly consumption expenditure as a proxy.

**Table 17: Effect of agricultural development projects on poverty Status.**

| Variables | Sample | Treated | Controls | Difference | Std. Err. | Stat |
|---|---|---|---|---|---|---|
| Monthly Expenditure | Unmatched | 8453.333 | 6406.25 | 2047.083 | 631.571 | 3.24 |
| | ATT | 8453.333 | 6870 | 1583.333 | 878.329 | 1.80** |
| | ATU | 6406.25 | 7268.75 | 862.5 | | |
| | ATE | | | 1313.021 | | |

The monthly consumption expenditure difference indicator of 1583.333 shown by ATT is positive and significant at 5% level. This illustrates that agricultural project participants increased their monthly consumption expenditure by Ksh. 1,583 and were better off compared to non-participants. The Average Treatment Effect (ATE) on monthly consumption expenditure for the randomly selected project participants and non-participants was also positive but a bit lower for the entire sample at 1,313.021. The Average Treatment Effect on the Untreated (ATU) result which reveals the treatment on randomly selected project participants and non-participants if they were not treated was positive as well. Overall, these results confirm that agricultural development projects had the potential to increase the monthly consumption expenditure and improve the welfare of the participants.

Finally a stepwise regression model was run to determine the effect of extent of farmers' participation and perceived project sustainability on poverty situation in Kakamega. The results in Table 17 illustrates that in the first model when monthly consumption expenditure a proxy for poverty level was regressed against longevity of participation and perceived project sustainability, longevity of participation was found to be statistically significant at 1 % level of significance. There was a positive relation between longevity of participation and monthly consumption expenditure. An increase in the number of months a farmer participated in a project led to an increment in the monthly consumption expenditure by 14%.

**Table 18: Stepwise regression results for monthly consumption expenditure against longevity of project participation and project perceived sustainability.**

| Model | | Unstandardized Coefficients | | Standardized Coefficients | | |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | t | Sig. |
| 1 | (Constant) | 6858.579 | 427.522 | | 16.043 | .000 |
| | Longevity of participation (in months) | 28.740 | 10.344 | .141 | 2.778 | .006 |

a. Dependent Variable: Monthly consumption expenditure

When farm size was added to the model, the results in Table 19 model 2 reveal that both farm size and longevity of participation significantly influenced monthly consumption expenditure whereas just as in Table 18 the farmers' perceptions on sustainability of agricultural projects did not have any significant effect on farmers monthly consumption expenditure.

Farm size and longevity of participation had a positive significant effect on farmers' monthly consumption expenditure. A unit increase in farm size increased monthly expenditures by 41% while a unit increase in the length of time a farmer participated in the project increased monthly expenditures by about 15%.

**Table 19: Stepwise regression results for monthly consumption expenditure against longevity of project participation, project perceived sustainability and farm size**

| Model | | Unstandardized Coefficients | | Standardized Coefficients | | |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | t | Sig. |
| 1 | (Constant) | 4767.082 | 437.096 | | 10.906 | .000 |
| | Farm size (in acres) | 1638.509 | 187.089 | .409 | 8.758 | .000 |
| 2 | (Constant) | 3869.855 | 513.412 | | 7.538 | .000 |
| | Farm size (in acres) | 1650.528 | 184.857 | .412 | 8.929 | .000 |
| | Longevity of participation ( in months) | 30.433 | 9.421 | .149 | 3.230 | .001 |

a. Dependent Variable: Monthly consumption expenditure

When more factors (gender, age, education level, household size, primary occupation, access to credit services and off-farm income) were added to the model, the results in Table 20 revealed that only farm size and longevity of participation were retained in the model as

statistically significant factors. The rest of the factors were excluded from the model and were found to have an insignificant effect on monthly consumption expenditures (poverty).

**Table 20: Stepwise regression estimates**

| Model | | Unstandardized Coefficients | | Standardized Coefficients | | |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | T | Sig. |
| 1 | (Constant) | 4767.082 | 437.096 | | 10.906 | .000 |
| | Farm size (in acres) | 1638.509 | 187.089 | .409 | 8.758 | .000 |
| 2 | (Constant) | 3869.855 | 513.412 | | 7.538 | .000 |
| | Farm size (in acres) | 1650.528 | 184.857 | .412 | 8.929 | .000 |
| | Longevity of participation (in months) | 30.433 | 9.421 | .149 | 3.230 | .001 |

a. Dependent Variable: Monthly consumption expenditure

# CHAPTER FIVE

# RESEARCH DISCUSSIONS

## 5.1 Overview

This section presents the discussions for this study's results and findings in the light of previous studies done.

## 5.2 Farmers socio-economic and institutional characteristics

From Table 4, the *chi square* test results revealed that there was a significant relationship between legal land ownership status and project participation. This could be explained by the fact that lack of security of tenure can encourage shortsighted land investment decisions and irresponsible use of land resources (Okumu, 2018). This finding is consistent with Udayakumara *et al.,* (2010) who also found out that farmers who cultivated on land owned by others were less likely to participate in soil and water conservation projects.

Access to credit, access to extension services and access to training were also found to have a significant association with project participation in Table 6. This could be explained by the fact that most financial institutions that have credit facilities for farmers usually partner with agriculture projects to provide credit services. In addition projects also avail agriculture extension services to farmers which comes with benefits such as the Training and Visit system and agriculture interventions such as Fertilizer and Seed Subsidy among others. Farmers in need of credit, training and subsidies are therefore more likely to participate in the agriculture projects in order to obtain these benefits. Etwire *et al.* (2013) concurs with these findings as he highlights that access to credit and agriculture extension increases the likelihood of participation in agriculture project.

A t-test value of 0.003 was found for income in Table 5, showing that there was a significant difference in the mean annual income for both participants and non- participants at 5% significance level. This could be attributed to high training and frequent extension visits which

provides necessary information, knowledge and skills among project participants resulting to increased farm productivity and consequently increased farm incomes.

### 5.3 Socio-demographic and institutional factors influencing extent of farmers' participation in agricultural development projects.

From Table 10, findings revealed that;

Longevity of farmers' participation in agricultural development projects funded by international agencies was lower compared to the length of participation in projects funded by the national government by about 18 months. This could be attributed to trust issues among participants and project funders. Farmers are familiar and already have a relationship with the national government implementing agencies like Ministry of Agriculture which they can directly sanction in case of poor performance of the adopted practices in the long run. On the other hand, non-governmental organizations implementing personnel are highly mobile and do not stay in one location for an extended period of time. This makes it difficult for farmers to be certain on who to hold accountable for the ultimate delivery of goods and services thus withdraw from the projects right after the project ends (Winters, 2010). These findings are consistent with those of Kumar (2002) who states that externally assisted projects in most cases are not sustainable and fail to continue once donor withdraw their support particularly funding. Dollar and Levin (2005) also confirms that a positive relationship exist between national governance quality and project performance.

Number of practices adopted by farmers from projects funded by international agencies were more compared to the number of practices adopted from projects funded by national government of Kenya by about 37%. This could be explained by the fact that international agencies avail adequately budgeted funds to their projects with defined frameworks for the flow of resources. This ensures timely and sufficient injection of funds which complements cost sharing among farmers and also supports efficient delivery of agriculture extension

services and training during implementation. This enhances higher adoption of climate smart practices among participants (Echeme, 2009). On the other hand, government funded projects most times only provide technical assistance to the participants. In case financial assistance is provided then the projects are likely to experience late and insufficient supply of funds (Echeme, 2009). These findings are supported by Amudavi (2007) who asserted that partnering with developmental agencies increased benefits accessible to farmers leading to higher adoption and utilization of agriculture practices.

Increment in the number of practices offered by the project marginally increased both longevity of participation in projects and the number of practices adopted by the farmer by 2 months and 45% respectively. Introduction of additional practices by the project significantly builds the confidence of the farmer in the project hence reducing the perceived risks and uncertainties in their mind. This subsequently influences the number of practices adopted and their length of participation in the project. According to Rogers (2003) and Wossink & Boonsaeng, (2003), perception is an important prerequisite that determines decisions and actions of farmers in the course of adopting agriculture technologies or practices.

Distance to the market had a negative effect on both longevity of farmers' participation in a project and the number of practices adopted at 10% and 5 % level of significance respectively. The closer the market the lower the transportation cost of agriculture inputs and outputs incurred. This encourages adoption of more agricultural practices from the project which automatically triggers continued project participation. A new practice requires access to new knowledge and proper skills which project membership guarantees through capacity building, frequent extension access and in some cases lowered input costs. These findings are in line with Tefera *et al.,* (2016) findings that showed that maize and teff technology package adoption improved as the households' residences became closer to market.

An increase in frequency of extension agent visits from other providers lowered the likelihood of farmers remaining project participants. Regular contact with extension officers enhances farmers' knowledge and equips them well with the necessary techniques. This may seem as a good thing but on the other hand it may bear a negative consequence on the length of time a farmer participates in the project. Once a farmer is able to frequently and easily access relevant quality information and training on the adopted practices, the chances of opting out from the project increase. Findings of this study concur with those of Tologbonse *et al.,* (2013) who noted frequency of extension contact influenced farmers' participation in projects. However, there was a contradiction in the results as there was a positive association between frequency of extension contact and project participation. It is important to note that the contradiction could be due to the fact that he was focusing on frequency of extension visits from agents within the project and not from other providers.

Legal land ownership status returned a significantly negative effect on the number of practices adopted by the farmer. These findings are backed up by Adusumilli and Wang (2019) whose results showed that landowners, irrespective of length of ownership, are more willing to participate in conservation programs.

**5.4 Socio-economic and institutional determinants of perceived sustainability of agricultural development projects.**

From Table 12, results revealed that;

An increase in farmers who do not have title deeds for their farms as compared to farmers who owned title deeds decreased the probability of a project being very sustainable by 15% while it consequently increased the probability of the projects being sustainable and unsustainable by 10% and 4% respectively. This implies that secured property rights give sufficient incentives to the farmers to invest in land development in order to increase their efficiencies and ensure environmental sustainability (Tenaw *et al.,* 2009). These results are consistent with Bamire and

Fabiyi (2002) who noted that farmers who acquire their land through borrowing, gifting, leasing, and sharing are typically less secure in embarking on long-term sustainable agriculture practices as opposed to farmers who acquire their land through purchasing and inheritance.

The results also showed that an additional year of farming experience decreased the probability of projects being very sustainable by 0.5 % which consequently increased the probability of the project being sustainable and unsustainable by 0.3 % and 0.1 % respectively. This could be attributed to the fact that due to experience with climate-related shocks over years, older farmers find it convenient to rely on the indigenous practices that allow them to be relatively resilient to climatic shocks than adopt modern practices that they are uncertain about and have steep learning curves (Nyong *et al.,* 2007). Similar findings were reported by Adesida *et al.,* (2021) whose results demonstrated that farmers with more farming experience were less likely to adopt crop diversification, animal manure, cover crops, and planting basins.

Number of practices adopted by the farmer increased the chances of a project being very sustainable by 6%. For as long as a new practice or technology is increasing productivity and incomes farmers would tend to continue utilizing it. Similar findings were reported by Mutiso *et al.,* 2015 who found out that one unit change in adoption of new technologies resulted to increase in sustainability of agricultural projects.

An additional month of participation in a project increased the likelihood of the projects being very sustainable by 0.2%. Participation equips beneficiaries with skills, expertise and knowledge that helps them to continue utilizing the project benefits as well as train other interested farmers even after cessation of the projects. This enables them to be supportive of the project thus increasing the likelihood of its success. In addition participation in the projects generates a sense of ownership by the community thereby increasing maintenance of the programmes (World Bank, 2014). These findings are consistent with Chrisostome, (2018) findings which established that with various aspects of beneficiary participation, the

sustainability of projects improved with greater beneficiary participation throughout the project cycle.

Training increased the chances of the project being very sustainable by 18% while it decreased the chances of the projects being sustainable and unsustainable by 12% and 5% respectively. This implies that relevant and frequent training of farmers on the new agricultural practices and technologies is likely to bring about high sustainability levels of agricultural development projects. Sufficient training enables farmers to continue training other farmers and generate intended project benefits. Mugo *et al.,* 2016 and Stirman *et al.* (2012) also found out that capacity building significantly influenced sustainability of agriculture projects.

A unit increase in the adoption cost of climate smart practices decreased the probability of the projects being very sustainable by 10% while it increased the probability of the projects being sustainable and unsustainable by 7% and 3% respectively. According to Rodriguez *et al.,* (2009) the most frequently mentioned economic barrier to adoption of new agriculture practices are the initial and transition costs due to uncertainties about the new practices.

**5.5 Effect of extent of farmers' participation and perceived project sustainability on poverty situation.**

Table 13 results showed that the indices for headcount, depth and severity of poverty were higher among non-participants than the participants. This implies that agricultural development projects increased monthly consumption expenditure levels of project participants contributing towards poverty reduction. This finding concurs with the findings of Oni and Olaniran, 2008; Olusegun *et al.,* 2015 and Etuk and Ayuk, 2021 which also indicated that the indices of poverty incidence, depth and severity were higher for programs/projects non-participants compared to participants.

From the propensity scores distribution results in Table 15, the average monthly consumption expenditure of project participants was higher than that of non-participants. The Average

Treatment Effect on the Treated (ATT) difference indicator of 1583.33 was also positive and significant at 5% level. This further backs up the results in Table 13 as it still confirms the agricultural projects potential to increase the participants' monthly consumption expenditures and consequently reducing poverty. These findings are in tandem with the findings of Etuk and Ayuk (2021); Marechera *et al.,* (2019); Olusegun *et al.,* (2015) and Haji *et al.,* (2013) who also found that the monthly consumption expenditures of beneficiaries of programs/ projects was higher than non-beneficiaries.

The stepwise regression results revealed that farmers' perception on sustainability of agricultural projects did not have a significant effect on poverty situation. On the other hand extent of farmers' participation in projects in terms of the length of time a farmer participated in an agricultural project had a significant positive effect on the poverty situation of farmers. This could be explained by the fact that by virtue of farmers' continued membership to a project, it enables them to acquire new farming ideas, new knowledge and skills. They are also likely to easily access higher credit, frequent extension services, improved subsidized inputs and even ready markets. This is likely to improve their agricultural productivity and incomes levels which consequently reduces poverty and improves their welfare. This findings are backed up by Minkler et al. (2008) who also observed that community participation in projects strengthened community capacity and subsequently improved the overall wellbeing of the community.

# CHAPTER SIX

# CONCLUSIONS AND RECOMMENDATIONS

## 6.1 Overview

This chapter presents the conclusions drawn from the findings of this study and makes key recommendations on interventions and strategies to be adopted.

## 6.2 Conclusions

From the censored Tobit regression results, it can be concluded that the type of project funder (international agencies or national government), number of agricultural practices offered by the project and distance to the market are the major influencers of extent of farmers' participation in agricultural development projects. These factors had a significant influence on extent of farmers' participation both in terms of longevity of participation and number of practices adopted by the farmer.

Farmers' participation and training are the main enhancers of agricultural project sustainability. This conclusion was drawn from the fact that both measures of extent of farmers' participation (longevity of participation and number of practices adopted by the farmer) and training were the only factors that positively affected perceived sustainability of agricultural development projects. All other factors in the model had no significant effect while legal land ownership status, farming experience and adoption cost possessed a negative effect on perceived sustainability of agricultural development projects.

Lastly, the extent of farmers' participation in agricultural projects has an effect on their poverty situation. An increase in the length of time a farmer participated in a project resulted to an increase in monthly consumption expenditure a proxy measure for poverty. This further demonstrates agricultural projects potential to reduce poverty.

### 6.3 Recommendations

Based on the findings and conclusions of the study, the following recommendations were made;

1. Project implementers should embrace partnerships between the national government and international agencies funding agriculture projects in order to offer a wide variety of new climate smart agricultural practices and enhance high farmer participation in terms of both longevity and high practice adoption. Establishment of marketing arrangements within the projects to bring down transaction costs, bargain for better prices and enforce farmer trader contracts should also be adopted.

2. To enhance the sustainability of agricultural development projects the relevant policy makers and stakeholders should design and develop projects and practices under a bottom up approach in order to allow initial assessment of the needs and capabilities of the local beneficiaries. This promotes farmers participation in the projects right from the onset and also reduces unnecessary efforts or expenses as the developed practices and technologies will be tailored to suit farmers' different needs and capabilities. In addition they should also explore opportunities for cost-sharing among farmers through collective action or by providing subsidies backed by local institutions that will continue to offer quality training, extension services, ready markets and other forms of support beyond the project period.

3. Concerning effect of extent of farmers' participation and perceived project sustainability on poverty situation, up scaling of agricultural development projects to the non-benefiting communities is recommended. This is because farmers' participation in the projects improves agricultural productivity which translates to high farm incomes, increased monthly consumption expenditures and reduction in poverty.

### 6.4 Areas of further research

Further analysis on actual sustainability of agricultural development projects and its impact on poverty situation is recommended so as to measure actual change in poverty situation that could be attributed to agricultural development projects.

Further analysis on effect of agricultural projects on poverty situation and effect of farmers' extent of project participation and perceived project sustainability on poverty situation using multi-dimensional measurement instruments of poverty is also recommended. Combination of income with other factors such as quality of education, health and employment is suggested to achieve an improved effect. In addition, rather than generalizing income, farm income should be clearly separated from other sources of income generation such as businesses, pension and others in order to get a clear and improved effect of agricultural projects on poverty situation.

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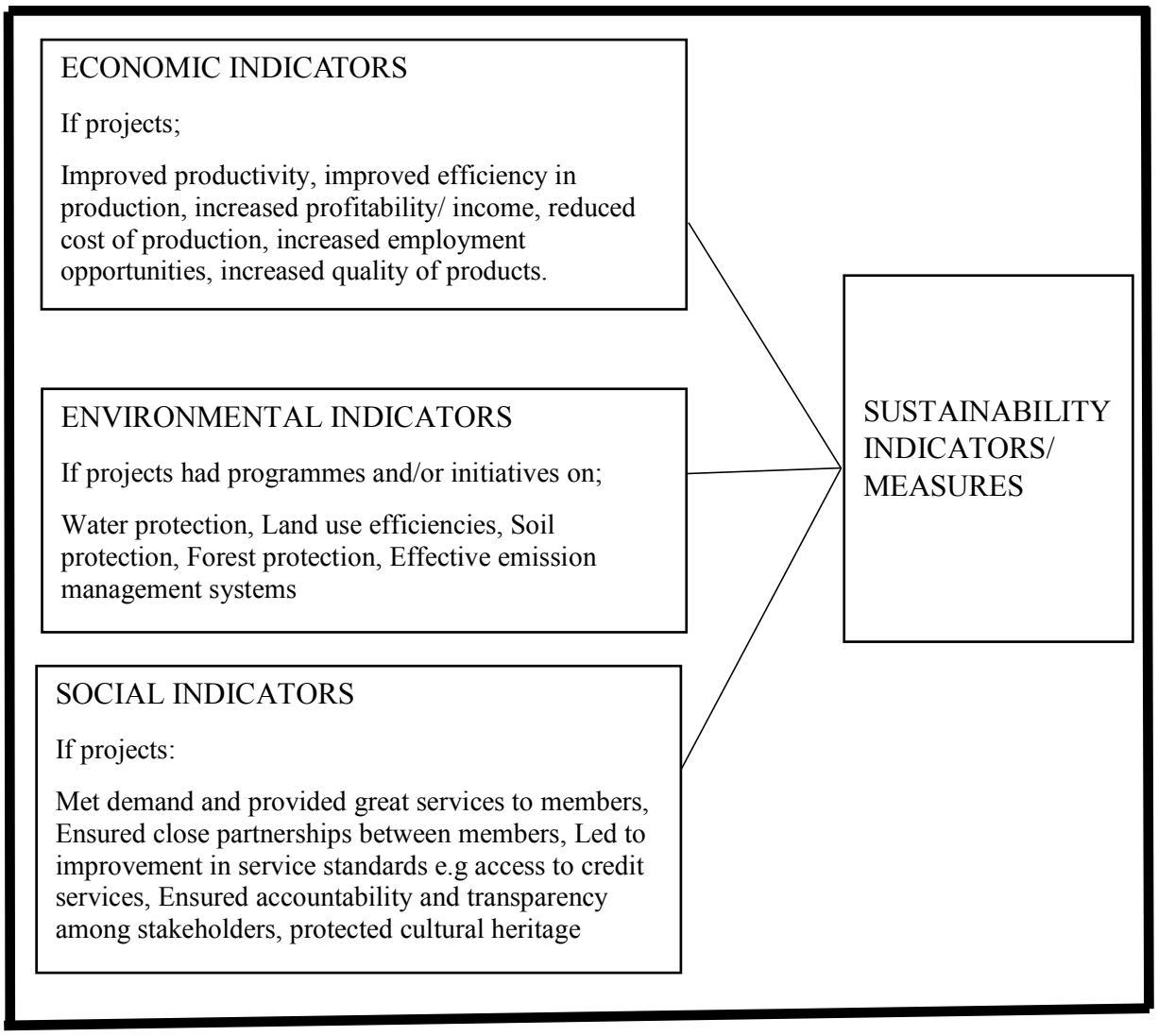
## APPENDICES

### APPENDIX I: SUSTAINABILITY INDICATORS FRAMEWORK



## APPENDIX II: QUESTIONNAIRE

**Dear Respondent,**
I am a postgraduate student at Maseno University. I am collecting data for my research titled "Extent of farmers' participation and perceived sustainability of agricultural development projects, their determinants and effect on poverty situation in Kakamega County, Kenya". You have been identified as a potential respondent in this research. I, therefore, hereby kindly request your assistance in filling the accompanying questionnaire by answering the questions honestly and completely. The information being sought will be used for educational research only. I guarantee confidential treatment of the information that you will provide. Your participation in the study will be highly appreciated.
Thank you in advance,
Yours Sincerely,

Janet Okumu

***Instructions***
*This questionnaire is expected to be filled by farmers who were project participants of completed agricultural development projects.*
**PART A: PERSONAL DETAILS**
[Please tick (√) where appropriate]

Questionnaire No: _____

Name of enumerator……

Name of respondent……

Telephone number of respondent……

Date of survey ……

Time of survey ……..

1. Sub-County…… Ward ……. Village……GPS …….
2. What is your gender? Male [ ] Female [ ] Other [ ]
3. What is your age? .....
4. What is your highest level of education?
1. Primary [ ] 2. Secondary [ ] 3. College [ ] 4. Graduate [ ] 5. Non Formal [ ]
5. What is your marital status?
Single [ ] Married [ ] Widowed [ ] Divorced [ ]
6. What is the number of dependents on your household? ……
7. What is the size of the farm that you own in acres? ……
8 What is the size of the farm owned is under agriculture production practices (in acres)? ……
9. What is the legal ownership status of the land under agriculture production?
1. Sole ownership [ ] 2. Joint Ownership [ ] 3. Family land [ ] 4.Community land [ ] 5. Leased [ ]
10. What is your primary occupation?
1. Farm income [ ] 2.Non-farm income specify e.g (business, employment, others) ……..
11. How many years have you been engaged in farming? …….

**SECTION B: Socio-demographic and institutional factors influencing extent of farmers' participation in agricultural development projects**

12. Which farming activities do you practice in your farm?
Livestock rearing [ ] Crop Farming [ ] Fish Farming [ ] Mixed Farming [ ]
Please indicate which crops or/and livestock and rank them in order of priority for each
……
……
13. Are you aware of Climate Smart Agriculture? Yes [ ] No [ ]
14 Are you aware of climate smart agriculture practices? Yes [ ] No [ ]
15. If yes, which climate smart agriculture practices are you aware of? (*Do not lead the farmer tick appropriately after response)*

| Practice | Tick |
|---|---|
| Planting early-maturing crops varieties | |
| Practicing conservation agriculture | |
| Soil and water conservation | |
| Planting-high-yielding seed varieties | |
| Up scaling appropriate modern storage facilities | |
| Planting pest-tolerant crop varieties | |
| Harvesting early | |
| Practicing agro-forestry | |
| Practicing value addition | |
| Use of inputs such as fertilizers, manure, and pesticides | |
| Adopting water-efficient application of irrigation technologies | |
| Conserving fodder | |
| Rearing improved breeds | |
| Vaccinating livestock | |
| Adoption of modern veterinary technologies | |
| Integrated forest, farm and fish systems | |

others…….....
.....
16. Which practices have you in cooperated in your farming activities? (*Do not lead the farmer tick appropriately after response)*

| Practice | Tick | Which crops or/and livestock | Since When |
|---|---|---|---|
| Planting early-maturing crops varieties | | | |
| Practicing conservation agriculture | | | |
| Soil and water conservation | | | |
| Planting-high-yielding seed varieties | | | |
| Up scaling appropriate modern storage facilities | | | |
| Planting pest-tolerant crop varieties | | | |
| Harvesting early | | | |
| Practicing agro-forestry | | | |
| Practicing value addition | | | |
| Use of inputs such as fertilizers, manure, and pesticides | | | |

| | | | |
|---|---|---|---|
| Adopting water-efficient application of irrigation technologies | | | |
| Conserving fodder | | | |
| Rearing improved breeds | | | |
| Vaccinating livestock | | | |
| Adoption of modern veterinary technologies | | | |
| Integrated forest, farm and fish systems | | | |

others…….....
.....

17. Do you know of any agricultural projects in your sub county? 1. Yes [ ] 2. No [ ]
If yes, please mention……

18. How did you learn about the project in your area? 1. Farmers field days [ ] 2. On farm trials/ demonstration center [ ] 3. Extension services visits [ ] 4. Media (Newspapers, Internet, Radio/TV) [ ] 5.Neighbor/ Fellow farmers [ ] 6. Farmer groups [ ]

19. Have you ever been a member of any of the agricultural development projects? 1. Yes [ ] 2.No [ ]

20. What is the name of the project that you were a member of?
……
……

21. What was the name of the donors/ funders of that project?
……
….

22. What is the name of the group under that project that you were a member of?
……..

23. What was the main goal/objective of the project? .....

24. For how long did your group receive funding from the donors of that project?

25. How many members did the group have at the beginning of the project? .....

26. How many members are there now? ……..

27. For how long were you a member of that agricultural project? .....

28. How did you learn about the project in your area? 1. Farmers field days [ ] 2. On farm trials/ demonstration center [ ] 3. Extension services visits [ ] 4. Media (Newspapers, Internet, Radio/TV) [ ] 5.Neighbor/ Fellow farmers [ ] 6. Farmer groups [ ]

29. Which agricultural practices were being offered by that agricultural project that you were a member of?

| Practice | Tick |
|---|---|
| Planting early-maturing crops varieties | |
| Practicing conservation agriculture | |
| Soil and water conservation | |
| | |
| Planting-high-yielding seed varieties | |
| Up scaling appropriate modern storage facilities | |
| Planting pest-tolerant crop varieties | |
| Harvesting early | |
| Practicing agro-forestry | |
| Practicing value addition | |

| | |
|---|---|
| Use of inputs such as fertilizers, manure, and pesticides | |
| Adopting water-efficient application of irrigation technologies | |
| Conserving fodder | |
| Rearing improved breeds | |
| Vaccinating livestock | |
| Adoption of modern veterinary technologies | |
| Integrated forest, farm and fish systems | |

others…….....

30. How many of the practices offered by the project did you undertake? …….

| Practice | Tick |
|---|---|
| Planting early-maturing crops varieties | |
| Practicing conservation agriculture | |
| Soil and water conservation | |
| Planting-high-yielding seed varieties | |
| Up scaling appropriate modern storage facilities | |
| Planting pest-tolerant crop varieties | |
| Harvesting early | |
| Practicing agro-forestry | |
| Practicing value addition | |
| Use of inputs such as fertilizers, manure, and pesticides | |
| Adopting water-efficient application of irrigation technologies | |
| Conserving fodder | |
| Rearing improved breeds | |
| Vaccinating livestock | |
| Adoption of modern veterinary technologies | |
| Integrated forest, farm and fish systems | |

others…….....

31. What reasons initially motivated you towards trying the practices?

1. Increases productivity [ ] 2. Enhances resilience to climate change [ ] 3. More profitable [ ] Less costly [ ] Saves labour and time [ ]

Others……

32. Did your farm income level influence your longevity and number of the climate smart practices you undertake/ undertook under the project? 1. Yes [ ] 2. No [ ]

Elaborate ……

33. Do you have non-farm income? Yes [ ] No [ ]

34. Please specify the source of your non-farm income

| Activity | Tick |
|---|---|
| Formal Employment | |
| Business(Specify) | |
| Wages (Specify) | |
| Others | |

35. Does non-farm income have any influence on the longevity and number of the practices you undertake under the project? 1. Yes [ ] 2. No [ ]

Elaborate
how…….
……
36. Did you have access to any credit institutions? 1. Yes [ ] 2. No [ ]
If yes, please list down the name of the credit institution(s)
……
37. Was the access to the credit institutions through the help of that agricultural projects?
Yes [ ] No [ ]

38. Did the agricultural project offer any training?
1. Yes [ ] 2. No [ ]
39. Was the training provided sufficient?
1. Yes [ ] 2. No [ ]
40. Did you access Agriculture extension services from the agricultural development projects?
1. Yes [ ] 2. No [ ]
41. If yes, how many times did you have access to agriculture extension services?
Once in a month [ ] several times in a month [ ] once in two months [ ] once in a year [ ]
Others……
42. How many extension officers did the agricultural project have? .....
43. Do you sell your products? Yes [ ] No [ ]
44. Are there ready markets for your products? Yes [ ] No [ ]
45. If yes, what is the distance to the market in Kms? .....
46. Does the distance to the market play a role in the number of practices you are undertaking?
Yes [ ] No [ ]
If yes, please elaborate how?
……
47. Did the project play a role in accessing the markets for your products?
1. Yes [ ] 2. No [ ]
48. How would rate the projects level of involvement in assisting in accessibility of ready markets for your produce? 1. Very low [ ] 2. Low [ ] 3. Medium [ ] 4. High [ ] 5. Very high

**SECTION C: Socio-economic and institutional factors affecting perceived sustainability of agricultural development projects.**

49. How was the cost of adopting the agricultural practices in your farm?
5. Very high [ ] 4. High [ ] 3. Medium [ ] 2. Low [ ] 1. Very low [ ]

50. Did you as a farmer make any contribution in the cost of implementation of agricultural projects?
Yes [ ] No [ ]
If yes, how? 1. Land provision [ ] 2. Labour [ ] 3. Cash [ ] 4. Other (specify)……

51. How would you rate the rate of adoption of the practices under the project during funding?
5. Very high [ ] 4. High [ ] 3.Medium [ ] 2.Low [ ] 1.Very low

52. How would you rate the rate of adoption of the practices under the project after cessation of funding?
5. Very high [ ] 4. High [ ] 3. Medium [ ] 2. Low [ ] 1.Very low

53. Do you think the agricultural development projects addressed your priorities as a farmer and its members?
1. Yes [ ] 2. No [ ]
Explain how ……
54. In your view were there any problems associated with the designing of the agricultural projects?
……

55. Projects have to end eventually, can the impact of the climate smart project in the Sub-county still be felt, recognized or traced up to date. Do you still utilize the agricultural projects results and benefits after the end of direct involvement of the donors/ stakeholders?
1. Yes [ ] 2. No [ ]
56. In your opinion what strategies should be employed in order to enhance sustainability of the projects?
……
……

**Project Sustainability Indicators included in the unadjusted Agriculture Project Sustainability index**
The numbers in the following table indicates the degree of agreement level on the sustainability indicators of agricultural development projects (on a scale of 1-5*). Please tick inside the box, which accurately reflects your opinion as a member of the project.

| Type of project sustainability indicator | Index score | | | | | Max score | Min score |
|---|---|---|---|---|---|---|---|
| **Economic indicators** | 1.Strongly disagree | 2. Disagree | 3. Undecided | 4. Agree | 5.Strongly agree | | |
| Did the Project; | | | | | | | |
| 1. improve productivity | | | | | | | |
| 2. improve efficiency in production | | | | | | | |
| 3. increase profitability/ income | | | | | | | |
| 4. Reduce cost of production | | | | | | | |
| 5. increase quality of products | | | | | | | |
| **Environmental Indicators** | | | | | | | |
| Did the project have educative programmes and/or initiatives on; | | | | | | | |
| 1.Water protection | | | | | | | |
| 2. Land use efficiencies | | | | | | | |
| 3. Soil protection | | | | | | | |
| 4.Forest protection | | | | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 5. Effective emission management systems | | | | | | | |
| **Social Indicators** | | | | | | | |
| Did the project; | | | | | | | |
| 1 Meet demand and provide great services to members e.g trainings | | | | | | | |
| 2. Ensure close partnerships between members | | | | | | | |
| 3. Lead to improvement in service standards e.g access to credit services, extension services | | | | | | | |
| 4. Ensure accountability and transparency among stakeholders | | | | | | | |
| 5. Protect cultural heritage | | | | | | | |

*Source: Own calculation based on surveyed data and the formula adopted from Chen Chuan (2019) and Terano et al., (2015)*

**SECTION C: Effect of farmers' extent of project participation and perceived project sustainability on poverty situation.**

57. What was the size of the farm when you started producing when you joined the project?
.....

58. What was the size of your farm during the cessation of agricultural project?

59. How much were you producing on your farm in a year before joining the projects?
……

60. On average, how much income did you generate from your farm in the production seasons when the groups under the project were very active?

0- 10,000 [ ] 10,001-20,000 [ ] 20,001- 30,000 [ ] 30,001 -40,000 [ ] 40,001- 50,000 [ ]

50,001- 60,000 [ ] 60001-70000 [ ] 70,001- 80,000 [ ] 80,001- 90,000 [ ] 90,001- 100,000 [ ] 100,001-150,000 [ ].

61. On average, how much income did you generate from your farm in the production seasons when the groups under the project started being inactive i.e after withdrawal of stakeholders' involvement?

0- 10,000 [ ] 10,001-20,000 [ ] 20,001- 30,000 [ ] 30,001 -40,000 [ ] 40,001- 50,000 [ ]

50,001- 60,000 [ ] 60001-70000 [ ] 70,001- 80,000 [ ] 80,001- 90,000 [ ] 90,001- 100,000 [ ] 100,001-150,000 [ ]

60. On average, how much income did you generate from your farm in the 2020 production season year?

0- 10,000 [ ] 10,001-20,000 [ ] 20,001- 30,000 [ ] 30,001 -40,000 [ ] 40,001- 50,000 [ ]
50,001- 60,000 [ ] 60001-70000 [ ] 70,001- 80,000 [ ] 80,001- 90,000 [ ] 90,001- 100,000 [ ] 100,001-150,000 [ ]
61. On average how much do you spend on food, clothing and shelter per month? .....

**THANK YOU**

**APPENDIX III: QUESTIONNAIRE**

**Dear Respondent,**
I am a postgraduate student at Maseno University. I am collecting data for my research titled "Extent of farmers' participation and perceived sustainability of agricultural development projects, their determinants and effect on poverty situation in Kakamega County, Kenya". You have been identified as a potential respondent in this research. I, therefore, hereby kindly request your assistance in filling the accompanying questionnaire by answering the questions honestly and completely. The information being sought will be used for educational research only. I guarantee confidential treatment of the information that you will provide. Your participation in the study will be highly appreciated.
Thank you in advance,
Yours Sincerely,

Janet Okumu

***Instructions***
*This questionnaire is expected to be filled by farmers who were project non- participants of completed agricultural development projects.*
**PART A: PERSONAL DETAILS**
[Please tick (√) where appropriate]

Questionnaire No: _____

Name of enumerator……

Name of respondent……

Telephone number of respondent……

Date of survey ……

Time of survey ……..

1. Sub-County…… Ward ……. Village……GPS …….
2. What is your gender? Male [ ] Female [ ] Other [ ]
3. What is your age? .....
4. What is your highest level of education?
1. Primary [ ] 2. Secondary [ ] 3. College [ ] 4. Graduate [ ] 5. Non Formal [ ]
5. What is your marital status?
Single [ ] Married [ ] Widowed [ ] Divorced [ ]
6. What is the number of dependents on your household? ……
7. What is the size of the farm that you own in acres? ……
8 What is the size of the farm owned is under agriculture production practices (in acres)? ……
9. What is the legal ownership status of the land under agriculture production?
1. Sole ownership [ ] 2. Joint Ownership [ ] 3. Family land [ ] 4.Community land [ ] 5. Leased [ ]
10. What is your primary occupation?
1. Farm income [ ] 2.Non-farm income specify e.g (business, employment, others) ……..
11. How many years have you been engaged in farming? …….

**SECTION B: Socio-demographic and institutional factors influencing extent of farmers' participation in agricultural development projects**

12. Which farming activities do you practice in your farm?
Livestock rearing [ ] Crop Farming [ ] Fish Farming [ ] Mixed Farming [ ]
Please indicate which crops or/and livestock and rank them in order of priority for each
……
……
13. Are you aware of Climate Smart Agriculture? Yes [ ] No [ ]
14. Are you aware of climate smart agriculture practices? Yes [ ] No [ ]
15. If yes, which climate smart agriculture practices are you aware of? (*Do not lead the farmer tick appropriately after response)*

| Practice | Tick |
|---|---|
| Planting early-maturing crops varieties | |
| Practicing conservation agriculture | |
| Soil and water conservation | |
| Planting-high-yielding seed varieties | |
| Up scaling appropriate modern storage facilities | |
| Planting pest-tolerant crop varieties | |
| Harvesting early | |
| Practicing agro-forestry | |
| Practicing value addition | |
| Use of inputs such as fertilizers, manure, and pesticides | |
| Adopting water-efficient application of irrigation technologies | |
| Conserving fodder | |
| Rearing improved breeds | |
| Vaccinating livestock | |
| Adoption of modern veterinary technologies | |
| Integrated forest, farm and fish systems | |

others…….....
.....
16. Which practices have you in cooperated in your farming activities? (*Do not lead the farmer tick appropriately after response)*

| Practice | Tick | Which crops or/and livestock | Since When |
|---|---|---|---|
| Planting early-maturing crops varieties | | | |
| Practicing conservation agriculture | | | |
| Soil and water conservation | | | |
| Planting-high-yielding seed varieties | | | |
| Up scaling appropriate modern storage facilities | | | |
| Planting pest-tolerant crop varieties | | | |
| Harvesting early | | | |
| Practicing agro-forestry | | | |
| Practicing value addition | | | |

| | | | |
|---|---|---|---|
| Use of inputs such as fertilizers, manure, and pesticides | | | |
| Adopting water-efficient application of irrigation technologies | | | |
| Conserving fodder | | | |
| Rearing improved breeds | | | |
| Vaccinating livestock | | | |
| Adoption of modern veterinary technologies | | | |
| Integrated forest, farm and fish systems | | | |

others…….....
.....

17. Do you know of any agricultural projects in your sub county? 1. Yes [ ] 2. No [ ]
If yes, please mention……
18. How did you learn about the projects in your area? 1. Farmers field days [ ] 2. On farm trials/ demonstration center [ ] 3. Extension services visits [ ] 4. Media (Newspapers, Internet, Radio/TV) [ ] 5.Neighbor/ Fellow farmers [ ] 6. Farmer groups [ ]
19. Have you ever been a member of any of the agricultural development projects? 1. Yes [ ] 2.No [ ]
20. Do you have non-farm income? Yes [ ] No [ ]
21. Please specify the source of your non-farm income

| Activity | Tick |
|---|---|
| Formal Employment | |
| Business(Specify) | |
| Wages (Specify) | |
| Others | |

22. Do you have access to any credit institutions? 1. Yes [ ] 2. No [ ]
If yes, please list down the name of the credit institution(s) ……
23. Have you ever received training related to agricultural practices?
1. Yes [ ] 2. No [ ]
24. Who were the providers of the training? 1. Agricultural project [ ] 2. Ministry of Agriculture [ ] 3. NGOs (specify) [ ] 4. Internet [ ]
5. Media [ ] 6. Others
25. Was the training provided sufficient?
1. Yes [ ] 2. No [ ]
26. Have you ever had Agriculture extension services?
1. Yes [ ] 2. No [ ]
27. Who were the source of the Agriculture extension services?
1. Ministry of Agriculture 2. NGOs 3. Training colleges 4. Agricultural development Project.
28. If yes, how many times did you have access to agriculture extension services?
Once in a month [ ] several times in a month [ ] once in two months [ ] once in a year [ ]
Others……
29. Do you sell your products? Yes [ ] No [ ]
30. Are there ready markets for your products? Yes [ ] No [ ]
31. If yes, what is the distance to the market in Kms? .....
32. Does the distance to the market play a role in the number of practices you are undertaking? Yes [ ] No [ ]

If yes, please elaborate how?

……

33. Projects have to end eventually, in your view can the impact of the climate smart project in the Sub-county still be felt, recognized or traced up to date. Do the members under the project still utilize the agricultural projects results and benefits after the end of direct involvement of the donors/ stakeholders?

1. Yes [ ] 2. No [ ]

34. In your opinion what strategies should be employed in order to enhance sustainability of the projects?

……

**SECTION C: Effect of agricultural development projects on poverty situation.**

35. On average, how much income did you generate from your farm in the 2020 production season year?

0- 10,000 [ ] 10,001-20,000 [ ] 20,001- 30,000 [ ] 30,001 -40,000 [ ] 40,001- 50,000[ ] 50,001- 60,000 [ ] 60001-70000 [ ] 70,001- 80,000 [ ] 80,001- 90,000 [ ] 90,001-100,000 [ ] 100,001-150,000 [ ]

36. On average how much do you spend on food, clothing and shelter per month?

**THANK YOU**

## APPENDIX IV: INTERVIEW SCHEDULE FOR KEY INFORMANTS

1. What major challenges do farmers experience in farming that are attributed to climate change?
2. In your view, which climate smart agriculture practices have been widely adopted by most farmers and why?
3. How many agricultural development projects that ended are you aware of in the Sub-county? Please name them and explain their main objective and the various groups set up if any?

| Project name | Period | Groups under the project | Funder |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |

4. How would you rate farmers' awareness level of agricultural development projects?
Very high [ ] High [ ] Satisfactory [ ] Low [ ] Very low [ ]
5. How would you rate farmers' participation level in the agricultural development projects?
Very high [ ] High [ ] Satisfactory [ ] Low [ ] Very low [ ]
6. What are the factors that influence the extent of farmers' participation in the agricultural development projects in terms the longevity and number of practices?
7. What factors hindered the farmers from participating in the agricultural development projects?
8. How were the stakeholders of the project involved in ensuring the projects are successful?

9. Were members of the community involved during the implementation? How?

10. How would you rate the projects performance?
Very high [ ] High [ ] Satisfactory [ ] Low [ ] Very low [ ]
11. In your opinion which problems are associated with designing of the projects?
……
12. Projects have to end eventually, from your observation, can the impact of the climate smart project still be recognized or traced up to date. Do farmers still utilize results and benefits from the climate smart project after end of direct involvement of the donors/ stakeholders in the agricultural projects?
1. Yes [ ] 2. No [ ]
13. What strategies should be employed in order to enhance sustainability of the projects?

**THANK YOU**

## APPENDIX V: MULTICOLLINEARITY TEST RESULTS

. vif

| Variable | VIF | 1/VIF |
|---|---|---|
| FarmingExp~e | 2.07 | 0.483974 |
| Age | 1.92 | 0.520115 |
| FarmSizeAg~c | 1.19 | 0.837095 |
| HHsize | 1.08 | 0.923318 |
| Num~yproject | 1.07 | 0.933246 |
| Frequencyo~e | 1.03 | 0.970748 |
| Mean VIF | 1.39 | |

. correlate Gender EducLevel LegalOwnFarmStat PrimaryOccup ProjectFunders Creditaccess TrainingonCSAPractices DistancetotheMarketInfluence Subcou
> nty
(obs=240)

| | Gender | EducLe~l | LegalO~t | Primar~p | Projec~s | Credit~s | Traini~s | Distan~e | Subcou~y |
|---|---|---|---|---|---|---|---|---|---|
| Gender | 1.0000 | | | | | | | | |
| EducLevel | -0.0037 | 1.0000 | | | | | | | |
| LegalOwnFa~t | 0.0381 | 0.1701 | 1.0000 | | | | | | |
| PrimaryOccup | 0.0203 | -0.1347 | -0.0565 | 1.0000 | | | | | |
| ProjectFun~s | -0.1518 | -0.1015 | -0.1498 | 0.0872 | 1.0000 | | | | |
| Creditaccess | 0.0333 | 0.0619 | 0.1027 | -0.0658 | -0.1825 | 1.0000 | | | |
| Trainingon~s | -0.0776 | 0.0297 | 0.0669 | 0.1592 | 0.0221 | -0.0274 | 1.0000 | | |
| Distanceto~e | 0.0201 | 0.0094 | 0.0988 | -0.0306 | -0.2144 | 0.1280 | 0.0164 | 1.0000 | |
| Subcounty | -0.1508 | -0.0450 | 0.0781 | -0.0797 | -0.0659 | 0.1397 | -0.0629 | -0.0127 | 1.0000 |

# APPENDIX V1: TOBIT RESULTS ON LONGEVITY OF PARTICIPATION

```
. tobit Longevity Gender  Age Nonformal Secondary Tertiary HHsize FarmSizeAgric  FamilyLand  AnglicanChurchofKenya GermanCooperation SweedishGover
> nment Numberofpractofferedbyproject Creditaccess TrainingonCSAPractices FrequencyofExtService DistancetotheMarketInfluence Butere Ikolomani Khwi
> sero Likuyani Lugari Lurambi Malava Matungu MumiasEast MumiasWest Navakholo, ll

Tobit regression                                Number of obs     =        240
                                                LR chi2(27)       =      69.20
                                                Prob > chi2       =     0.0000
Log likelihood = -1071.3136                     Pseudo R2         =     0.0313
```

| Longevity | Coef. | Std. Err. | t | P>\|t\| | [95% Conf. | Interval] |
|---|---|---|---|---|---|---|
| Gender | -1.527784 | 3.30022 | -0.46 | 0.644 | -8.033059 | 4.977491 |
| Age | .0612579 | .152962 | 0.40 | 0.689 | -.2402551 | .362771 |
| Nonformal | 4.56995 | 6.670434 | 0.69 | 0.494 | -8.578569 | 17.71847 |
| Secondary | 2.021137 | 3.376582 | 0.60 | 0.550 | -4.634658 | 8.676933 |
| Tertiary | -6.054091 | 5.878018 | -1.03 | 0.304 | -17.64063 | 5.532447 |
| HHsize | .4566189 | .6976549 | 0.65 | 0.513 | -.9185733 | 1.831811 |
| FarmSizeAgric | .3774593 | 1.08775 | 0.35 | 0.729 | -1.766675 | 2.521594 |
| FamilyLand | -5.242062 | 3.809524 | -1.38 | 0.170 | -12.75126 | 2.267133 |
| AnglicanChurchofKenya | 5.080943 | 12.25011 | 0.41 | 0.679 | -19.06603 | 29.22791 |
| GermanCooperation | -17.95414 | 6.438682 | -2.79 | 0.006 | -30.64584 | -5.262442 |
| SweedishGovernment | -2.207957 | 4.973926 | -0.44 | 0.658 | -12.01238 | 7.596466 |
| Numberofpractofferedbyproject | 2.11648 | .9933234 | 2.13 | 0.034 | .1584763 | 4.074483 |
| Creditaccess | -1.411508 | 3.880576 | -0.36 | 0.716 | -9.06076 | 6.237743 |
| TrainingonCSAPractices | .0679566 | 6.382804 | 0.01 | 0.992 | -12.5136 | 12.64951 |
| FrequencyofExtService | -2.75129 | 1.539489 | -1.79 | 0.075 | -5.785876 | .283296 |
| DistancetotheMarketInfluence | -6.332856 | 3.596256 | -1.76 | 0.080 | -13.42166 | .7559535 |
| Butere | -2.18027 | 7.56956 | -0.29 | 0.774 | -17.10111 | 12.74057 |
| Ikolomani | -5.812185 | 7.268962 | -0.80 | 0.425 | -20.1405 | 8.51613 |
| Khwisero | -4.43169 | 7.472266 | -0.59 | 0.554 | -19.16075 | 10.29737 |
| Likuyani | -6.702532 | 7.076181 | -0.95 | 0.345 | -20.65084 | 7.245779 |
| Lugari | .9426789 | 7.184812 | 0.13 | 0.896 | -13.21976 | 15.10512 |
| Lurambi | -12.28897 | 7.615485 | -1.61 | 0.108 | -27.30034 | 2.722399 |
| Malava | -13.39401 | 7.592268 | -1.76 | 0.079 | -28.35962 | 1.57159 |
| Matungu | -12.17973 | 7.398618 | -1.65 | 0.101 | -26.76361 | 2.404162 |
| MumiasEast | -9.137472 | 8.268233 | -1.11 | 0.270 | -25.43551 | 7.16057 |
| MumiasWest | -19.26834 | 7.494758 | -2.57 | 0.011 | -34.04173 | -4.494941 |
| Navakholo | 4.283534 | 7.679724 | 0.56 | 0.578 | -10.85446 | 19.42153 |
| _cons | 45.55546 | 12.94594 | 3.52 | 0.001 | 20.03689 | 71.07403 |
| /sigma | 21.60873 | .9922726 | | | 19.65279 | 23.56466 |

```
      2  left-censored observations at Longevity <= 0
    238     uncensored observations
      0 right-censored observations

.
```

## APPENDIX VII: TOBIT RESULTS ON DETERMINANTS OF NUMBER OF PRACTICES ADOPTED

```
. tobit Numberofpractadoptedfromproject Gender  Age Nonformal Secondary Tertiary HHsize FarmSizeAgric  FamilyLand  AnglicanChurchofKenya GermanCoo
> peration SweedishGovernment Numberofpractofferedbyproject Creditaccess TrainingonCSAPractices FrequencyofExtService DistancetotheMarketInfluence
>  Butere Ikolomani Khwisero Likuyani Lugari Lurambi Malava Matungu MumiasEast MumiasWest Navakholo, ll

Tobit regression                                Number of obs     =        240
                                                LR chi2(27)       =     172.81
                                                Prob > chi2       =     0.0000
Log likelihood =  -323.7334                     Pseudo R2         =     0.2107
```

| Numberofpractadoptedfrompro~t | Coef. | Std. Err. | t | P>\|t\| | [95% Conf. | Interval] |
|---|---|---|---|---|---|---|
| Gender | -.1205155 | .142217 | -0.85 | 0.398 | -.4008485 | .1598174 |
| Age | .0080819 | .006577 | 1.23 | 0.220 | -.0048824 | .0210463 |
| Nonformal | -.2389051 | .2874319 | -0.83 | 0.407 | -.8054805 | .3276703 |
| Secondary | -.1161557 | .1454375 | -0.80 | 0.425 | -.4028368 | .1705254 |
| Tertiary | .2901579 | .2532817 | 1.15 | 0.253 | -.2091019 | .7894176 |
| HHsize | .0146269 | .0300661 | 0.49 | 0.627 | -.0446384 | .0738922 |
| FarmSizeAgric | .0045805 | .046878 | 0.10 | 0.922 | -.0878237 | .0969847 |
| FamilyLand | -.4226741 | .1640301 | -2.58 | 0.011 | -.7460044 | -.0993439 |
| AnglicanChurchofKenya | .12718 | .5277593 | 0.24 | 0.810 | -.91312 | 1.16748 |
| GermanCooperation | -.090966 | .2777079 | -0.33 | 0.744 | -.6383737 | .4564418 |
| SweedishGovernment | .3671387 | .2142974 | 1.71 | 0.088 | -.0552765 | .789554 |
| Numberofpractofferedbyproject | .4518606 | .0427698 | 10.56 | 0.000 | .3675543 | .536167 |
| Creditaccess | -.0131464 | .1672808 | -0.08 | 0.937 | -.3428844 | .3165916 |
| TrainingonCSAPractices | .3774405 | .2740369 | 1.38 | 0.170 | -.1627312 | .9176121 |
| FrequencyofExtService | .0170546 | .0660756 | 0.26 | 0.797 | -.1131913 | .1473004 |
| DistancetotheMarketInfluence | -.32997 | .1550216 | -2.13 | 0.034 | -.6355429 | -.024397 |
| Butere | -.4523222 | .3261445 | -1.39 | 0.167 | -1.095207 | .1905621 |
| Ikolomani | -.2673861 | .3132143 | -0.85 | 0.394 | -.8847829 | .3500107 |
| Khwisero | -.6865586 | .3220032 | -2.13 | 0.034 | -1.32128 | -.0518374 |
| Likuyani | -.3945818 | .3049299 | -1.29 | 0.197 | -.9956485 | .206485 |
| Lugari | -.090604 | .3096186 | -0.29 | 0.770 | -.700913 | .519705 |
| Lurambi | -.7972381 | .3281633 | -2.43 | 0.016 | -1.444102 | -.1503745 |
| Malava | -1.366695 | .3271638 | -4.18 | 0.000 | -2.011589 | -.7218019 |
| Matungu | .2115665 | .3187953 | 0.66 | 0.508 | -.4168313 | .8399643 |
| MumiasEast | .0785768 | .3567767 | 0.22 | 0.826 | -.6246886 | .7818422 |
| MumiasWest | .2164653 | .3227281 | 0.67 | 0.503 | -.4196847 | .8526152 |
| Navakholo | -.1758231 | .3309095 | -0.53 | 0.596 | -.8281 | .4764538 |
| _cons | 1.146853 | .5558023 | 2.06 | 0.040 | .0512755 | 2.24243 |
| /sigma | .9311851 | .0428007 | | | .8468179 | 1.015552 |

```
      2  left-censored observations at Num~mproject <= 1
    238     uncensored observations
      0 right-censored observations
```

## APPENDIX VIII: MARGINAL EFFECTS OF TOBIT RESULTS ON DETERMINANTS OF NUMBER OF PRACTICES ADOPTED

Expression : Linear prediction, predict()

dy/dx w.r.t. : Gender Age Nonformal Secondary Tertiary HHsize FarmSizeAgric FamilyLand AnglicanChurchofKenya GermanCooperation SweedishGovernment Numberofpractofferedbyproject Creditaccess TrainingonCSAPractices FrequencyofExtService DistancetotheMarketInfluence Butere Ikolomani Khwisero Likuyani Lugari Lurambi Malava Matungu MumiasEast MumiasWest Navakholo

| | Delta-method dy/dx | Std. Err. | z | P>\|z\| | [95% Conf. | Interval] |
|---|---|---|---|---|---|---|
| Gender | -.1205155 | .142217 | -0.85 | 0.397 | -.3992556 | .1582246 |
| Age | .0080819 | .006577 | 1.23 | 0.219 | -.0048087 | .0209726 |
| Nonformal | -.2389051 | .2874319 | -0.83 | 0.406 | -.8022612 | .3244511 |
| Secondary | -.1161557 | .1454375 | -0.80 | 0.424 | -.4012079 | .1688965 |
| Tertiary | .2901579 | .2532817 | 1.15 | 0.252 | -.2062652 | .7865809 |
| HHsize | .0146269 | .0300661 | 0.49 | 0.627 | -.0443017 | .0735554 |
| FarmSizeAgric | .0045805 | .046878 | 0.10 | 0.922 | -.0872986 | .0964596 |
| FamilyLand | -.4226741 | .1640301 | -2.58 | 0.010 | -.7441672 | -.101181 |
| AnglicanChurchofKenya | .12718 | .5277593 | 0.24 | 0.810 | -.9072091 | 1.161569 |
| GermanCooperation | -.090966 | .2777079 | -0.33 | 0.743 | -.6352634 | .4533315 |
| SweedishGovernment | .3671387 | .2142974 | 1.71 | 0.087 | -.0528764 | .7871539 |
| Numberofpractofferedbyproject | .4518606 | .0427698 | 10.56 | 0.000 | .3680333 | .535688 |
| Creditaccess | -.0131464 | .1672808 | -0.08 | 0.937 | -.3410109 | .314718 |
| TrainingonCSAPractices | .3774405 | .2740369 | 1.38 | 0.168 | -.159662 | .9145429 |
| FrequencyofExtService | .0170546 | .0660756 | 0.26 | 0.796 | -.1124512 | .1465604 |
| DistancetotheMarketInfluence | -.32997 | .1550216 | -2.13 | 0.033 | -.6338067 | -.0261332 |
| Butere | -.4523222 | .3261445 | -1.39 | 0.165 | -1.091554 | .1869093 |
| Ikolomani | -.2673861 | .3132143 | -0.85 | 0.393 | -.881275 | .3465027 |
| Khwisero | -.6865586 | .3220032 | -2.13 | 0.033 | -1.317673 | -.0554438 |
| Likuyani | -.3945818 | .3049299 | -1.29 | 0.196 | -.9922334 | .2030699 |
| Lugari | -.090604 | .3096186 | -0.29 | 0.770 | -.6974453 | .5162373 |
| Lurambi | -.7972381 | .3281633 | -2.43 | 0.015 | -1.440426 | -.1540499 |
| Malava | -1.366695 | .3271638 | -4.18 | 0.000 | -2.007925 | -.7254661 |
| Matungu | .2115665 | .3187953 | 0.66 | 0.507 | -.4132608 | .8363938 |
| MumiasEast | .0785768 | .3567767 | 0.22 | 0.826 | -.6206927 | .7778464 |
| MumiasWest | .2164653 | .3227281 | 0.67 | 0.502 | -.4160701 | .8490007 |
| Navakholo | -.1758231 | .3309095 | -0.53 | 0.595 | -.8243938 | .4727477 |

## APPENDIX IX: ORDERED PROBIT RESULTS ON DETERMINANTS OF SUSTAINABILITY

Ordered probit regression — Number of obs = 239
LR chi2(27) = 118.88
Prob > chi2 = 0.0000
Log likelihood = -138.51314 — Pseudo R2 = 0.3003

| PSI | Coef. | Std. Err. | z | P>\|z\| | [95% Conf. | Interval] |
|---|---|---|---|---|---|---|
| EducLevel | .1302823 | .1461546 | 0.89 | 0.373 | -.1561754 | .41674 |
| FarmSizeAgric | .0616916 | .0685408 | 0.90 | 0.368 | -.0726458 | .196029 |
| FamilyLand | -.5713187 | .2339873 | -2.44 | 0.015 | -1.029925 | -.1127121 |
| Offfarm | -.5558247 | .969475 | -0.57 | 0.566 | -2.455961 | 1.344311 |
| FarmingExperience | -.0179634 | .0102501 | -1.75 | 0.080 | -.0380533 | .0021265 |
| AnglicanChurchofKenya | -.4597995 | .677451 | -0.68 | 0.497 | -1.787579 | .86798 |
| GermanCooperation | -.5546847 | .4215289 | -1.32 | 0.188 | -1.380866 | .2714968 |
| SweedishGovernment | -.1088076 | .3334393 | -0.33 | 0.744 | -.7623365 | .5447214 |
| FundingPeriod | -.0991296 | .0741768 | -1.34 | 0.181 | -.2445136 | .0462543 |
| Numberofpractadoptedfromproject | .2463723 | .0810239 | 3.04 | 0.002 | .0875683 | .4051764 |
| Longevity | .0070583 | .004153 | 1.70 | 0.089 | -.0010814 | .015198 |
| FrequencyofExtService | -.0417435 | .0961454 | -0.43 | 0.664 | -.230185 | .1466979 |
| Creditaccess | -.0065113 | .2504326 | -0.03 | 0.979 | -.4973502 | .4843276 |
| TrainingonCSAPractices | .6961096 | .3692218 | 1.89 | 0.059 | -.0275519 | 1.419771 |
| DistancetotheMarketInfluence | -.2464558 | .2231425 | -1.10 | 0.269 | -.6838071 | .1908955 |
| AdoptionCost | -.3920288 | .1771074 | -2.21 | 0.027 | -.7391529 | -.0449048 |
| Butere | -.4112316 | .4840228 | -0.85 | 0.396 | -1.359899 | .5374356 |
| Ikolomani | .3368377 | .5197502 | 0.65 | 0.517 | -.6818539 | 1.355529 |
| Khwisero | -.4803249 | .4607722 | -1.04 | 0.297 | -1.383422 | .422772 |
| Likuyani | .2212692 | .507468 | 0.44 | 0.663 | -.7733497 | 1.215888 |
| Lugari | -.2136374 | .4675228 | -0.46 | 0.648 | -1.129965 | .7026905 |
| Lurambi | -.9633776 | .4938959 | -1.95 | 0.051 | -1.931396 | .0046407 |
| Malava | -.6327538 | .4732695 | -1.34 | 0.181 | -1.560345 | .2948374 |
| Matungu | .113349 | .5416986 | 0.21 | 0.834 | -.9483608 | 1.175059 |
| MumiasEast | -.5316001 | .5993779 | -0.89 | 0.375 | -1.706359 | .6431589 |
| MumiasWest | -.727095 | .4744886 | -1.53 | 0.125 | -1.657076 | .2028856 |
| Navakholo | .8952627 | .5967257 | 1.50 | 0.134 | -.2742982 | 2.064824 |
| /cut1 | -2.643272 | 1.074654 | | | -4.749556 | -.5369886 |
| /cut2 | -.6033985 | 1.054573 | | | -2.670324 | 1.463527 |

# APPENDIX X: MARGINAL EFFECTS OF ORDERED PROBIT RESULTS ON DETERMINANTS OF SUSTAINABILITY

```
. margins, dydx ( EducLevel FarmSizeAgric FamilyLand Offfarm FarmingExperience AnglicanChurchofKenya GermanCooperation SweedishGovernment FundingP
> eriod Numberofpractadoptedfromproject Longevity FrequencyofExtService Creditaccess TrainingonCSAPractices DistancetotheMarketInfluence AdoptionC
> ost Butere Ikolomani Khwisero Likuyani Lugari Lurambi Malava Matungu MumiasEast MumiasWest Navakholo)

Average marginal effects                        Number of obs     =        239
Model VCE     : OIM

dy/dx w.r.t. : EducLevel FarmSizeAgric FamilyLand Offfarm FarmingExperience AnglicanChurchofKenya GermanCooperation SweedishGovernment
               FundingPeriod Numberofpractadoptedfromproject Longevity FrequencyofExtService Creditaccess TrainingonCSAPractices
               DistancetotheMarketInfluence AdoptionCost Butere Ikolomani Khwisero Likuyani Lugari Lurambi Malava Matungu MumiasEast MumiasWest
               Navakholo
1._predict   : Pr(PSI==2), predict(pr outcome(2))
2._predict   : Pr(PSI==3), predict(pr outcome(3))
3._predict   : Pr(PSI==4), predict(pr outcome(4))
```

| | | Delta-method dy/dx | Std. Err. | z | P>\|z\| | [95% Conf. | Interval] |
|---|---|---|---|---|---|---|---|
| EducLevel | | | | | | | |
| | _predict | | | | | | |
| | 1 | -.0098518 | .0112418 | -0.88 | 0.381 | -.0318854 | .0121817 |
| | 2 | -.0230129 | .025701 | -0.90 | 0.371 | -.0733859 | .0273601 |
| | 3 | .0328648 | .0367139 | 0.90 | 0.371 | -.0390932 | .1048227 |
| FarmSizeAgric | | | | | | | |
| | _predict | | | | | | |
| | 1 | -.0046651 | .0052443 | -0.89 | 0.374 | -.0149436 | .0056135 |
| | 2 | -.0108971 | .0120763 | -0.90 | 0.367 | -.0345563 | .0127721 |
| | 3 | .0155622 | .0172106 | 0.90 | 0.366 | -.01817 | .0492945 |
| FamilyLand | | | | | | | |
| | _predict | | | | | | |
| | 1 | .0432027 | .019164 | 2.25 | 0.024 | .005642 | .0807634 |
| | 2 | .1009171 | .0411238 | 2.45 | 0.014 | .020316 | .1815182 |
| | 3 | -.1441198 | .0575632 | -2.50 | 0.012 | -.2569416 | -.031298 |
| Offfarm | | | | | | | |
| | _predict | | | | | | |
| | 1 | .042031 | .0739372 | 0.57 | 0.570 | -.1028833 | .1869454 |
| | 2 | .0981802 | .1706128 | 0.58 | 0.565 | -.2362148 | .4325752 |
| | 3 | -.1402113 | .2439208 | -0.57 | 0.565 | -.6182872 | .3378647 |
| FarmingExperience | | | | | | | |
| | _predict | | | | | | |
| | 1 | .0013584 | .0008046 | 1.69 | 0.091 | -.0002187 | .0029355 |
| | 2 | .003173 | .001809 | 1.75 | 0.079 | -.0003726 | .0067187 |
| | 3 | -.0045314 | .0025515 | -1.78 | 0.076 | -.0095323 | .0004695 |
| AnglicanChurchofKenya | | | | | | | |
| | _predict | | | | | | |
| | 1 | .0347697 | .0513694 | 0.68 | 0.498 | -.0659124 | .1354518 |
| | 2 | .0812185 | .1198523 | 0.68 | 0.498 | -.1536877 | .3161246 |
| | 3 | -.1159882 | .1706025 | -0.68 | 0.497 | -.4503629 | .2183866 |
| GermanCooperation | | | | | | | |
| | _predict | | | | | | |
| | 1 | .0419448 | .0325946 | 1.29 | 0.198 | -.0219393 | .105829 |
| | 2 | .0979789 | .0743036 | 1.32 | 0.187 | -.0476536 | .2436113 |
| | 3 | -.1399237 | .1054545 | -1.33 | 0.185 | -.3466107 | .0667633 |
| SweedishGovernment | | | | | | | |
| | _predict | | | | | | |
| | 1 | .0082279 | .0252999 | 0.33 | 0.745 | -.041359 | .0578149 |
| | 2 | .0192196 | .0587278 | 0.33 | 0.743 | -.0958847 | .134324 |
| | 3 | -.0274476 | .0839575 | -0.33 | 0.744 | -.1920013 | .1371061 |
| FundingPeriod | | | | | | | |
| | _predict | | | | | | |
| | 1 | .0074961 | .0055922 | 1.34 | 0.180 | -.0034644 | .0184566 |
| | 2 | .0175101 | .0133674 | 1.31 | 0.190 | -.0086894 | .0437097 |
| | 3 | -.0250063 | .0186994 | -1.34 | 0.181 | -.0616564 | .0116439 |
| Numberofpractadoptedfromproject | | | | | | | |
| | _predict | | | | | | |
| | 1 | -.0186305 | .0069738 | -2.67 | 0.008 | -.032299 | -.004962 |
| | 2 | -.0435189 | .0140186 | -3.10 | 0.002 | -.0709949 | -.016043 |
| | 3 | .0621494 | .019548 | 3.18 | 0.001 | .023836 | .1004628 |
| Longevity | | | | | | | |
| | _predict | | | | | | |
| | 1 | -.0005337 | .0003283 | -1.63 | 0.104 | -.0011771 | .0001096 |
| | 2 | -.0012468 | .0007302 | -1.71 | 0.088 | -.002678 | .0001845 |
| | 3 | .0017805 | .0010349 | 1.72 | 0.085 | -.0002479 | .003809 |
| FrequencyofExtService | | | | | | | |
| | _predict | | | | | | |
| | 1 | .0031566 | .0072689 | 0.43 | 0.664 | -.0110902 | .0174035 |
| | 2 | .0073735 | .0170289 | 0.43 | 0.665 | -.0260024 | .0407495 |
| | 3 | -.0105301 | .0242619 | -0.43 | 0.664 | -.0580826 | .0370223 |
| Creditaccess | | | | | | | |
| | _predict | | | | | | |
| | 1 | .0004924 | .018932 | 0.03 | 0.979 | -.0366136 | .0375983 |
| | 2 | .0011502 | .0442445 | 0.03 | 0.979 | -.0855675 | .0878678 |
| | 3 | -.0016425 | .0631761 | -0.03 | 0.979 | -.1254655 | .1221804 |
| TrainingonCSAPractices | | | | | | | |
| | _predict | | | | | | |
| | 1 | -.0526393 | .0293088 | -1.80 | 0.072 | -.1100834 | .0048048 |
| | 2 | -.12296 | .0648669 | -1.90 | 0.058 | -.2500967 | .0041767 |
| | 3 | .1755993 | .0915941 | 1.92 | 0.055 | -.0039218 | .3551204 |
| DistancetotheMarketInfluence | | | | | | | |
| | _predict | | | | | | |
| | 1 | .0186368 | .0173918 | 1.07 | 0.284 | -.0154505 | .0527241 |
| | 2 | .0435337 | .0389073 | 1.12 | 0.263 | -.0327232 | .1197906 |
| | 3 | -.0621705 | .0557678 | -1.11 | 0.265 | -.1714733 | .0471323 |
| AdoptionCost | | | | | | | |
| | _predict | | | | | | |
| | 1 | .0296449 | .0143476 | 2.07 | 0.039 | .0015242 | .0577657 |
| | 2 | .0692475 | .0310258 | 2.23 | 0.026 | .0084381 | .1300569 |
| | 3 | -.0988925 | .0436753 | -2.26 | 0.024 | -.1844945 | -.0132904 |
| Butere | | | | | | | |
| | _predict | | | | | | |
| | 1 | .031097 | .0371775 | 0.84 | 0.403 | -.0417696 | .1039636 |
| | 2 | .0726395 | .08509 | 0.85 | 0.393 | -.0941338 | .2394128 |
| | 3 | -.1037365 | .1215786 | -0.85 | 0.394 | -.3420262 | .1345531 |
| Ikolomani | | | | | | | |
| | _predict | | | | | | |
| | 1 | -.0254714 | .0395999 | -0.64 | 0.520 | -.1030858 | .052143 |
| | 2 | -.0594986 | .0916063 | -0.65 | 0.516 | -.2390437 | .1200464 |
| | 3 | .0849701 | .130774 | 0.65 | 0.516 | -.1713422 | .3412823 |
| Khwisero | | | | | | | |
| | _predict | | | | | | |
| | 1 | .0363218 | .0357289 | 1.02 | 0.309 | -.0337056 | .1063492 |
| | 2 | .084844 | .0808395 | 1.05 | 0.294 | -.0735984 | .2432865 |
| | 3 | -.1211658 | .1155861 | -1.05 | 0.295 | -.3477105 | .1053788 |
| Likuyani | | | | | | | |
| | _predict | | | | | | |
| | 1 | -.0167322 | .0385355 | -0.43 | 0.664 | -.0922604 | .0587959 |
| | 2 | -.0390847 | .0894102 | -0.44 | 0.662 | -.2143256 | .1361561 |
| | 3 | .055817 | .1277546 | 0.44 | 0.662 | -.1945775 | .3062115 |
| Lugari | | | | | | | |
| | _predict | | | | | | |
| | 1 | .0161551 | .0355126 | 0.45 | 0.649 | -.0534482 | .0857584 |
| | 2 | .0377367 | .0825246 | 0.46 | 0.647 | -.1240086 | .1994819 |
| | 3 | -.0538918 | .1178438 | -0.46 | 0.647 | -.2848613 | .1770778 |
| Lurambi | | | | | | | |
| | _predict | | | | | | |
| | 1 | .0728499 | .0396291 | 1.84 | 0.066 | -.0048218 | .1505216 |
| | 2 | .1701699 | .0862646 | 1.97 | 0.049 | .0010944 | .3392455 |
| | 3 | -.2430198 | .1222175 | -1.99 | 0.047 | -.4825618 | -.0034778 |
| Malava | | | | | | | |
| | _predict | | | | | | |
| | 1 | .0478484 | .0372558 | 1.28 | 0.199 | -.0251718 | .1208685 |
| | 2 | .1117689 | .0821912 | 1.36 | 0.174 | -.0493229 | .2728608 |
| | 3 | -.1596173 | .1177998 | -1.35 | 0.175 | -.3905006 | .0712661 |
| Matungu | | | | | | | |
| | _predict | | | | | | |
| | 1 | -.0085714 | .040968 | -0.21 | 0.834 | -.0888672 | .0717245 |
| | 2 | -.0200218 | .0957133 | -0.21 | 0.834 | -.2076165 | .1675728 |
| | 3 | .0285932 | .1366343 | 0.21 | 0.834 | -.239205 | .2963914 |
| MumiasEast | | | | | | | |
| | _predict | | | | | | |
| | 1 | .0401992 | .0460408 | 0.87 | 0.383 | -.050039 | .1304374 |
| | 2 | .0939012 | .1054346 | 0.89 | 0.373 | -.1127468 | .3005492 |
| | 3 | -.1341004 | .1505449 | -0.89 | 0.373 | -.4291631 | .1609622 |
| MumiasWest | | | | | | | |
| | _predict | | | | | | |
| | 1 | .0549824 | .0372661 | 1.48 | 0.140 | -.0180577 | .1280225 |
| | 2 | .1284332 | .0829734 | 1.55 | 0.122 | -.0341917 | .2910582 |
| | 3 | -.1834156 | .1180483 | -1.55 | 0.120 | -.414786 | .0479548 |
| Navakholo | | | | | | | |
| | _predict | | | | | | |
| | 1 | -.0676991 | .0468366 | -1.45 | 0.148 | -.1594971 | .024099 |
| | 2 | -.1581382 | .1048276 | -1.51 | 0.131 | -.3635965 | .0473201 |
| | 3 | .2258373 | .1490256 | 1.52 | 0.130 | -.0662475 | .517922 |

# APPENDIX X1: PROPENSITY SCORE MATCHING RESULTS

```
. sum MonthlyExpenditure
```

| Variable | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| MonthlyExp~e | 384 | 7685.677 | 6065.511 | 0 | 50000 |

```
.  bysort ClimateSmartProjectMembership: sum MonthlyExpenditure
```

-> ClimateSmartProjectMembership = No

| Variable | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| MonthlyExp~e | 144 | 6406.25 | 3265.741 | 0 | 20000 |

-> ClimateSmartProjectMembership = Yes

| Variable | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| MonthlyExp~e | 240 | 8453.333 | 7141.275 | 1000 | 50000 |

```
. ttest MonthlyExpenditure, by ( ClimateSmartProjectMembership)
```

Two-sample t test with equal variances

| Group | Obs | Mean | Std. Err. | Std. Dev. | [95% Conf. | Interval] |
|---|---|---|---|---|---|---|
| No | 144 | 6406.25 | 272.1451 | 3265.741 | 5868.303 | 6944.197 |
| Yes | 240 | 8453.333 | 460.9673 | 7141.275 | 7545.256 | 9361.411 |
| combined | 384 | 7685.677 | 309.5293 | 6065.511 | 7077.088 | 8294.267 |
| diff | | -2047.083 | 631.5715 | | -3288.875 | -805.2916 |

```
    diff = mean(No) - mean(Yes)                                   t =  -3.2413
Ho: diff = 0                                     degrees of freedom =      382

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.0006         Pr(|T| > |t|) = 0.0013          Pr(T > t) = 0.9994

. gen lnMonthlyExpenditure = ln(MonthlyExpenditure)
(1 missing value generated)

. ttest lnMonthlyExpenditure, by(ClimateSmartProjectMembership)
```

Two-sample t test with equal variances

| Group | Obs | Mean | Std. Err. | Std. Dev. | [95% Conf. | Interval] |
|---|---|---|---|---|---|---|
| No | 143 | 8.663122 | .0390418 | .4668722 | 8.585944 | 8.7403 |
| Yes | 240 | 8.855442 | .0362091 | .5609485 | 8.784112 | 8.926772 |
| combined | 383 | 8.783636 | .0273538 | .5353243 | 8.729853 | 8.837419 |
| diff | | -.1923201 | .0557617 | | -.3019593 | -.0826809 |

```
    diff = mean(No) - mean(Yes)                                   t =  -3.4490
Ho: diff = 0                                     degrees of freedom =      381

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.0003         Pr(|T| > |t|) = 0.0006          Pr(T > t) = 0.9997
```

```
. psmatch2 ClimateSmartProjectMembership Gender Age Nonformal Secondary Tertiary MaritalStat HHsize Familyland Nonfarmincome FarmingExperience Creditacc
> ess AccessofAgricExtensionService DistancetotheMarketInfluence Income2020 FarmSizeatCSAAdoptio Butere Ikolomani Khwisero Likuyani Lugari Lurambi Malav
> a Matungu MumiasEast MumiasWest Navakholo, out ( MonthlyExpenditure) logit common

Logistic regression                             Number of obs     =        384
                                                LR chi2(26)       =     191.49
                                                Prob > chi2       =     0.0000
Log likelihood = -158.29536                     Pseudo R2         =     0.3769

------------------------------------------------------------------------------
ClimateSmartProjectMembership |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
------------------------------+-----------------------------------------------
                       Gender |   .1110921   .3173617     0.35   0.726    -.5109255    .7331097
                          Age |  -.0020254   .0209211    -0.10   0.923     -.04303    .0389791
                     Nonformal |  -.3973481   .6283681    -0.63   0.527    -1.628927    .8342308
                    Secondary |  -.0575986   .3400107    -0.17   0.865    -.7240075    .6088102
                     Tertiary |  -.4142732   .5099889    -0.81   0.417    -1.413833    .5852866
                   MaritalStat |  -1.371267   1.269614    -1.08   0.280    -3.859665    1.117131
                        HHsize |   .0801879    .073182     1.10   0.273    -.0632463    .2236221
                   Familyland |   .7697499   .4337795     1.77   0.076    -.0804422    1.619942
                 Nonfarmincome |   1.805284   1.239592     1.46   0.145    -.6242722     4.23484
            FarmingExperience |   .0012465   .0232611     0.05   0.957    -.0443444    .0468374
                 Creditaccess |  -.9939965   .3296135    -3.02   0.003    -1.640027   -.3479658
AccessofAgricExtensionService |   4.550985   .5304327     8.58   0.000     3.511356    5.590614
 DistancetotheMarketInfluence |   .9703248   .3790117     2.56   0.010     .2274754    1.713174
                   Income2020 |   .1508413   .0757009     1.99   0.046     .0024703    .2992123
         FarmSizeatCSAAdoptio |   -.141493   .1305346    -1.08   0.278    -.3973362    .1143502
                      Butere |  -.2650707   .7874381    -0.34   0.736    -1.808421     1.27828
                   Ikolomani |  -.5823818   .7060337    -0.82   0.409    -1.966182    .8014188
                    Khwisero |  -.1178463   .7707657    -0.15   0.878    -1.628519    1.392827
                    Likuyani |  -.7420213    .670092    -1.11   0.268    -2.055377    .5713348
                      Lugari |  -.4895308   .7183516    -0.68   0.496    -1.897474    .9184125
                    Lurambi |  -.2947869   .7848279    -0.38   0.707    -1.833021    1.243448
                      Malava |  -.1726688   .8086917    -0.21   0.831    -1.757675    1.412338
                     Matungu |  -.1856916   .7252103    -0.26   0.798    -1.607078    1.235695
                   MumiasEast |  -.4485871   .7403908    -0.61   0.545    -1.899726    1.002552
                   MumiasWest |   -.280582   .6947752    -0.40   0.686    -1.642316    1.081152
                    Navakholo |  -.3672009   .8416889    -0.44   0.663    -2.016881    1.282479
                        _cons |  -1.205136   2.840153    -0.42   0.671    -6.771734    4.361462
------------------------------------------------------------------------------

-------------------------------------------------------------------------------
      Variable     Sample |    Treated     Controls   Difference          S.E.   T-stat
-----------------------------+-------------------------------------------------
MonthlyExpendi~e  Unmatched |  8453.33333      6406.25   2047.08333   631.571484     3.24
                       ATT |   8728.3105   6953.42466   1774.88584   885.593216     2.00
-------------------------------------------------------------------------------
Note: S.E. does not take into account that the propensity score is estimated.

 psmatch2:  |  psmatch2: Common
 Treatment  |        support
assignment  | Off suppo  On suppor |     Total
------------+----------------------+----------
 Untreated  |         0        144 |       144
   Treated  |        21        219 |       240
------------+----------------------+----------
      Total |        21        363 |       384
```

```
. psmatch2 ClimateSmartProjectMembership Gender Age Nonformal Secondary Tertiary MaritalStat HHsize Familyland Nonfarmincome FarmingExperience Creditacc
> ess AccessofAgricExtensionService DistancetotheMarketInfluence Income2020 FarmSizeatCSAAdoptio Butere Ikolomani Khwisero Likuyani Lugari Lurambi Malav
> a Matungu MumiasEast MumiasWest Navakholo, out ( MonthlyExpenditure) logit ate

Logistic regression                             Number of obs     =        384
                                                LR chi2(26)       =     191.49
                                                Prob > chi2       =     0.0000
Log likelihood = -158.29536                     Pseudo R2         =     0.3769
```

| ClimateSmartProjectMembership | Coef. | Std. Err. | z | P>\|z\| | [95% Conf. | Interval] |
|---|---|---|---|---|---|---|
| Gender | .1110921 | .3173617 | 0.35 | 0.726 | -.5109255 | .7331097 |
| Age | -.0020254 | .0209211 | -0.10 | 0.923 | -.04303 | .0389791 |
| Nonformal | -.3973481 | .6283681 | -0.63 | 0.527 | -1.628927 | .8342308 |
| Secondary | -.0575986 | .3400107 | -0.17 | 0.865 | -.7240075 | .6088102 |
| Tertiary | -.4142732 | .5099889 | -0.81 | 0.417 | -1.413833 | .5852866 |
| MaritalStat | -1.371267 | 1.269614 | -1.08 | 0.280 | -3.859665 | 1.117131 |
| HHsize | .0801879 | .073182 | 1.10 | 0.273 | -.0632463 | .2236221 |
| Familyland | .7697499 | .4337795 | 1.77 | 0.076 | -.0804422 | 1.619942 |
| Nonfarmincome | 1.805284 | 1.239592 | 1.46 | 0.145 | -.6242722 | 4.23484 |
| FarmingExperience | .0012465 | .0232611 | 0.05 | 0.957 | -.0443444 | .0468374 |
| Creditaccess | -.9939965 | .3296135 | -3.02 | 0.003 | -1.640027 | -.3479658 |
| AccessofAgricExtensionService | 4.550985 | .5304327 | 8.58 | 0.000 | 3.511356 | 5.590614 |
| DistancetotheMarketInfluence | .9703248 | .3790117 | 2.56 | 0.010 | .2274754 | 1.713174 |
| Income2020 | .1508413 | .0757009 | 1.99 | 0.046 | .0024703 | .2992123 |
| FarmSizeatCSAAdoptio | -.141493 | .1305346 | -1.08 | 0.278 | -.3973362 | .1143502 |
| Butere | -.2650707 | .7874381 | -0.34 | 0.736 | -1.808421 | 1.27828 |
| Ikolomani | -.5823818 | .7060337 | -0.82 | 0.409 | -1.966182 | .8014188 |
| Khwisero | -.1178463 | .7707657 | -0.15 | 0.878 | -1.628519 | 1.392827 |
| Likuyani | -.7420213 | .670092 | -1.11 | 0.268 | -2.055377 | .5713348 |
| Lugari | -.4895308 | .7183516 | -0.68 | 0.496 | -1.897474 | .9184125 |
| Lurambi | -.2947869 | .7848279 | -0.38 | 0.707 | -1.833021 | 1.243448 |
| Malava | -.1726688 | .8086917 | -0.21 | 0.831 | -1.757675 | 1.412338 |
| Matungu | -.1856916 | .7252103 | -0.26 | 0.798 | -1.607078 | 1.235695 |
| MumiasEast | -.4485871 | .7403908 | -0.61 | 0.545 | -1.899726 | 1.002552 |
| MumiasWest | -.280582 | .6947752 | -0.40 | 0.686 | -1.642316 | 1.081152 |
| Navakholo | -.3672009 | .8416889 | -0.44 | 0.663 | -2.016881 | 1.282479 |
| _cons | -1.205136 | 2.840153 | -0.42 | 0.671 | -6.771734 | 4.361462 |

| Variable | Sample | Treated | Controls | Difference | S.E. | T-stat |
|---|---|---|---|---|---|---|
| MonthlyExpendi~e | Unmatched | 8453.33333 | 6406.25 | 2047.08333 | 631.571484 | 3.24 |
| | ATT | 8453.33333 | 6870 | 1583.33333 | 878.32909 | 1.80 |
| | ATU | 6406.25 | 7268.75 | 862.5 | . | . |
| | ATE | | | 1313.02083 | . | . |

Note: S.E. does not take into account that the propensity score is estimated.

| psmatch2: Treatment assignment | psmatch2: Common support On suppor | Total |
|---|---|---|
| Untreated | 144 | 144 |
| Treated | 240 | 240 |
| Total | 384 | 384 |

```
. teffects psmatch (MonthlyExpenditure) (ClimateSmartProjectMembership Gender Nonformal Secondary Tertiary MaritalStat HHsize Familyland Nonfarmincome F
> armingExperience Creditaccess AccessofAgricExtensionService DistancetotheMarketInfluence Income2020 FarmSizeatCSAAdoptio Butere Ikolomani Khwisero Lik
> uyani Lugari Lurambi Malava Matungu MumiasEast MumiasWest Navakholo, logit), atet

Treatment-effects estimation                Number of obs      =       384
Estimator      : propensity-score matching  Matches: requested =         1
Outcome model  : matching                               min =         1
Treatment model: logit                                  max =         2
```

| MonthlyExpenditure | Coef. | AI Robust Std. Err. | z | P>\|z\| | [95% Conf. | Interval] |
|---|---|---|---|---|---|---|
| ATET | | | | | | |
| ClimateSmartProjectMembership (Yes vs No) | 1200 | 572.949 | 2.09 | 0.036 | 77.04062 | 2322.959 |

```
. teffects psmatch (MonthlyExpenditure) (ClimateSmartProjectMembership Gender Age Nonformal Secondary Tertiary MaritalStat HHsize Familyland Nonfarminco
> me FarmingExperience Creditaccess AccessofAgricExtensionService DistancetotheMarketInfluence Income2020 FarmSizeatCSAAdoptio Butere Ikolomani Khwisero
>  Likuyani Lugari Lurambi Malava Matungu MumiasEast MumiasWest Navakholo)

Treatment-effects estimation                Number of obs      =       384
Estimator      : propensity-score matching  Matches: requested =         1
Outcome model  : matching                               min =         1
Treatment model: logit                                  max =         1
```

| MonthlyExpenditure | Coef. | AI Robust Std. Err. | z | P>\|z\| | [95% Conf. | Interval] |
|---|---|---|---|---|---|---|
| ATE | | | | | | |
| ClimateSmartProjectMembership (Yes vs No) | 1313.021 | 478.0038 | 2.75 | 0.006 | 376.1505 | 2249.891 |

## APPENDIX XII: STEPWISE REGRESSION RESULTS

**Y= Monthly consumption expenditure $X_s$= Longevity of participation, perceived project sustainability.**

**Variables Entered/Removed[a]**

| Model | Variables Entered | Variables Removed | Method |
|---|---|---|---|
| 1 | Length of time one has been a member of that agricultural project (months)? | . | Forward (Criterion: Probability-of-F-to-enter <= .050) |

a. Dependent Variable: On average how much would you say do you spend on food, clothing and shelter per

**Model Summary**

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate | Change Statistics | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | R Square Change | F Change | df1 | df2 | Sig. F Change |
| 1 | .141[a] | .020 | .017 | 6012.993 | .020 | 7.720 | 1 | 382 | .006 |

a. Predictors: (Constant), Length of time one has been a member of that agricultural project (months)?

**Coefficients[a]**

| Model | | Unstandardized Coefficients | | Standardized Coefficients | | |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | t | Sig. |
| 1 | (Constant) | 6858.579 | 427.522 | | 16.043 | .000 |
| | Length of time one has been a member of that agricultural project (months)? | 28.740 | 10.344 | .141 | 2.778 | .006 |

a. Dependent Variable: On average how much would you say do you spend on food, clothing and shelter per

**Excluded Variables[a]**

| Model | | Beta In | t | Sig. | Partial Correlation | Collinearity Statistics Tolerance |
|---|---|---|---|---|---|---|
| 1 | Projects have to end eventually, can the impact of the agricultural projects st | .054[b] | 1.047 | .296 | .054 | .976 |

a. Dependent Variable: On average how much would you say do you spend on food, clothing and shelter per

b. Predictors in the Model: (Constant), Length of time one has been a member of that agricultural project (months)?

**Y= Monthly consumption expenditure $X_s$= Longevity of participation, perceived project sustainability, land size under agriculture.**

**Variables Entered/Removed[a]**

| Model | Variables Entered | Variables Removed | Method |
|---|---|---|---|
| 1 | Size of the farm owned that is under agricultural production practices (in acres | . | Forward (Criterion: Probability-of-F-to-enter <= .050) |
| 2 | Length of time one has been a member of that agricultural project (months)? | . | Forward (Criterion: Probability-of-F-to-enter <= .050) |

a. Dependent Variable: On average how much would you say do you spend on food, clothing and shelter per

**Model Summary**

| Model | R | | | Change Statistics |
|---|---|---|---|---|

| | | R Square | Adjusted R Square | Std. Error of the Estimate | R Square Change | F Change | df1 | df2 | Sig. F Change |
|---|---|---|---|---|---|---|---|---|---|
| 1 | .409[a] | .167 | .165 | 5542.449 | .167 | 76.701 | 1 | 382 | .000 |
| 2 | .435[b] | .189 | .185 | 5475.243 | .022 | 10.435 | 1 | 381 | .001 |

a. Predictors: (Constant), Size of the farm owned that is under agricultural production practices (in acres

b. Predictors: (Constant), Size of the farm owned that is under agricultural production practices (in acres, Length of time one has been a member of that agricultural project (months)?

**Coefficients[a]**

| Model | | Unstandardized Coefficients B | Unstandardized Coefficients Std. Error | Standardized Coefficients Beta | t | Sig. |
|---|---|---|---|---|---|---|
| 1 | (Constant) | 4767.082 | 437.096 | | 10.906 | .000 |
| | Size of the farm owned that is under agricultural production practices (in acres | 1638.509 | 187.089 | .409 | 8.758 | .000 |
| 2 | (Constant) | 3869.855 | 513.412 | | 7.538 | .000 |
| | Size of the farm owned that is under agricultural production practices (in acres | 1650.528 | 184.857 | .412 | 8.929 | .000 |
| | Length of time one has been a member of that climate smart project (months)? | 30.433 | 9.421 | .149 | 3.230 | .001 |

a. Dependent Variable: On average how much would you say do you spend on food, clothing and shelter per

**Excluded Variables[a]**

| Model | Beta In | t | Sig. | Partial Correlation | Collinearity Statistics Tolerance |
|---|---|---|---|---|---|

| | | | | | | |
|---|---|---|---|---|---|---|
| 1 | Projects have to end eventually, can the impact of the agricultural projects st | .057[b] | 1.216 | .225 | .062 | .998 |
| | Length of time one has been a member of that agricultural project (months)? | .149[b] | 3.230 | .001 | .163 | 1.000 |
| 2 | Projects have to end eventually, can the impact of the agricultural projects st | .034[c] | .730 | .466 | .037 | .973 |

a. Dependent Variable: On average how much would you say do you spend on food, clothing and shelter per

b. Predictors in the Model: (Constant), Size of the farm owned that is under agricultural production practices (in acres

c. Predictors in the Model: (Constant), Size of the farm owned that is under agricultural production practices (in acres, Length of time one has been a member of that agricultural project (months)?

**$Y$ = Monthly consumption expenditure**

**$X_s$ =Longevity of farmers' participation, Perceived project sustainability, Farm size, Gender, Age, Education level, Household size, Primary occupation, Access to credit services, off-farm income**

**Variables Entered/Removed[a]**

| Model | Variables Entered | Variables Removed | Method |
|---|---|---|---|
| 1 | Size of the farm owned that is under agricultural production practices (in acres | . | Forward (Criterion: Probability-of-F-to-enter <= .050) |
| 2 | Length of time one has been a member of that climate smart project (months)? | . | Forward (Criterion: Probability-of-F-to-enter <= .050) |

a. Dependent Variable: On average how much would you say do you spend on food, clothing and shelter per

**Model Summary**

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate | Change Statistics R Square Change | F Change | df1 | df2 | Sig. F Change |
|---|---|---|---|---|---|---|---|---|---|
| 1 | .409[a] | .167 | .165 | 5542.449 | .167 | 76.701 | 1 | 382 | .000 |
| 2 | .435[b] | .189 | .185 | 5475.243 | .022 | 10.435 | 1 | 381 | .001 |

a. Predictors: (Constant), Size of the farm owned that is under agricultural production practices (in acres

b. Predictors: (Constant), Size of the farm owned that is under agricultural production practices (in acres, Length of time one has been a member of that climate smart project (months)?

**Coefficients[a]**

| Model | | Unstandardized Coefficients B | Unstandardized Coefficients Std. Error | Standardized Coefficients Beta | t | Sig. |
|---|---|---|---|---|---|---|
| 1 | (Constant) | 4767.082 | 437.096 | | 10.906 | .000 |
| | Size of the farm owned that is under agricultural production practices (in acres | 1638.509 | 187.089 | .409 | 8.758 | .000 |
| 2 | (Constant) | 3869.855 | 513.412 | | 7.538 | .000 |
| | Size of the farm owned that is under agricultural production practices (in acres | 1650.528 | 184.857 | .412 | 8.929 | .000 |
| | Length of time one has been a member of that climate smart project (months)? | 30.433 | 9.421 | .149 | 3.230 | .001 |

a. Dependent Variable: On average how much would you say do you spend on food, clothing and shelter per

**Excluded Variables[a]**

| Model | Beta In | t | Sig. | Partial Correlation | Collinearity Statistics Tolerance |
|---|---|---|---|---|---|

| | | | | | | |
|---|---|---|---|---|---|---|
| 1 | Projects have to end eventually, can the impact of the agricultural projects st | .057[b] | 1.216 | .225 | .062 | .998 |
| | Length of time one has been a member of that climate smart project (months)? | .149[b] | 3.230 | .001 | .163 | 1.000 |
| | Gender of the respondent | .016[b] | .351 | .725 | .018 | .994 |
| | Age of the respondent | -.013[b] | -.275 | .783 | -.014 | .985 |
| | Highest level of education of the respondent | .014[b] | .305 | .760 | .016 | .998 |
| | Primary occupation of the respondent | .005[b] | .107 | .915 | .005 | .996 |
| | Number of dependents in the household (Household size) | .063[b] | 1.349 | .178 | .069 | .996 |
| | Did you have access to credit? | .034[b] | .719 | .473 | .037 | .995 |
| | Do you have non-farm income? | .077[b] | 1.652 | .099 | .084 | .998 |
| 2 | Projects have to end eventually, can the impact of the agricultural projects st | .034[c] | .730 | .466 | .037 | .973 |
| | Gender of the respondent | .015[c] | .325 | .745 | .017 | .994 |
| | Age of the respondent | -.027[c] | -.585 | .559 | -.030 | .976 |
| | Highest level of education of the respondent | .021[c] | .464 | .643 | .024 | .996 |
| | Primary occupation of the respondent | -.013[c] | -.278 | .781 | -.014 | .982 |
| | Number of dependents in the household (Household size) | .059[c] | 1.279 | .202 | .065 | .995 |
| | Did you have access to credit? | .059[c] | 1.253 | .211 | .064 | .970 |
| | Do you have non-farm income? | .078[c] | 1.693 | .091 | .087 | .998 |

a. Dependent Variable: On average how much would you say do you spend on food, clothing and shelter per

b. Predictors in the Model: (Constant), Size of the farm owned that is under agricultural production practices (in acres

c. Predictors in the Model: (Constant), Size of the farm owned that is under agricultural production practices (in acres, Length of time one has been a member of that climate smart project (months)