FACTORS AFFECTING THE EFFECTIVENESS OF PAYMENT FOR ECOSYSTEM SERVICES SCHEME IN THE UPPER CATCHMENT AREAS OF RIVER MALEWA IN NYANDARUA COUNTY, KENYA

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A Thesis Submitted in Partial Fulfillment of the Requirements for the Award of the Degree of Master of Science in Environment and Natural Resource Management in the Department of Environment and Natural Resource Management and the School of Science and Technology of Africa Nazarene University

July 2020

DECLARATION

I declare that this research thesis is my original work and that it has not been presented in any other University for academic work.

_____ _____

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This research thesis is submitted with our approval as University supervisors.

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DEDICATION

This thesis is dedicated to my spouse, Mr. Geoffrey Malel and my children; Roy, Ryan and Brandy.

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ABSTRACT

Human beings have been exerting growing impact on earth's ecosystems as they seek various ecosystem services resulting in ecosystem degradation. To mitigate degradation, motivational approaches such as Payment for Ecosystem Services (PES) have been used to provide incentives to land owners to undertake environmental conservation measures. Due to degradation in River Malewa upper catchment resulting from agricultural production, PES scheme was introduced to provide incentive for farmers to carry out environmental conservation measures with a view to enhancing water quality and quantity in River Malewa which recharges Lake Naivasha. The aim of this study was to evaluate how selected factors affect the Effectiveness of Payment for Ecosystem Services (EPES) scheme in River Malewa upper catchment, Nyandarua County. The selected factors considered included: socio-economic characteristics of the households (age, sex, land size and land tenure), land use types (agro-pastoralism, crop farming and livestock keeping), capacity building, and mode of payment for environmental practices. The study used a descriptive survey research design. The target population was 3600 individuals that are current residents of Kianjogu, Wanjohi and Upper Turasha within River Malewa upper catchment. A stratified random sample of 260 respondents was interviewed using a structured questionnaire. The collected data were analyzed using descriptive and inferential statistics provided for in Statistical Package for Social Science (SPSS version 25) software. The analyzed data was presented using frequency distribution tables and multiple regression analysis to bring out the relationship between the independent and dependent variables. The study found out that the majority of the farmers had very significantly (χ^2 =137.36, *df*=2, *p*<.001) high levels EPES (4-5 on a scale of 1-5). Land use diversification (agro-pastoralism) was found to have higher effects on the EPES than crop and livestock farming. Capacity building had significant (β= 430, t=7.657, *p*< .001) effect on EPES and mode of payment (β= 494, t=9.133, *p*< .001). The socio-economic characteristics (age, sex and land size) did not show significant effects, while land tenure did (β= 313, t=5.273, *p*< .001). The results indicate that to have an effective PES the scheme should have secure land tenure, capacity building, diversified land use types, and a good mode of payment system. This study will provide the stakeholders involved in the management of the river Malewa watershed with information on the factors that need to be considered in designing and up scaling future PES scheme so as to manage the natural resources for sustainable environmental services.

OPERATIONAL DEFINITION OF TERMS

For the purposes of this study, the following operational terms are adopted.

Capacity Building: This is the process of developing and strengthening the skills, instincts, abilities, processes and resources that individuals and communities need to be in a position to carry out the management of the ecosystem.

Ecosystem Services: These are the benefits derived from natural environment through regulation of ecosystem processes such as supply of food, water and timber (provisioning services); the regulation of air quality, climate and flood risk (regulating services); opportunities for recreation, tourism and education (cultural services); and essential underlying functions such as soil formation and nutrient cycling (supporting services) (Smith et al., 2013)

Effectiveness: Achievement of stated objectives additional to what would have been achieved in the absence of the PES intervention (Martin et al., 2014).

Land Use practices: This involves the management and modification of natural environment or wilderness into built environment such as settlements and semi-natural habitats such as arable fields, pastures and managed woods.

Mode of Payment: This is the means by which a payment is made, such as cash, cheque, credit card, Vouchers or in kind.

Payment for Ecosystem Services: Schemes in which the beneficiaries, or users, of ecosystem services provide payment to the stewards, or providers, of ecosystem services (Smith et al., 2013)

Socio-economic characteristics: This is an economic and sociological combined total measure of a person's work experience and of an individual's or family's economic and social position in relation to others based on economic, education and occupation.

ABBREVIATIONS AND ACRONYMS

ANU	: Africa Nazarene University
CARE	: Cooperative for Assistance and Relief Everywhere
CHANS	: Coupled Human and Natural Systems
ES	: Ecosystem Services
EPES	: Effectiveness of Payment for Ecosystem Services
KFS	: Kenya Forest Service
LaNaWRUA	: Lake Naivasha Water Resource User Association
MEA	: Millennium Ecosystem Assessment
MoA	: Ministry of Agriculture
NEMA	: National Environment Management Authority
NFCP	: Natural Forest Conservation Program
PES	: Payment for Ecosystem Services
SPSS	: Statistical Package for Social Sciences
ToC	: Theory of Change
WRA	: Water Resource Authority
WRUA	: Water Resource Users Association
WWF	: World Wildlife Fund

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Despite the importance of environmental conservation, people tend not to be serious with this exercise. A number of motivational approaches have been applied in order to make them cooperate in carrying out some environmental conservation measures. This study aims at assessing the factors affecting the effectiveness of one of these approaches, an approach known as Payment for Ecosystem Service (PES). This chapter looks at the views of various scholars on the same subject globally. The following sub-sections are included in this chapter: background of the study, statement of the problem, purpose of the study, objectives of the study, research questions, significance of the study, scope of the study, delimitation, limitations, assumptions, theoretical framework and conceptual framework of the study.

Growing and significant impact has been exerted on the Earth's ecosystems by human beings leading to worldwide biodiversity loss and degradation of ecosystem. This is according to the Millennium Ecosystem Assessment (MEA) report, (2005). This Assessment also established that whilst some ecosystem services such as food production had increased on a global scale, the majority of ecosystem services have declined. The increase in agricultural productivity in particular is accompanied by a decline in other ecosystem services, particularly those relating to biodiversity and air, soil and water quality, as semi-natural habitats were lost or degraded (MEA, 2005).The main challenge therefore, is to increase food production while reducing the

agricultural sector's impact on other ecosystem services through sustainable intensification.

This has been confirmed by the studies carried out by Wackernagel et al. (2002) and Luck et al. (2004). This negative practice has been found to be not only limited to landscapes dominated by humans, but it has also affected many protected areas around the world (Liu et al., 2001, Curran et al., 2004). Conservation measures such as PES have been undertaken by the government, the private sector and non-governmental organizations (Ferraro & Kiss, 2002). This program gives incentives to the service providers to carry out activities that are desired for environmental benefits; an approach which is found to be promising improved effectiveness of conservation investments (Ferraro & Kiss, 2002; Wunder, 2007). Effectiveness of PES depends on program design as well as human actions in response to the program since it aims at reducing human impacts through shaping human actions (Zbinden & Lee, 2005).

China's economy has been growing faster than that of other major countries and this has fueled significant ecosystem degradation which has led to shocking socioeconomic impacts (Liu & Raven, 2010). For example, the 1997 harsh droughts and the 1998 major floods were partially the outcome of excessive deforestation (World Bank, 2001). To mitigate the impacts of its degraded ecosystems, China has been implementing several PES programs (Liu & Diamond, 2005; Liu, 2010). One of the largest Payments for Ecosystem program in the world is the Natural Forest Conservation Program (NFCP), which is also called the Natural Forest Protection Program (NFPP) (Xu et al., 2006a; Liu et al., 2008). This program has conserved natural forests through bans on logging and afforestation by giving enticements to

rural communities and forest enterprises (Xu et al., 2006a). Studies have revealed that Payment for Ecosystems Program has played a key role in reducing soil and wind erosions, restoring deteriorated ecosystems (Sierra & Russman, 2006), and has also provided habitat to wildlife (McMaster & Davis, 2001; Asquith et al., 2008). It has been a matter of concern to the conservation practitioners to ensure effectiveness of conservation investments (Ferraro & Kiss, 2002).

There is a neglect of how dynamics of characteristics interact resulting in macro-level environmental outcomes by some cost-effective analyses of conservation investments incorporating individual-level characteristics (Siikamäki & Layton, 2007; Chen et al., 2010). This is largely attributed to the fact that there is lack of incorporation of changing human-nature interactions into the evaluation of conservation measures. Complex nature and emerging patterns of human interaction has not been well understood despite recognizing its importance (Foley et al., 2005; MEA, 2005). This is largely attributed to the separate development of social and ecological sciences. There is an interaction between humans and nature which is called CHANS (Liu et al., 2007a, b). Social-ecological systems and coupled human-environment systems (Turner et al., 2007) are concepts which are similar to CHANS. Complexity features in human-nature interactions can be demonstrated in many forms, from the perspective of systems theory. These include nonlinear relationships, heterogeneous components, uncertainty, multiple interactions, and stochasticity, for example, learning and feedback, among different components (Crawford et al., 2005). The past studies have discovered the importance of intricacy features in human-nature interactions (An et al., 2005; Malanson et al., 2006; Liu et al., 2007a, and Walsh et al., 2008).

The widespread adoption of PES marks important issues (Pirard et al., 2010). Due to the uncertainty, asset specificity, and complexity involved in managing ecosystem services, the validity and suitability of formulating PES theory on Coasean grounds has been challenged (Farley & Costanza, 2010; Kosoy & Corbera, 2010; Muradian et al., 2010; Vatn, 2010, Muradian, 2013). If the programs are well designed, it is argued by some that win-win conservation and development outcomes are likely (Pokorny et al., 2012; Kinzig et al., 2011), but to others this is too optimistic given the influence of diverse contingent factors (Redford & Adams, 2009; Muradian et al., 2013). PES implementation may also be hindered by a number of practical obstacles which include scheme design and payment structure (e.g., Engel et al., 2008; Kelsey Jack et al., 2008; Kemkes et al., 2010; Adhikari & Boag, 2012); modes of implementation (e.g.,Engel & Palmer, 2008; Zhang & Pagiola, 2011); trade-off management arising from the need to balance efficiency, effectiveness and equity (e.g., Pascual et al., 2010, Narloch et al., 2011); embeddedness of the institutions and tendency to cooperate (e.g., Muradian et al., 2010; Vatn, 2010); spatial targeting, participation, compliance and monitoring(e.g., Wünscher et al., 2008; Wendland et al., 2010); the adequacy of property rights (Lockie, 2013); and social and well-being outcomes (e.g. Bulte et al., 2008; Pattanayak et al., 2010; Daw et al., 2011).

In the study of NFCP in China, it was recommended by Chen et al. (2010) that if cash payment as a mode of payment for ecosystem service is replaced with an electricity payment, there are likely to be 435 km² of forests in 2030, or an increase of 201 km² of forests to the baseline projection. However, the behavior of newly formed households if not included in the payment scheme may threaten the effectiveness of

the NFCP (Chen et al., 2010). In addition, under different policy scenarios, the effects of socio-demographic factors on forests will also differ.

In some areas, the program has not been successful with the questions arising as to why there has been no positive impact of the program. Due to the lack of sizeable socio-economic impacts, a question as to why landowners continue to participate in PES is thus raised. It was concluded by Arriagada et al. (2015) that a complete understanding of the socio-economic impacts of Payment for Ecosystem Services 'requires looking beyond simple economic rationales and material outcomes (ibid. 13).

According to Muradian et al. (2010), in addition to their conservation goals, an increasing number of PES program now include economic development objectives. The evidence of a causal relationship between PES programs and socio-economic outcomes is scarce despite this new interest in the socio-economic impacts of these initiatives (Pattanayak et al., 2010). In 2014, a systematic review of socio-economic impact evaluations of PES programs was conducted by Samii et al. (2013) and found that only two articles met their inclusion criteria of ''. . .well-designed experimental or quasi-experimental studies that use robust methods to construct approximations to the counterfactual for the areas or individuals subject to a PES programme."(p. 25). The question the researcher seeks to answer is how effective implementation of the PES program affect the success of the conservation program as an incentive by looking at it from the beneficiaries of the schemes' point of view.

This study therefore aims at examining factors affecting effectiveness of PES scheme in upper catchment of River Malewa in Nyandarua County, Kenya.

1.2 Statement of the Problem

PES Scheme implemented in upper catchment of River Malewa is facilitated currently by WWF and formerly by WWF and CARE in collaboration with key Government bodies such as the Ministry of Agriculture (MoA), Water Resource Authority (WRA), Kenya Forest Service (KFS) on the basis that downstream beneficiaries (buyers) of environmental services should provide incentives to upstream land managers (sellers) for their voluntary conservation efforts resulting in watershed conservation and thus continued supply of the agreed environmental services and poverty reduction in the long run. Conservation efforts that farmers are expected to implement include: rehabilitation and maintenance of riparian zones, establishment of grass strips and terracing along steep slopes, reduction of fertilizers and pesticide use, and tree planting which results in improved quality and quantity of river water. Verification of farms to check implementation levels of conservation measures by each farmer is done in order to determine which farmers qualify for the incentives. This is carried out by the WRUAs and PES coordinators, as well as buyers.

From the verification carried out, implementation levels vary from one farmer to another raising the concern on the factors that affect the ability of a farmer to implement the conservation measures. The implementation level of conservation measures will determine the outcome of the Scheme. This research therefore, seeks to assess the extent to which various factors affect PES outcome which in turn determines the effectiveness of PES scheme as an incentive for environmental

conservation amongst farmers in Upper Catchment of River Malewa in Nyandarua County.

1.3 Purpose of the Study

The purpose of this study was to evaluate how selected factors affect PES outcome which is determined by implementation level and thus effectiveness of Payment for Ecosystem Services as an incentive for environmental conservation amongst farmers in the upper catchment of river Malewa in Nyandarua County.

1.4 Objectives of the Study

1.4.1 General Objective

The general objective of this study was to assess factors affecting the effectiveness of Payment for Ecosystem Services Scheme in the upper catchment of River Malewa in Nyandarua County.

1.4.2 Specific Objectives

This study was guided by the following specific objectives:

(i) To assess the effectiveness of payment for ecosystem services scheme in the upper catchment of river Malewa.

(ii) To determine the effect of farmer's socio-economic characteristics (age, sex, land size and land tenure) on effectiveness of payment for ecosystem services scheme in the upper catchment of river Malewa.

(iii) To evaluate the influence of land use types (agro-pastoralism, crop farming and livestock farming) on effectiveness of payment for ecosystem services scheme in the upper catchment of river Malewa.

(iv) To assess the effect of farmers capacity building for environmental practices on effectiveness of payment for ecosystem services scheme in the upper catchment of river Malewa.

(v) To evaluate the effect of mode of payment on effectiveness of payment of ecosystem services scheme in the upper catchment of River Malewa.

1.5 Research Questions

This study tried to answer the following research questions:

(i) How effective is payment for ecosystem services scheme in the upper catchment of river Malewa?

(ii) How does land use type affect effectiveness of payment for ecosystem services scheme in the upper catchment of River Malewa?

(iii) To what extent does capacity building influence effectiveness of payment for ecosystem services scheme in the upper catchment of River Malewa?

(iv) How have farmer's socio economic characteristics impacted the effectiveness of payment for ecosystem services scheme in the upper catchment of River Malewa?

(v) What effect does mode of payment have on effectiveness of payment for ecosystem services scheme in River Malewa upper Catchment?

1.6 Significance of the Study

This study is of great significance to the implementers of the PES scheme in Lake Naivasha basin as they will be in a position to understand how different factors facilitate or constrain implementation of conservation measures which determines the outcome of PES scheme and thus the success of the environmental conservation programs. The results generated from this study will provide useful lessons in future

for designing and up scaling PES schemes in Lake Naivasha basin and other areas of the world. Government agencies like National Environment Management Authority (NEMA), Water Resource Authority (WRA) and Ministry of Agriculture (MoA) will use this report to come up with relevant policies that concerns the management of the environment and especially in relation to the PES approach. Other beneficiaries of this research will include graduate and undergraduate students pursuing environmental science, natural resources, wildlife management, agribusiness, agriculture and other related courses as they will use the findings to broaden their knowledge on environmental management using various approaches. Future researchers are another group which will utilize the information from this study as they will be using it to get the relevant literature and also to identify research gaps. Scholars too will benefit from this research as they will use it to build on the existing theories or to confirm otherwise.

1.7 Scope of the Study

This study was carried out in the upper catchment of Malewa River (a sub catchment of Lake Naivasha basin) situated in Nyandarua County. This region is found relevant as the PES program has been started and implemented successfully here. The study collected information only from those who have benefited from the program. The target population for this study was 3600 from which a sample of 260 was selected. The study took place in the months June through to August 2019.

1.8 Delimitation of the Study

The study aims at getting information related to the factors affecting the effectiveness of PES scheme in the upper catchment of river Malewa. The study was limited to four factors which include land use practices, capacity building, farmer's

socio-economic characteristics and mode of payment. The choice of the four factors was guided by the previous studies done in other regions of the world indicating that PES implementation have been hindered by a number of obstacles including the above four factors. The effectiveness of the PES scheme was measured using the outcomes which include livelihood improvement, household income level, altered agricultural practices and soil and water conservation measures implemented as a result of the program by the beneficiaries.

1.9 Limitations of the Study

The sample selected for this study was specific to the geographical region and local dwellers within the upper-catchment area of River Malewa, thus the study findings may not be readily generalisable to other ecosystems in other parts of the world. The study was also expected to meet perceived operational challenges like some respondents failing to cooperate for fear of victimization or they may as well give exaggerated information about the success of the project hoping that they would get better pay compared to the rest. However, this limitation was overcome by first explaining to the respondents the aim of the study so that they do not give false information for fear of intimidation or for expecting a reward for the same. Besides, the researcher and research assistants secured their cooperation of the respondents through their PES coordinators. Most of the respondents were busy carrying out their daily crucial activities, hence therefore may not have had time to fill the questions in the questionnaire. This was overcome by interviewing them where they were working.

1.10 Assumptions of the Study

This study assumed that the instruments used were valid and reliable and gave the exact information that was required and when the research was carried out, the respondents were truthful and gave the correct answers.

1.11 Theoretical Framework

1.11.1 Theory of the Tragedy of the Commons

The theory of tragedy of the commons was postulated by William Forster Llyod (1794 -1952) and Garrett Hardin (1915-2003). It is an economic theory that describes how people often use natural resources to their advantage without considering the good of a group or society as a whole. When a number of individuals consider only their own welfare in this manner, it leads to negative outcomes for everybody, as the natural resources become depleted. “The commons” includes any natural resources that are not owned by an individual or corporation. The atmosphere can be seen as a global resource and as people fail to limit the amount of pollution they produce, everyone is affected by the resulting climate change. Other problems connected to the theory of the tragedy of the commons are deforestation, overpopulation, depletion of gas and oil reservoirs and harm to ground water. Several solutions have been proposed to offset negative outcomes related to the tragedy of the commons (Libecap, 2006). In general, solving this problem requires collaboration and cooperation as people come together to preserve resources for the good of all. Regulation and taxation by the government can limit the effects people have on certain resources. Informal or formal property rights can be given to individuals or groups to restrict peoples’ overuse of other resources. This theory is applied in this study in reference to Lake Naivasha which was benefiting the flower growers

(Buyers) economically and yet the 80% of the water drains from River Malewa. This implies that if River Malewa upper Catchment is not conserved properly it may lead to reduction in water quantity and quality reaching Lake Naivasha thus affecting floriculture. PES Scheme therefore compensates the upstream dwellers for undertaking conservation measures in the catchment and thus ensuring continuous supply of water to Lake Naivasha.

1.11.2 Theory of Change

The idea of the Theory of Change (ToC) approach seems to have first emerged in the United States in the 1990s, in the context of improving evaluation theory and practice in the field of community initiatives (Weiss, 1995). Yet the "current evolution draws on two streams of development and social programme practice: evaluation and informed social practice" (Vogel, 2012). From the evaluation perspective, ToC is part of broader program analysis or program theory. In the development field, it also grew out of the tradition of logic planning models such as the logical framework approach developed from the 1970s onwards. The notion of developing informed social practice has a long history; practitioners have often sought (and used) tools to attempt to consciously reflect on the underlying theories for development practice.

Since their use in the field of community development, ToC approaches have increasingly become main-stream. This is largely due to the demands of key funders, whose focus on ToCs has strengthened in the last few years. Though some may view ToC as simply a 'buzzword', it does appear that it also represents an increased desire for organizations to be able to explore and represent change in a way that reflects a

complex and systemic understanding of development (James, 2011). This desire stems at least in part from the 'results agenda': ToC is seen as a way to plausibly demonstrate impact in fragile and conflict-affected regions of the world.

In its early conceptualization in 1995, Weiss described a ToC as "a theory of how and why an initiative works" (Weiss, 1995). More fully articulated, this can be understood as a way to describe the set of assumptions that explain both the mini-steps that lead to a long term goal and the connections between these activities and the outcomes of an intervention or programme (Anderson, 2004). ToC has been called a number of other things: "a roadmap, a blueprint, an engine of change, a theory of action and more" (Reisman et al., 2007). Beyond these initial conceptualizations, there is little consensus on how ToC is defined. However, like Weiss' initial definition, ToC is most often defined in terms of the connection between activities and outcomes, with the articulation of this connection the key component of the ToC process. The ability to articulate this connection rests on the idea that, "social programs are based on explicit or implicit theories about how and why the program will work" (Weiss, 1995). Articulating these theories commonly involve exploring a set of beliefs or assumptions about how changes will occur (Rogers, 2012).

1.12 Conceptual Framework

This study aims at assessing the factors affecting the effectiveness of PES scheme in the upper catchment of River Malewa Upper-catchment in Nyandarua County. The four factors (land use types, farmer's capacity building, mode of payment and socioeconomic characteristics) are the independent variables while the dependent variable is effectiveness of PES scheme. The variables were measured

using various indicators. Measurable indicators for Land use types include: crop farming, agro pastoralism (mixed farming) and livestock farming. Measurable indicators for capacity building (acquisition of skills, knowledge and resources) this include: training undertaken to farmers, availability of resources to carry out conservation measures and access to extension services. Measurable indicators for mode of payment include: amount received, cost of implementing the conservation measures and form of payment. Measurable indicators for farmers' socio economic characteristics include: age, gender, farm size, and land tenure.

The moderating variables influenced independent variables by defining legal and institutional framework under which community groups are established. The institutions established by existing laws provide entry points to the community. This relationship between dependent and independent variables is demonstrated in Figure 1.1.

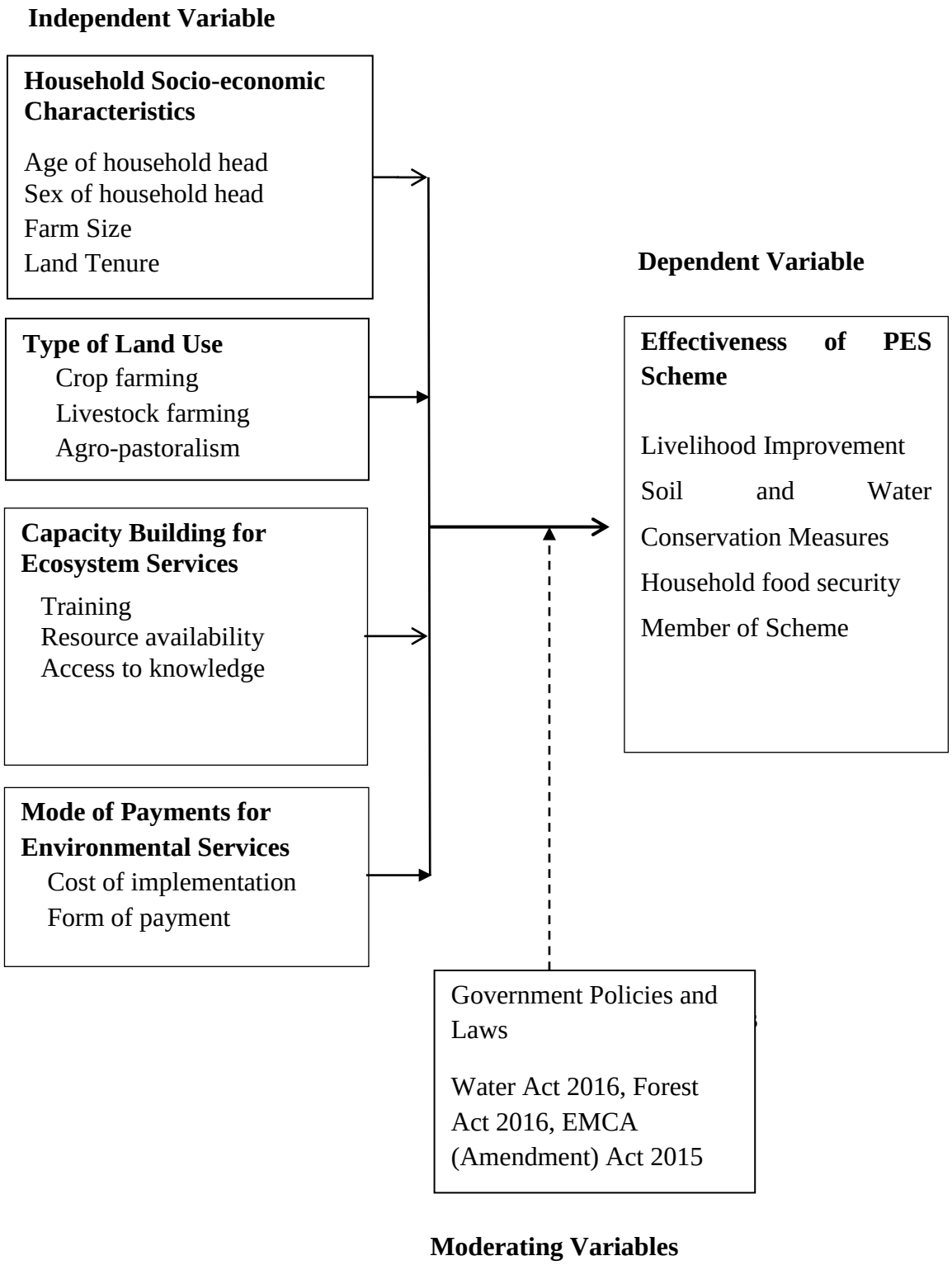

Figure 1.1: Conceptual Framework showing the Factors Affecting the Effectiveness of Payment for Ecosystem Services scheme.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter contains the review of the literature with respect to the research objectives which are Land use types, Capacity building, Nature of payment and socio-economic characteristics culminating in the conclusion and the knowledge gap.

2.2 Effectiveness of Payment for Ecosystem Services (EPES)

Payment for Ecosystem Service (PES) incentives are used to influence the decision to produce the service. The implementing organization or user group is constrained to using positive incentives, as there may be no legal justification for negative incentives. This context is particularly common when individuals are paid to implement certain farming practices, such as to develop or maintain hedgerows under agri-environment schemes (Dobbs & Pretty, 2008). This is also the case in most user-financed PES schemes, where downstream water users create incentives for upstream landowners to safeguard water quality through particular land-management practices.

Effectiveness is defined as the achievement of stated objectives additional to what would have been achieved in the absence of the PES intervention. Effectiveness and efficiency prioritization poses some problems for PES in practice. Fisher et al. (2009) notes that there is the problem of measuring the additional good provided by the intervention due to scientific uncertainty about the link between land management practices, ecosystem functions and service provision.

Even though conditional positive incentives have been found to define characteristic of PES, in practice, there are additional considerations that influence the

ultimate success of an intervention. In particular, a consideration of additionality provides assurance to investors (buyers) that an intervention will have a measurable impact, but a consideration of the institutional context surrounding implementation ensures that the specific design of a PES intervention is appropriate (Sommerville et al.,2009). Additionality is the measure of outcomes in relation to what would have occurred in the absence of the intervention. According to Engel and Palmer (2008) it is essential for assessing intervention impacts of PES. It is a central criterion for the most developed environmental-service markets for carbon (Pfaff et al., 2000; Niesten et al., 2002), and it is frequently used as an indicator of PES effectiveness (Engel & Palmer, 2008; Wunder et al., 2008).

Past reviews have shown that key obstacles for the adoption and environmental effectiveness of PES include: low willingness to pay among poor service users, state control of environmentally sensitive lands, high transaction costs, or weak institutions and organizational capacity among both service providers (e.g., tenure insecurity) and users (e.g., monitoring and enforcement infrastructure) (Ferraro,2009; Huang, Upadhyaya, Jindal, & Kerr, 2009; Martin- Ortega, Ojea, & Roux, 2013; Southgate & Wunder, 2009). Other conditions identified that, if present, will impede PES development or limit their future effectiveness, include; longstanding tenure conflicts, unidentifiable or unavailable service providers, or unacceptable social impacts and high implementation risks (Milne & Niesten, 2009). Ezzine-de-Blas et al. (2016) in the study of potential determinants of PES performance established that design factors, such as the degree of spatial targeting (on ecosystem service density and degradation threat), enforcement of conditionality (through monitoring and sanctioning), and differentiation of payments, have positive

contribution to environmental effectiveness while sectorial clusters (public, for-profit, NGO) were non-significant predictors of additionality, but asset-building schemes, were more strongly associated with additionality than conservation PES, perhaps due to lower baseline compliance levels and outcome observability.

2.2.1 Land Use Types

Amount of biomass can be increased through increase or decrease of atmospheric carbon dioxide as a result of land-use changes. According to Intergovernmental Panel on Climate Change (2007), agriculture and forestry currently account for approximately 30% of anthropogenic greenhouse gas emissions. Various incentives, one of them being Payment for Ecosystems Service programs have been established to sequestrate carbon dioxide or to prevent carbon dioxide emissions from land management.

On smallholder land in Rwanda, planting bamboo and adopting agroforestry are two favorable means of sequestering carbon. The planting of trees along with traditional agricultural crops is a practice called agroforestry. By doing this, the trees increase the biomass on a plot of land through the appropriation and storage of carbon from the atmosphere. The estimated potential carbon sequestration is between 1.5 to 3.5 Mg C/ha/year for smallholder agroforestry systems in the tropics. This also helps decrease pressure to convert natural forests, since it has indirect effect on Carbon sequestration by which are large sinks of terrestrial Carbon (Montagnini & Nair, 2004). In Rwanda currently smallholder farmers plant fruit trees or trees which are used for firewood, timber, or other wood products. Agroforestry provides many other benefits to the environment and small holder farmers. Agroforestry, for example, is a

means for farmers to get firewood, to prevent soil erosion on hilly land and, sometimes to replenish soil minerals, like Nitrogen, Phosphorus, Calcium, and Magnesium and protect water quality (Roose & Ndayizigiye, 1997). Bamboo trees, for example, are fast growing species that can rapidly sequester Carbon, preventing soil erosion, helping to restore degraded land, serving as a source of energy, and can as well be providing raw materials for various marketable products. In a mature stand in Ethiopian highlands, as reported by Embaye, Weih, Ledin and Christersson (2005) there is an aboveground and belowground biomass content of 66 Mg carbon per ha per year. It can be selectively harvested on a yearly basis, as a result of its being very fast in growth rate, making it very suitable for poor farmers.

Programs that promote the alleviation of poverty through the adoption of land use change are not new and have formed a major aspect of rural development efforts over the past four decades (Lipper & Cavatassi, 2004). However, despite the positive effects of these programs, the adoption of low-cost technology, such as agroforestry, has remained low. The agricultural and economic development literature has frequently stressed that disparities in access to labor, land, asset, and money as well as farmer's knowledge, institutional linkages, and social networks define how vulnerable resource users are to uncertainties and risks intrinsic in technology adoption and market participation (Lipper & Cavatassi, 2004; Perez, Roncoli, Neely, & Steiner, 2007; Shiferaw, Okello, & Reddy, 2009).

2.2.2 Capacity Building on Environmental Practices

Capacity building involves equipping the team with the necessary skills, motivation and providing the resources required for the successful carrying out of activities assigned. Practices that seem feasible and eligible for Carbon payments in one location or social group may not necessarily be so in another location and therefore there is need for resource allocation. For instance a study by Bidogeza, Berentsen, Graaff and Lansink (2009) found that female-headed households in Rwanda were adopting relatively cheap inputs, such as compost and green manure, as they are inhibited by their education being low and farm size being too small preventing them from adopting other more expensive technologies. They therefore need to be taken through some training seminars to make them informed and have some knowledge on the kind of inputs that are relevant. Understanding these social and spatial variations is important in designing a carbon credit scheme that contributes to poverty reduction if smallholder farmers are to be successfully engaged in a carbon sequestration program.

Important factor also is the adoption of appropriate institutional arrangements. Perez et al. (2007) puts it without suitable institutional plans to facilitate the process of monitoring, segregation, and verification, economic incentives to sequester carbon may not necessarily translate into carbon sequestration programs. Given the extremely small parcel size it would be difficult to develop carbon credits by reforesting individual fields or parts of fields, since Rwanda's landscape is a mosaic of small agriculture plots averaging less than a hectare. Aggregating small amounts of carbon sequestered in a large number of small plots to scales large enough to be tradable on carbon markets is one way of addressing this issue. An example of a way of

overcoming these challenges could be aggregating and organizing families under carbon cooperatives in which local communities agree to reforest and protect a section of their land that could be used jointly for sustainable wood harvesting and generation of carbon credits. Provision of support to farmers and selling of Carbon credit would be the work of the cooperative. It is noted by Eaton and Shepherd (2001) that it is not enough to identify activities with high income generation potential for rural people, it is also critical to provide a reliable and cost-effective support and services ranging from fertilizers, seeds, extension advice, and credit to facilitate smallholder farmer participation. Institutional arrangements that can facilitate the provision of support for smallholder participation in carbon markets are thus essential.

Crucial is the facilitation of cooperation among various administrative agencies that affect the management of smallholder land. To enable people to participate more directly in the governance processes and empower marginalized communities, the government of Rwanda has embraced decentralization as a form of local governance. The policy has created conducive environment for cooperatives and associations by opening opportunities for institutional capacity building at the local level. At the national level, it is unclear which government agencies will, in practice, control forest-based carbon credits given the current institutional arrangement. For example the National Forest Authority (NAFA) is responsible for managing and monitoring deforestation, forest cover, and overall land use changes and centralizes carbon credit transactions from forest-based projects. It is the responsibility of The Rwandan Environment Management Authority (REMA) to manage the bio-physical environment throughout the country and contains the Designated National Authority (DNA) for Clean Development Mechanisms (CDM) projects. Proposed within the

scope of the CDM, the DNA has the responsibility of approving carbon projects. If inter-institutional and inter-sectorial collaboration is to be encouraged and ensuring transparency in measuring and accounting procedures and equitable access to information by rural communities, a cross-administration forest-carbon group could be established. The group ought not only to be having clear authority to evaluate and support forest-carbon projects, but also to develop a set of guidelines on revenue-sharing, community benefits and ecological values, in which every potential project has to adhere.

As suggested by Corbera, Soberanis, and Brown (2009) substantial funding can be lost in preparation of unsuccessful project proposals because of lack of necessary knowledge and capacity as experienced in some other countries like Mexico. The requirements to developing a successful carbon project in terms of design, implementation, monitoring, verification, certification, and interactions with intermediaries are not always explained by project developers in plain language. An impression unfortunately has been created, that PES programs are a foreign owned process creating skepticism in many countries, including Rwanda. Despite the fact that technical capacities are present in Rwanda for example GIS analysis and remote sensing, they are scattered in different government agencies, universities, and non-governmental organizations. In order to assess the capacity needs and design a capacity building program to adapt to the evolving opportunities in carbon sequestration it is important that efforts be made. To improve PES's social outcomes, sharing experiences with other indigenous groups like the Bolsa Floresta carbon scheme, as well as a more targeted approach to local capacity building and contract management, could help (Borge & Martinez, 2009).

2.2.3 Socio-Economic Characteristics

As was previously mentioned, there is considerable pressure for PES to support both environmental protection and poverty alleviation goals (e.g. Landell-Mills & Porras, 2002; Turpie et al., 2008; Lipper et al., 2009). Hence, there has been significant discussion in the literature of potential poverty effects of PES programs. Much of this work has been nicely reviewed in Bulte et al. (2008), Lipper et al. (2009) and in Palmer and Engel (2009). Earlier work has suggested that there are some potential situations in which the poor might benefit from PES and that there may be tradeoffs in targeting. However, robust conclusive evidence on either point is still lacking.

Being a recipient of payments, however, is quite different from whether or not a PES program actually aids in moving households out of poverty. Clearly, the former is a necessary condition for the latter, but much of the poverty/PES literature focuses on participation of the poor, rather than changes in their outcomes as a result of an incentive program. Ollivier (2012) uses a general equilibrium framework to identify key tensions generated by transfers conditional on forest conservation. Under the assumption that farmers can substitute capital for land, and in the absence of labor market frictions, she shows that low transfers can increase agricultural productivity, and thus raise welfare, by raising the capital to land ratio. At higher transfer levels, however, the capital over land ratio becomes “too high”, thus decreasing returns to agriculture.

In the case where the external transfer does not fully compensate for this decrease, welfare can be reduced by the transfer. Zilberman et al. (2008) present a

useful microeconomic framework for understanding the potential impacts of both land diversion and working-land programs on PES sellers. Using a separable household model of decision making, where households vary in farm size, environmental benefits of their land holdings, and wealth, they show that in the case of land diversion programs–such as avoided deforestation PES–the poor landholders are most likely to benefit if the main impacts of the program are through increased agricultural rents, while wage and price effects are minimal. In the same setting, landless rural poor may benefit if PES leads to higher labor demand. On the other hand landless lose if payments increase local food prices.

Overall however, as in the case of the working lands programs, the increase in labor demand may lead to poverty alleviation. On the empirical side, applied work on poverty alleviation and environmental effects exists only for China and Mexico. China's Sloped Land Conversion Program (SLCP), which pays for reforestation, does not appear to have major tradeoffs between environmental and development goals (Uchida et al., 2007; 2009; Gauvin et al., 2010). More recently, an analysis of Mexico's PES program on accepted and rejected applicants' reveals very interesting and significant tradeoffs between targeting on poverty alleviation versus targeting on environmental effectiveness (Alix-Garcia et al., 2013). In particular, using matching and panel data analysis, Alix-Garcia et al. (2013) find that the environmental impact is highest where poverty is low, but poverty alleviation is highest where risk of deforestation is low. On average the wealth effects are small. These findings demonstrate that the claim that PES programs can both generate inexpensive carbon sequestration and alleviate poverty is not generalizable, and that the underlying correlation between poverty and deforestation risk determines the ability of a PES

policy to achieve the dual objectives of poverty alleviation and environmental conservation.

2.2.4 Mode of Payment for Ecosystem Services Scheme

Instead of designing a PES scheme for a specific ecosystem service paid for by the beneficiaries at the same scale at which that service is provided, a promising alternative to increase the total benefits is to batch payments from several ecosystem service beneficiaries for the simultaneous provision of several ecosystem services across multiple scales (OECD 2010). Bundling can reduce transaction costs because a single institution could administer the program and manage the monitoring, reporting and verification of all the ecosystem services (OECD 2010). An important element is monitoring the provision of the ecosystem service and the conditional disbursement of revenues (Engel et al., 2008; OECD 2010). It is necessary to attend the lack of available and reliable data on land tenure, forest quality and quantity, high cost monitoring technology, low human capacity, and poor information exchange and coordination among sectors and government agencies (To et al., 2012; Alston et al., 2013; Pham et al., 2013b). From the social point of view, PES has generated important benefits for indigenous communities in Costa Rica. Although the transparency of payment distribution methods within indigenous groups has been questioned (Meland-Rød, 2010), it is unquestionable that the programme is a major source of income for these communities – which has helped them diversify their economic activities, invest in education and local infrastructure, and strengthen local institutions (Borge & Martinez, 2009).

Studies done by Miranda et al. (2003) and Zbinden and Lee (2005) report that payments to the farmers tend to go disproportionately to landowners with higher

levels of education, income, and with relatively large farms and diversified income, majority of whom are not dependent on farming. Excluding indigenous and group contracts, the average property size participating in the PES programme between 1997 and 2012 was approximately 115 hectares, with an average size of a little over 70 hectares for individuals, and 160 hectares for legal entities. Matulis (2012) attributes this bias towards large landowners to the fixed cost of transaction and monitoring incurred by *regente forestales* who act as intermediaries. Larger farms of between 100 and 300 hectares held the greatest share in number of contracts and proportion of the whole PES budget (26 and 49 per cent respectively). Smaller properties (less than 30 hectares) have an increasing proportion since the introduction of agroforestry contracts (34 per cent of all contracts), but their share in the budget remains low (7 per cent). Contracts with larger farms of more than 300 hectares are less common (5 per cent) but they hold a substantial share of the funds distributed at 19 per cent.

The role of monetary payments as positive incentives needs to be considered in the design of PES interventions. According to Gneezy and Rustichini (2000) and Frey and Jergen (2001) payments have been shown to act as negative incentives under some circumstances, because small payments can insult participants and, therefore, can lower the motivation of individuals, or payments can "crowd out" other pre-existing forms of motivation such as altruism. Similarly, there is cause for concern in terms of diminishing returns through time from the repeated use of positive incentives (Benebou & Tirole, 2003). Over time, positive incentives may become perceived not as incentives but as entitlements, and thus lose their motivational force.

2.3 Conclusion and Knowledge Gap

The reviewed literature shows that a number of factors play a role in the success of the Payment for Ecosystem Service (PES) scheme. Various studies on the selected factors have been carried out in various countries like Rwanda, China, and Uruguay among others and what is found out is that there is significant correlation, either positive or negative, between these factors and the effectiveness of PES. Mode of payment, for example, as presented by Miranda et al. (2003) and Zbinden and Lee (2005) has a negative influence on the effectiveness of PES when there is discrimination of the who to be paid and the amount paid based size of the farm, education level, level of poverty among other things. Land use practices has also been found by the scholars to have an influence of the effectiveness of PES, for example if the land is not being used in accordance with the program then there is no way the program is going to succeed. Similarly, people will not be able to cooperate if they are not taught the importance of the program and how they are going to benefit from the same. Worse still is when they don't know how to carry out the necessary activities aimed at conserving the ecosystem. Socio-economic factors have also been confirmed to have a direct influence on the success of the PES scheme in the sense that if the people are poor then the payment can act as an incentive to them and they would be willing to cooperate.

Most of this literature was carried out in other countries and there is scanty information about the same in Kenya. This study therefore tries to bridge the gap by carrying out an investigation on effect of selected factors on the effectiveness of PES scheme in Nyandarua, River Malewa upper-catchment.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter contains the research design employed in this study, research site, target population, research sample size, sampling procedure, data collection methods, data processing and analysis, instrument validity and instrument reliability.

3.2 Research Design

The study adopted a descriptive survey research design. This type of study design was suitable for this work given that it involved gathering data in order to answer questions based on the current status of the subjects of study. According to Punch (2010) descriptive survey design is best suitable for collecting information on a population at a single point in time and hence, the data on the factors affecting effectiveness of PES scheme amongst farmers was collected to the required extent and standard as expected in this study. Benefits associated with this design also include ease of establishing correlation between variables and comparison, possibility of administration to many people and anonymous completion of questionnaires.

3.3 Research Site

The study was carried out in the River Malewa Upper Catchment situated in Lake Naivasha Basin in Nakuru and Nyandarua County (*Fig. 3:1*). River Malewa catchment covers an area of approximately 1,700 Km^2. The upper Malewa catchment is located on the South Western Aberdare ranges and contains the South Kinangop forest. The study was done in this area because the catchment is the source of River Malewa and Gilgil; two perennial rivers that feed Lake Naivasha. The main tributaries

of the River Malewa are the Turasha, kianjogu and Wanjohi rivers which were the main focus areas of the study.

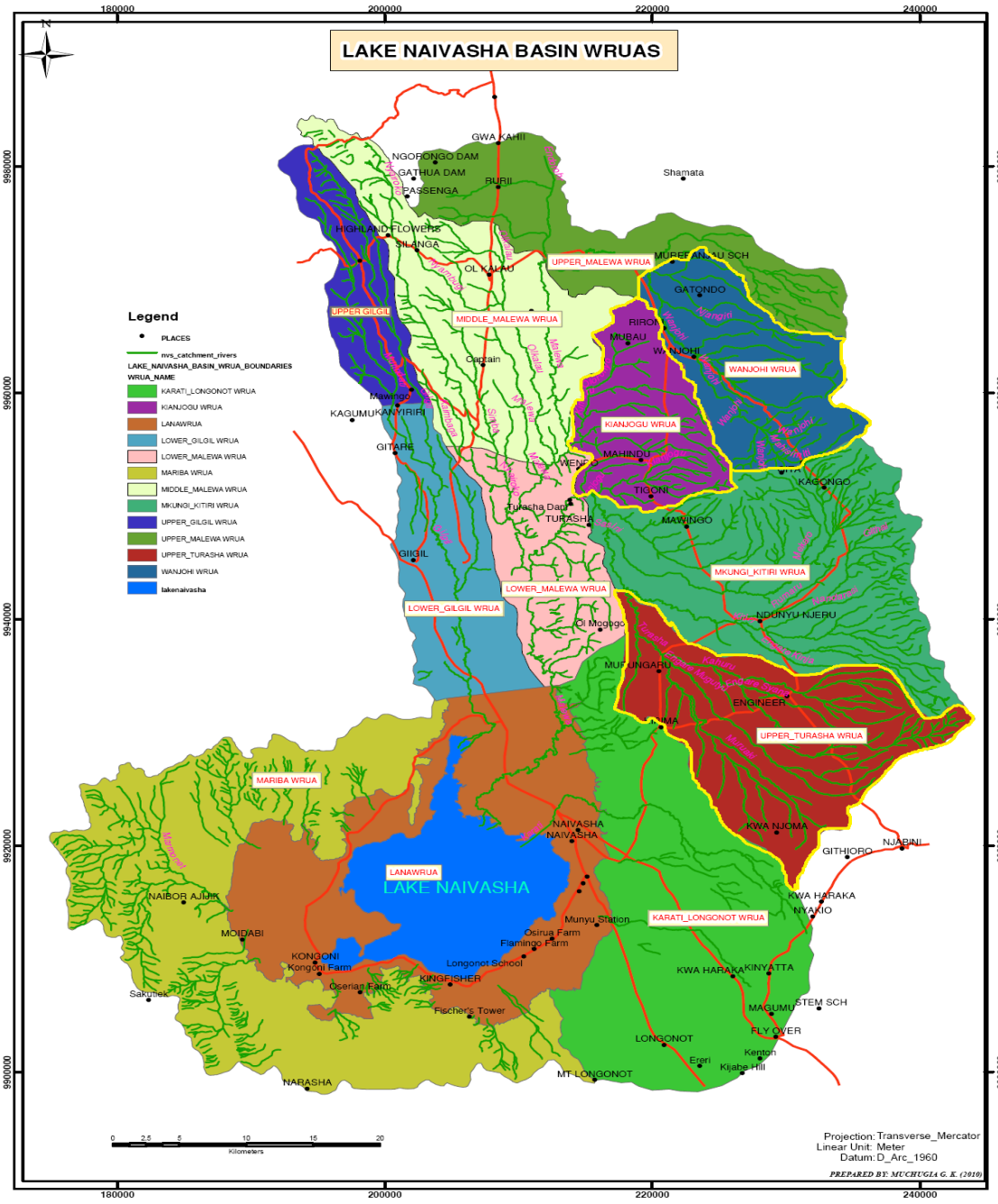

Fig. 3.1: **Map of Study area: Location of River Malewa Upper Catchment (Wanjohi, Kianjogu and Upper Turasha) in Lake Naivasha Basin**
Source: IMARISHA, Naivasha

3.4 Target Population

Population is the entire set of units for which the study data are to be used to make inferences (Kothari, 2004). Target population defines those units for which the findings of the study are meant to be generalized from (Dempsey, 2003). The target population of the study was 3600 farmers residing in Kianjogu, Upper Turasha and Wanjohi areas (Table 3.1) who are members of the WRUAs and have implemented PES scheme. The target population of the study is as shown in Table 3.1.

Table 3.1: Target Population

Area	Number
Kianjogu	986
Wanjohi	964
Upper Turasha	1650
Total	**3600**

Source: LaNaWRUA 2018 Annual report

3.5 Research Sample Size

Sampling technique is the procedure a researcher uses to gather people, places or things to study (Orodho & Kombo, 2002). In this case, it refers to the procedure the researcher uses to select the final sample to study. A sample is part of the target (or accessible) population that has been procedurally selected to represent it and whose properties are studied to gain information about the whole. Sample size for this study, was determined using Yamane Taro (1967) formula. The formula is applicable mostly when dealing with a large size of the population and it is also found to be suggesting a sample size that is more representative of the population. The formula was applied as follows:

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

Where,

n = is the sample size

N = Population Size (N=3600)

e = Acceptable sampling error (e = 0.05, when confidence level is 95%)

Therefore $3600/[1+3600(0.05)^2]$ gave n value of 360. Given that the target population was homogenous, the population was stratified to select 260 respondents due to limited time and financial resources. The sample size of 260 was enough and gave good analysis.

3.6 Sampling Procedure

The Sample was constructed using stratified sampling and simple random sampling techniques. Stratified sampling technique was used to divide the study area into three geographical regions; Kianjogu, Wanjohi and Upper Turasha. Each region in the upper-catchment was treated as a stratum, from which a proportionate size of sample respondents was taken to form the desired sample size of the target population. Simple random sampling technique was then used to select respondents to administer questionnaire (Appendix A) in each strata. This approach gave each item in the population a fair chance of being selected into the sample. Proportional allocation was considered most efficient and an optimal design when the cost of selecting an item is equal for each stratum, there is no difference in within-stratum variances, and the purpose of sampling happens to be to estimate the population value of some characteristics (Kothari, 2004).Using proportional allocation the sample sizes for each strata is as shown in Table 3.2.

Table 3.2: Target Population and Sample Size

Stratum	Target Population	Sample Size
Kianjogu	986	71
Wanjohi	964	70
Upper Turasha	1650	119
Total	**3600**	**260**

3.7 Data Collection Methods

The primary data was collected by use of interview schedules and structured questionnaires (Appendix A) through face to face interview. These instruments were designed in a manner that would answer the research questions. The questionnaires were randomly administered to the farmers by the researcher with the help of research assistants who translated in either local dialect or swahili for ease in response. Key informants who were interviewed included PES coordinators for Kianjogu, Wanjohi and upper Turasha WRUA, government officers (KFS, WRA, and MoA) and Civil Society officers (WWF) who have been involved in the implementation of the project.

3.8 Data Processing and Analysis

Data analysis employed the models of inferential statistics and descriptive statistics like the mean, standard deviation, correlation as well as frequency distribution tables to analyze the quantitative data. Inferential statistical model of Chi Square was applied to test fitness among the influences of the factors on effectiveness of PES. The entire analysis was done using the computer software, statistical package for Social Sciences (SPSS) version 25.0. Multiple linear regression equation was used

to bring out the relationship between the independent and dependent variables as shown below:

$Y= \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4$

Where,

Y = Effectiveness of Payment for Ecosystem Services scheme

α = Y-intercept

β_{1-3} = Coefficient of the variables

X_1 = Land use Types

X_2 = Capacity Building

X_3 = Socio-economic characteristics

X_4 = Mode of Payment

The summary of data analysis is shown in Table 3.3.

3.9 Instrument Validity

Validity of the instruments measures and ensures accuracy level in data collection. In this study, accuracy of the research instruments was ensured by having all the instruments assessed by experienced experts and researchers in the department of Environment and Natural Resources Management at Africa Nazarene University.

Table 3.3: Summary of Data Analysis

Research Questions	Independent variable	Dependent variable	Statistical analysis
(i) How have farmer's socio economic characteristics impacted the effectiveness of payment for ecosystem services scheme in River Malewa upper Catchment?	Household Socio-economic Characteristics	Effectiveness of PES Scheme	Descriptive statistics (Frequency, Mean, Std. Dev, Mode, median) and Inferential statistics (multiple linear regression, ANOVA,F-test, Levenes test, t-test, Chi square test)
(ii) How does land use type affect effectiveness of payment for ecosystem services scheme in River Malewa upper Catchment?	Land use types	Effectiveness of PES Scheme	Descriptive statistic (Mean, Std. Dev, Min, Max) and Inferential statistics (one way ANOVA,F-test, Bonferroni post hoc tests, mean comparisons, t-test)
(iii)To what extent does capacity building influence effectiveness of payment for ecosystem services scheme in River Malewa upper Catchment?	Capacity Building	Effectiveness of PES Scheme	Descriptive Statistics (Frequency, Mean, Std. Dev, Mode, median, Min, Max) and Inferential statistics(simple linear regression, F-test, t-test)
(iv)What effect does mode of payment have on effectiveness of payment for ecosystem services scheme in River Malewa upper Catchment?	Mode of payment	Effectiveness of PES Scheme	Descriptive statistics (Frequency, Mean, Std. Dev, Mode, median, Min, Max) and Inferential statistics(simple linear regression, ANOVA,F-test, t- test)

3.10 Reliability of Research Instruments

This study used internal consistency technique to ensure reliability of the instruments. The internal consistency of data was determined from the scores obtained from a single test administered to 10 respondents who were not among those in the study. The scores from one item were correlated with scores obtained from other items in the instrument and used Cronbach's Alpha to calculate the reliability of the instrument. The Cronbach test formula used is as shown below:

$$\alpha = Np/[1+p(N-1)]$$

Where N = Total number of items

p = Mean inter item correlation

In the questionnaire, the number of items being measured was 5, therefore N which is number of items being measured was 5 and p refers to the mean inter item correlation which was .4. Therefore, 5(.4)/ [1+.4(5-1)] gave alpha value of 0.76. The alpha value was 0.76 and since the coefficient was more than 0.7 then the instrument was reliable.

3.11 Legal and Ethical Considerations

Ethical standards and regulations were maintained during the whole process of data collection. Informed consent from the respondents was sought for before being involved in the study. The respondents were assured of anonymity. All the respondents were briefed beforehand about the research before getting information from them. All literature cited in this thesis was referenced besides; the researcher obtained the required legal permit from NACOSTI (Appendix D) before commencing field work. An introduction letter from Africa Nazarene University (Appendix C) was used to explain and identify the enumerators used in the data collection. The

introductory letter was also submitted to local authorities to inform them of the intended research. A feedback report to the community has been arranged and will take place in the near future.

CHAPTER FOUR

DATA ANALYSIS AND FINDINGS

4.1 Introduction

This chapter presents results and their interpretation on the factors affecting the effectiveness of payment for ecosystem services in the upper catchment areas of river Malewa in Nyandarua county, Kenya The chapter is divided into the following sections: (i) personal characteristics of the respondents, (ii) characteristics of the farming system, (iii) effectiveness of payment for ecosystem services in the upper catchment of river Malewa, (iv) effects of socioeconomic characteristics of the farmers on the effectiveness of payment for ecosystem services, (v) effects of land use type on the effectiveness of payment for ecosystem services scheme, (vi) effects of capacity building on the effectiveness of payment for ecosystem services scheme, (vii) effects of mode of payment on the effectiveness of payment for ecosystem services scheme.

4.2 Personal Characteristics of the Household Heads Living in the Watershed

The characteristics of the respondents interviewed have been organized in four categories namely age, gender, marital status, level of formal education, level of professional training and employment status. This form of categorization of respondents was envisaged to generate responses which are representative of the general view of the household members in Nyandarua County where the research was conducted.

4.2.1 Age of the Household Heads

The household heads were asked to state the year they were born and the number of years was calculated from the information. The frequency distribution and the descriptive statistics of the respondents are given in Table 4.1.

Table 4.1: Age Distribution of the Respondents

Age Categories in Years	Frequency	Percent
Below 25	12	4.6
26-35	32	12.3
36-45	53	20.4
46-55	88	33.9
Above 56	75	28.8
Total	**260**	**100.0**

Mean 48±.76, median 49, mode 55, std. dev 12, minimum 23, maximum 71

The majority (62.7 %) of the farmers in the upper catchment of the Malewa River were above 46 years of age. A chi-square test for equality of categories of the age groups was conducted and the results are shown in Table 4.2

Table 4.2 Chi-square test for Equality of Categories for the Age Groups

Age in Years	Observed N	Expected N	Residual	Statistics
Below 25	12	43.3	-31.3	χ^2 =136.27
26-35	32	43.3	-11.3	df=5
36-45	53	43.3	9.7	p<.001
46-55	87	43.3	43.7	
Above 56	75	43.3	31.7	
44.00	1	43.3	-42.3	
Total	**260**			

The chi-square test revealed a statistical (p <.001) significant differences among the different household head age categories. The category with 46 to 55 years was significantly (χ^2=136.27, df=5, p < .001) higher than the other categories, indicating that the majority of the household heads within the river Malewa catchment were from this category.

4.2.2 Gender of the Respondents

The sex of the respondent was noted during the interview and was recorded and the information was analysed and is presented in Table 4.2.

Table 4.2: Sex of the Household Heads

Gender of Household Heads	Frequency	Percent
Male headed households	147	56.5
Female headed households	113	43.5
Total	**260**	**100.0**

The majority (56.5 %) of the household in the Malewa river catchment were headed by men. The female headed households were 43.5 %, this figure was found to be significant and was attributed to existing population structure in the study area. This implies that the PES scheme gave an equal chance of participation of both genders in the program.

4.2.3 Level of Formal Education

The household heads were asked to state the highest level of formal education they had attained. The data was then analysed and the frequency distribution is given in Table 4.3.

Table 4.3: Household head Level of Formal education

Level of Formal Education	Frequency	Percent
Primary	145	55.8
Secondary	92	35.4
Certificate	14	5.4
Diploma	6	2.3
Degree	3	1.2
Total	**260**	**100.0**

The majority (55.8 %) of the household heads had attained the primary level. The respondents that had gone above the level of secondary school were 8.9 %. The influence of free primary education was evident.

4.2.4 Occupation of Household Heads

The respondents were asked to state the occupation they were engaged in for their livelihood. The information was analysed and is presented in the form of frequency distribution in a multiple response Table 4.4.

Table 4.4: Occupation of the Household Heads
(Multiple Response Table)

Occupation	Frequency	Percent
Farmer	246	94.6
Business	38	14.6
Teacher	9	3.5
Public Administrator	7	2.7

The household heads in the study area were engaged in four different types of occupation. The majority (94.6 %) of the respondents were dependent on farming as livelihood, while 14.6 % were engaged in business and farming.

4.3 Farming System in the Upper Catchment Areas of River Malewa

The farming system in the upper catchment areas of river Malewa were discussed under the following sub-topics: area of watershed covered by the study, years lived in the watershed, land size owned, land use type, duration in PES scheme and importance of land tenure.

4.3.1 Area of Watershed Covered by the Study

The area covered by the study were upper Turasha, Kianjogu, Wanjohi and the frequency distribution for each area was determined and presented in Table 4.5.

Table 4.5: Area of the Watershed Covered by the Survey

Area	Frequency	Percent
Upper Turasha	119	45.7
Kianjogu	71	27.3
Wanjohi	70	27.0
Total	**260**	**100.0**

The majority (45.7 %) of the households were found in the Upper Tarasha area, while the remaining was in Kianjogu and Wanjohi. This was attributed to higher target population of farmers in Upper Turasha who have implemented PES scheme since inception because Upper Turasha was the pilot study site before it was up scaled to other areas of Kianjogu and Wanjohi.

4.3.2 Number of Years Lived in the Watershed

The number of years the members of the family had lived in the river Malewa Catchment was determined from the interviews. The data was then analysed and put into categories, as follows: less than 10 years, 11-20 years, 21-30 years, 31-40 years

and above 41 years. The frequency distribution and the descriptive statistics are given in Table 4.6.

Table 4.6: Number of Years Lived by Household Head in the Watershed

Number of Years	Frequency	Percent
Less than 10years	30	11.5
11-20 years	54	20.8
21-30 years	48	18.5
31-40 years	53	20.4
More than 41 years	75	28.8
Total	**260**	**100.0**

Mean 28±.80, median 31, mode 42, std. dev 12.9, minimum 5, and maximum 46

The average number of years the households had lived in the watershed was 28 years and ranged between 5 and 46 years. 88.5% of the respondents have lived in the study area beyond program implementation time frame. This is important in witnessing the changes that have occurred since the inception of the PES program.

4.3.3 Land Size Owned by the Households within River Malewa Catchment

The size of land owned by the households within the watershed was determined by asking the household heads to state the maximum land size they owned within the river Malewa watersheds. The data was then grouped into six (6) categories and the descriptive statistics and frequency distributions were determined and are given in Table 4.7.

Table 4.7: Land Size Owned by Households in Acres

Area in Acres	Frequency	Percent
less than 1	71	27.3
1-3	127	48.8
4-6	37	14.2
7-9	16	6.2
10-13	7	2.7
More than 14	2	.8
Total	**260**	**100.0**

Mean 2.8±.17, Median 2, mode 3, Std. dev 2.84, minimum .14, maximum 15

The average land size owned by the households within the upper catchment of river Malewa was 2.8 Acres with a standard deviation of 2.84 acres. This could be attributed to land subdivision due to increase in population in the study area over time owing to perceived high productivity of land due to close proximity to the Aberdare forest. As the land size decreases the pressure on land to provide livelihood increases and thus contributing to degradation and thus the reason for the choice of site for PES implementation as hot spot.

4.3.4 Duration Households were in PES Scheme Membership

The length of time households were in PES scheme membership was calculated from the year they joined the scheme. The descriptive statistics and the frequency distribution are shown in Table 4.8

Table 4.8: Years Households were Members of the PES Program

Years in Programme	Frequency	Percent
Less than 1 years	51	19.6
1-3 years	89	34.2
4-6 years	55	21.2
More than 7 years	65	25.0
Total	**260**	**100.0**

Mean 4.3±.18, median 3, mode 3, std. dev 2.6, minimum .50, maximum 10

The average duration the households had been members of the PES scheme was 4.3 years. The households that had been members of the PES scheme for more than 3 years were 46.2 % while 53.8% have been members for less than 3 years. This implies that the interest to join the PES Scheme has been growing over the years and this could be attributed to benefits gained through the program.

4.3.5 Importance of Land Tenure

The household heads were asked to state how they perceived the importance of land tenure to the success of the PES scheme and their responses and frequency distribution are shown in Table 4.9

Table 4.9: Importance of Land Tenure to the Functioning of PES Scheme

Importance	Frequency	Percent
Not important at all	6	2.3
Small extent	25	9.6
Moderate extent	46	17.7
High extent	82	31.5
Very high extent	101	38.8
Total	**260**	**100.0**

The majority (70.3%) of the household perceived that the land tenure's importance to the PES scheme was between high and very high. This due to the fact that, the scheme required one to have a legal document showing ownership of the land in order to participate in the scheme.

4.4 Effectiveness of Payment for Ecosystem Services Scheme in the Upper Catchment of River Malewa.

The dependent variable for this study was Effectiveness of Payment for Ecosystem Services (EPES) scheme in the upper catchment of river Malewa. The variable measured level of effectiveness of EPES scheme to households within the

river Malewa catchment and it was operationalized as an index which included three domains; improvement of the peoples livelihood due to payments made to the households, level of use of soil and water conservation practices (SWCP) within the catchment, a signed agreement accepting to maintain and sustain the developed SWCP.

The indicators for the first domain, improvement of people's livelihood were improved food security, improvement in the livelihood undertaken by the household. The two indicators were measured using a 5-point rating scale with the score of 1 being the lowest and the score of 5 being the highest.

The second dimension level of use of soil and water conservation practices had fifteen (15) indicators. These were the different SWCP undertaken by individual households on their farms, these were: (i) minimum tillage, (ii) use of mulch, (iii) contour planting of crops, (iv) planting of grass strips along the contours, (v) terracing, (vi) making contours within the farm, (vii) agroforestry, (viii) re-vegetation (planting grass and trees), (xi) managing the grazing animal and pastures (grazing management), (x) use of cover crops, (xi) river bank protection and riparian rehabilitation, (xii) cut off drains, (xiii) water storage (reservoirs, dams), (xiv) earth bunds, and (xv) check dams. This dimension was assessed on a 5-point scale to indicate the level of use of the practice, where 1 was Very low extent, 2 was Low extent, 3 was Moderate extent, 4 was High extent and 5 was very high extent.

The third dimension, signed agreement was measured as a dummy variable or a 0, 1 variable. The scores were then summed up to form the index of EPES and the descriptive statistics for all the indicators were calculated and presented in Table 4.10.

Table 4.10: Descriptive Statistics for the Indicators Forming the Effectiveness of PES scheme

Indicators	Mean	Median	Mode	Std dev	Range
Minimum tillage	4.18	4.00	5.00	.954	4
Mulching	4.28	4.00	4.00	.711	4
Contour planting	4.08	4.00	4.00	.692	4
Gras strips	3.44	4.00	4.00	.568	4
Terracing	3.95	4.00	4.00	.829	4
Contours	3.93	4.00	4.00	.872	4
Agroforestry	3.75	4.00	4.00	.129	4
Re-vegetation	4.11	4.00	4.00	.853	4
Grazing management	3.98	4.00	4.00	.807	4
Cover crops	3.228	4.00	4.00	.934	4
River bank protection	4.28	4.00	4.00	.711	4
Cut off drains	4.08	4.00	4.00	.692	4
Reservoirs /dams	3.83	4.00	4.00	.777	4
Check dams	3.66	4.00	4.00	.872	4
Earth bunds	3.33	4.00	4.00	.672	4
SWCP	**4.03**	**4.06**	**4.06**	**.444**	**3.50**
Improved livelihood	4.24	4.00	5.00	.846	4.00
Improved Food security	4.35	4.00	5.00	.718	4
Improved life style	**4.30**	**4.50**	**4.00**	**.632**	**3**
EPES	**4.13**	**4.12**	**3.88**	**.406**	**1.96**

The index of effectiveness of payment for environmental services was then categorized into five groups, as follows: 0-1 very low, 1.01-2 low, 2.01-3 moderate, 3.01-4 high, and 4.01-5 very high. The descriptive statistics and the frequency distribution for the index in five categories are shown in Table 4.11.

Table 4.11: Descriptive Statistics and the Frequency Distribution for the EPES Index

Categories	Frequency	Percent
2.01-3 Moderate	3	1.2
3.01-4 High	102	39.2
4.01-5 Very High	155	59.6
Total	260	100.0

Mean 4.1±.02, median 4.1, mode 3.88, std. dev .406, minimum 2.96, maximum 4.92

The majority (59.6%) of the households had very high levels of EPES. The mean of the index was 4.1 (very high level). This frequency distribution was found to be statistically significant as shown in Table 4.12.

Table 4.12: Chi-square test for the Equality of Categories for the Household Level of EPES

	Observed N	Expected N	Residual	Statistics
2.01-3 Moderate	3	86.7	-83.7	χ^2=137.36
3.01-4 High	102	86.7	15.3	df=2
4.01-5 Very High	155	86.7	68.3	p<.001
Total	260			

The chi-square test revealed statistical ($p < .001$) significant differences among the different categories of household level of EPES. The category of very high (4.01-5) was significantly (χ^2=137.36, $df = 2$, $p < .001$) higher than the other categories, indicating that the majority of the households had a very high level of effectiveness of payment for environmental services in the river Malewa watershed. The payment of ecosystem services scheme in the upper catchment of river Malewa was very effective as a conservation tool.

4.5 Effects of Socioeconomic Characteristics of the Farmers on the Effectiveness of Payment for Ecosystem Services Scheme in the Upper Catchment Areas of River Malewa

The second objective of this study was to determine the effects of farmer's socioeconomic characteristic on the effectiveness of payment for ecosystem services scheme in the upper catchment of river Malewa. Four socioeconomic characteristics of the farmers, which were considered important to the functioning of PES scheme were selected for this assessment. The selected socioeconomic characteristics included the following: age of the household head, sex of the household head, size of the farm, and land tenure. These variables are described in section 4.2 of this thesis.

4.5.1 Effect of Age, Land Size and Land Tenure on the Effectiveness of PES

The three independent variables: age, land size owned and land tenure are discussed in section 4.3 of this thesis.

The influence of age, land size owned and land tenure (independent variables) on the effectiveness of PES scheme (dependent variable) was determined by use of multiple linear regression. The results of the regression model are presented in Table 4.13

Table 4.13: Regression Model Summary for Age, Land Size and Land Tenure and the Effectiveness of PES scheme

R	R Square	Adjusted R Square	Std. Error of the Estimate
.433	.187	.104	.386

Predictors (constant) Age, land size, land tenure
Dependent: Effectiveness of PES scheme

The model indicates an adjusted R^2 value of .104; this means that the independent variables age, land size owned and land tenure explained approximately

negative 10% of the variation in the dependent variable effectiveness of PES scheme, which was low. The F test for the regression model is shown in the ANOVA Table 4.14.

Table 4.14: ANOVA Table for the Regression Testing the Fit of the Model

	Sum of Squares	df	Mean Square	F	p
Regression	4.448	3	1.483	9.919	.001
Residual	38.264	256	.149		
Total	42.711	259			

The overall regression model was found to be significant (F (3, 256) = 9.91, p<.001). The regression coefficients of the model showing the beta, t statistics and the collinearity statics are shown in Table 4.15.

Table 4.15: Regression Coefficients for Age, Land Size owned, Land tenure and Effectiveness of PES Scheme

	Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics
	B	Std. Error	Beta	t	p.	VIF
(Constant)	3.531	.135		26.103	.000	
Age	.003	.002	.105	1.683	.225	
Land size	.009	.009	-.060	-.985	.492	
Land tenure	.118	.022	.313	5.273	.001	1.004

The regression analysis shows that two (age and land size) of the three independent variables had no significant effect on the level of effectiveness in PES scheme within the upper catchment of river Malewa, while land tenure was statistically significant. The results indicate that age (β= 105, t= 1.683, p = .225), land size (β= -.060, t= -.985, p = .492) non-significant effect on effectiveness of PES scheme. Land tenure indicated a (β= 313, t= 5.273, p < .001) significant effect on the

effectiveness of PES scheme, this could be attributed to the fact that land tenure was a mandatory requirement for the household participation in PES scheme.

4.5.2 Determination of the Influence of Farmers Sex on Effectiveness of PES Scheme

The data was analysed to determine the means of male and female headed household's effectiveness of PES scheme in the upper catchment of river Malewa and the results are shown in Table 4.16.

Table 4.16: Means of Male and Female Headed Households Effectiveness of PES Scheme

Sex	n	Mean	Std. Deviation	Std. Error Mean
Male	147	4.149	.413	.034
Female	113	4.126	.397	.037

The mean of household effectiveness of PES scheme for the male headed households was higher (4.14) than for the female headed households (4.12). The t-test for the distribution of the households and the *Levene's Test* for Equality of Variances are shown in Table 4.17

Table 4.17: Mean Comparison between the Male and Female Headed Households

	Levene's Test		*t*-test for Equality of Means			
	F	*p*	*t*	*df*	*p*	*Difference*
Equal variances assumed	.485	.487	.456	258	.649	-.0231
Equal variances not assumed			.458	245.45	.647	-.0231

The effectiveness of PES scheme for both the male and female headed households was statistically (t=.456, df= 258, p=.647) not different from each other.

This means that the effectiveness of PES scheme was not influenced by the sex of the household head.

4.6 Effects of Type of Land Use on the Effectiveness of Payment for Ecosystem Services in the Upper Catchment Areas of River Malewa

The third objective of the study was to evaluate the effects of land use types on the effectiveness of payment for ecosystem services. There were three land use types: (i) agro-pastoralism this was a type of mixed farming, where the farmers kept livestock and planted crops, (ii) arable farming, where the farmers planted crops only and (iii) livestock farmers who kept livestock only.

4.6.1 Comparison of the Effects of Land Use Types on the Effectiveness of PES Scheme

The effectiveness for PES scheme was analysed in relation to the land use types practiced within the river Malewa catchment (agro-pastoralism, crop farming, and livestock farming). The analysis was done to determine which of the three land use types in the catchment had the highest mean in terms of the effectiveness of PES. An ANOVA was conducted to compare the means of the three land use types. The descriptive statistics (means, standard deviation, standard error and minimum and maximum values) of the three land use types are shown in Table 4.18.

Table 4.18: Descriptive Statistics for Effectiveness of PES for the Land Use Types

Livelihoods	n	Mean	Std. Dev.	Std. Error	Min	Max
Agro-pastoralism	54	4.68	.121	.016	4.50	4.92
Crop farming	142	4.15	.195	.016	3.83	4.77
Livestock farming	63	3.63	.255	.032	2.96	3.88
Total	259	4.14	4.06	.025	2.96	4.92

n=number of samples, std. dev =standard deviation, min =minimum, max =maximum

The results (Table 4.18) for the three land use types indicate that Agro-pastoralism had the highest mean, followed by crop farming and finally livestock farming. The main purpose of running the one-way ANOVA was to establish whether there were any statistically significant differences on the dependent variable (Effectiveness of PES scheme) among the three independent variables (agro-pastoralism, crop farming, and livestock farming). The research question that was addressed was whether the independent variables were significantly different statistically. The result of the one-way ANOVA for the mean comparisons is shown in Table 4.19.

Table 4.19: ANOVA Table for Mean Comparisons Showing the F-test

	Sum of Squares	*df*	*Mean Square*	*F*	*p*
Between Groups	32.387	2	16.193	404.73	.001
Within Groups	10.243	256	.040		
Total	42.629	258			

The *F*-test (Table 4.19) results indicate that there was a statistically significant difference in effectiveness of PES scheme for the three land use types, $F(2, 256) = 404.73$, $p < .001$). We can therefore conclude that statistically significant differences do exist in the Effectiveness of PES for the three different land use types (agro-pastoralism, crop farming, and livestock farming) in households found in river Malewa catchment

A post hoc test was then conducted to determine the means that were statistically significant from the others. Post hoc analysis was performed using Bonferroni post hoc tests. The comparison of the mean pairs for agro-pastoralism (I) and crop farming (J) and livestock farming (J) the 95 % confidence interval for the

difference between group I and J, statistical significance value (*p* value) and standard error are are shown in Table 4.20.

Table 4.20: Pairwise Comparisons

(I) Main source of livelihood	(J) Main source of livelihood (I-J)	Mean Difference (I-J)	Std. Error	p	95% Confidence Interval	
					Lower Bound	Upper Bound
Agro-pastoralism	crop	.525	.031	.001	.449	.600
	livestock	1.05	.037	.001	.966	1.14

The mean comparison results for the mean pairs in Table 4.20, indicate that effectiveness of PES for the crop farming and livestock farming were statistically significantly lower than for agro-pastoralism.

In comparing the mean differences for the crop farming and livestock farming, the agro-pastoralism land use type had significantly higher mean differences .525 (95% CI, .449 to .600), $p < .001$ than the crop farming and 1.05 (95% CI, .966 to 1.14), $p < .001$ for livestock farming. This implies that diversification of the land use types enhances the effectiveness of PES among the households.

4.7 Effects of Farmers Capacity Building on the Effectiveness of Payment for Ecosystem Services in the Upper Catchment Areas of River Malewa

The fourth objective of this study was to assess the effect of farmer's capacity building on the effectiveness of payment for ecosystem services scheme in the upper catchment of River Malewa.

4.7.1 Farmers Capacity Building for Payment for Ecosystem Services

Capacity building for payment for ecosystem services was an independent variable that was defined as a process by which individual farmers and households obtained, improved and retained skills, knowledge, tools, equipment and other resources needed to perform land management practices well. The households with higher capacity were expected to perform their land management practices at greater capacity causing a higher impact of the PES scheme. The capacity building involved training of households, making resources available to the households, and assisting in access to knowledge on ecosystem management.

The farmers level of capacity building in the river Malewa catchment was developed by the ten (10) different agencies, which included: Kenya Forest Service, Religious organizations, elected leaders, county government administrators, Ministry of Agriculture, local community leaders, civil society organizations, water resources user association, Water Resource Authority and extension officers. The level of their capacity building offered to the households was rated using a 5-point scale with 1 being low and 5 very high, the results are shown in Table 4.21.

Table 4.21: Rating of Level of Capacity Building by Different Organizations in the Upper River Malewa Catchment

	Rating by Household heads	
Organizations Providing Capacity Building	**Mean**	**Range**
Kenya Forest Service (KFS)	2.52	4
Religious Organizations	2.26	
Elected Leaders	2.73	
County Government Administrators	3.81	
Ministry of Agriculture	3.13	
Local Community Leaders	4.32	
Civil Society Organizations	4.13	
Water Resource User Association (WRUA)	3.91	
Water Resource Authority (WRA)	3.83	
Extension Officers	3.80	

n= 260

The variable capacity building was operationalized as an index that involved three main domains; training, resource provision and access to knowledge. These three domains had fifteen indicators as follows: land use practices, river bank protection, conservation, rights on services, changing culture, land use changes, effects of chemicals, clean environments, tree establishment, choice of environment friendly crops, riverine protection, water quality monitoring, alternative livelihoods, soil conservation, farm products, and natural resource conservation.

The household heads assessed the influence of the fifteen indicators on a 5-point scale as follows: 1= Very Low, 2= Low, 3= Moderate, 4= High, and 5= Very High. The scores were then summed up to create an index of the farmer's level of capacity building at the household level. The descriptive statistics, frequency distribution of the index of household level of capacity building is as shown in Table 4.22.

Table 4.22: Descriptive Statistics and Frequency Distribution for the Index of Farmers level of Capacity Building

Categories	Frequency	Percent
2.01-3	3	1.2
3.01-4	83	31.9
4.01-5	174	66.9
Total	260	100.0

Mean 4.13±.019, median 4.12, mode 4, std. dev .316, min. 2.88, max. 4.88

The resulting index of farmer's level of capacity building within the upper river Malewa catchment had a mean of 4.13 and a standard deviation of .316. The majority (66.9 %) of the farmers had an index of between 4.01 and 5, which was Very high. This is possible due to high number of organizations involved in developing

farmer's capacity building and the importance of this catchment to Lake Naivasha. This index was then used as the independent variable for subsequent analysis.

4.7.2 Assessing the Effect of Farmers Level of Capacity Building on the Effectiveness of PES scheme within river Malewa Catchment

The effect of farmer's level of capacity building on the effectiveness of the PES scheme within the river Malewa catchment was assessed using simple linear regression. The independent variable was the index of farmers level of capacity building at the household level and the dependent variable was the effectiveness of PES scheme. The results of the regression model are presented in Table 4.23.

Table 4.23: Regression Model Summary for Farmers Capacity Building and Effectiveness of PES scheme

R	R Square	Adjusted R Square	Std. Error of the Estimate
.430[a]	.185	.182	.36728

The model indicates an adjusted R^2 value of 0.182; this means that the independent variable farmer's capacity building explained approximately 18% of the variation in dependent variable effectiveness of PES scheme. The F test for the regression model is shown in Table 4.24.

Table 4.24: ANOVA Table for the Regression Testing the Fit of the Model

	Sum of Squares	*df*	*Mean Square*	*F*	*p.*
Regression	7.909	1	7.909	58.633	.001
Residual	34.802	258	.135		
Total	42.711	259			

Dependent Variable: effectiveness of PES scheme-average
Predictors: (Constant), capacity building

The overall regression model was found to be significant (F (1, 258) =58.63, p <. 001). The regression coefficient of the model showing the *beta, t* statistics and the collinearity statistics is shown in Table 4.25.

Table 4.25: Regression Coefficients for Farmers Capacity Building and Effectiveness of PES Scheme

	Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics
	B	*Std. Error*	*Beta*	*t*	*p*	*VIF*
(Constant)	2.518	.213		11.827	.000	
Capacity building	.389	.051	.430	7.657	.001	1.000

The regression analysis shows that farmers capacity building has positive significant effect (β=.430, t=7.657, p<.001) on the effectiveness of PES scheme in the upper river Malewa catchment. This indicates that as the farmer's capacity building is enhanced it increases the effectiveness of PES scheme.

4.8 Effects of Mode of Payment on the Effectiveness of Payment for Ecosystem Services Scheme in the Upper Catchment Areas of River Malewa

The fifth objective of this study was to evaluate the mode of payment on the effectiveness of ecosystem services scheme in the upper catchment of river Malewa.

4.8.1 Mode of Payment for Ecosystem Services

The mode of payment for ecosystem services to farmers in the watershed was an independent variable that dealt with the payment package to the farmers participating in the PES scheme. The mode of payment for ecosystem services was operationalized as an index that involved indicators related to the positive aspects of the way payments are made to farmers to encourage them to effectively participate in the scheme, these included: (i) payment in cash, (ii) cost-sharing for services, (iii)

uniformity of payments, (iv) payment at individual level, (v) payments in kind, (vi) timely payments, and (vii) voucher payments. The farmers were asked to assess these indicators on a 5-point scale with 1 being rated as low level and 5 as high level. These ratings were then added together to form the index of farmer's mode of payment. The descriptive statistics and the frequency distribution of the index are shown in Table 4.26.

Table 4.26: Descriptive Statistics and the Frequency Distributions of the Farmers Index for the Level of mode of Payment for Ecosystem Services

Categories	Frequency	Percent
1-2	5	1.9
2.01-3	58	22.3
3.01- 4	147	56.5
4.01-5	50	19.2
Total	260	100.0

Mean 3.49±.039, median 3.57, mode 3.42, Std. dev .633, min 1.85, max 5.

The majority (56.5%) of the farmers had a level of mode of payment for ecosystem services of between 3.01 and 4.

4.8.2 Evaluation of the Effects of Mode of Payment for Ecosystem Services and the Effectiveness of PES in the River Malewa Catchment

The evaluation of the effects of mode of payment for ecosystem services on the effectiveness for the PES scheme was accomplished using simple linear regression. The independent variable was the index for mode of payment for environmental services and the dependent variable was the effectiveness of PES scheme. The results of the regression model are presented in Table 4.26.

Table 4.26: Regression Model Summary for Farmers Mode of Payment for Ecosystem Services and the Effectiveness of the PES Scheme

R	R Square	Adjusted R Square	Std. Error of the Estimate
.494[a]	.244	.241	.35370

The model indicates an adjusted R^2 value of 0.241, this means that the independent variable which is farmer's mode of payment for ecosystem services explained approximately 24% of the variation in dependent variable effectiveness of PES scheme. The F test for the regression model is shown in Table 4.27.

Table 4. 27: ANOVA Table for the Regression Testing the Fit of the Model

	Sum of Squares	df	Mean Square	F	p.
Regression	10.435	1	10.435	83.414	.001
Residual	32.276	258	.125		
Total	42.711	259			

Dependent Variable: effectiveness of PES scheme
Predictors: (Constant), mode of payment for ecosystem services

The overall regression model was found to be significant (F (1, 258) =83.41, p <. 001). The regression coefficient of the model showing the *beta*, *t* statistics and the collinearity statistics is shown in Table 4.28.

Table 4.28: Regression Coefficients for Mode of Payment for Ecosystem Services and the Effectiveness of the PES scheme

	Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics
	B	Std. Error	Beta	t	p	VIF
(Constant)	2.681	.161		16.627	.001	
Mode of payment	.389	.043	.494	9.133	.001	1.000

The regression analysis shows that the mode of payment for the environmental services has positive significant influence (β=.494, t=9.133, p<.001) on the level of effectiveness of PES scheme within the upper catchment of the river Malewa. This indicates that positive mode of payment for environmental services increase the effectiveness of PES scheme.

CHAPTER FIVE

DISCUSSIONS, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter presents the summary of the findings, their discussion, conclusions and recommendations.

5.2 Summary of the Study

This study aimed at assessing the factors affecting the effectiveness of payment for environmental services in the upper catchment of the river Malewa. The study specifically examined four factors that affect the PES scheme, these included: socioeconomic factors (age, sex, land size and land tenure), land use types (agro-pastoralism, crop farming and livestock farming), capacity building, and mode of payment for ecosystem services.

In achieving these objectives, the study used primary data which was collected using a structured questionnaire that was organized according to the key thematic areas corresponding to specific objectives of the study such as general information; socio-economic factors; capacity building of the farmer; land use types undertaken by the households and mode of payment for the ecosystem services. The study then utilized descriptive statistics and inferential statistics to analyse the data.

The results showed that socio-economic factors (age, sex, and land size) did not significantly affect the effectiveness of PES scheme, while land tenure did significantly affect it.

The following factors: land use types, capacity building and mode of payment for ecosystem services had significant effect on the effectiveness of PES scheme.

5.3 Discussion

The study findings for this study are discussed based on the specific objectives stated in section 1.4 of this thesis.

5.3.1 Effect of Household Socio-economic Factors on the Effectiveness of Payment for Ecosystem Services Scheme within the River Malewa Catchment

Socio economic factors (sex, age and land size) were found not to significantly affect the effectiveness of PES scheme. This could be attributed to the fact that every land users despite their age, sex and lands size value increased and sustained agricultural production for improved livelihoods which was achieved by intensification of agricultural production through implementation of sustainable practices for continued improvement and diversification of agricultural production which can help strengthening resilience to changes (be it induced by climate, markets or policies) and diversify livelihood sources. All the farmers in the study site were facing land degradation and therefore irrespective of age, sex and land size the need to improve land productivity were critical and this explains the insignificance. These results corroborate with study findings of Nyongesa et al. (2016) on socio-economic factors influencing farmer's WTA to provide ecosystem services. Similarly Napier (2001) in his study found no significance relationship between land size and adoption of soil conservation practices.

Land tenure on the other hand had significant effect on the effectiveness of PES scheme. The research findings corroborate with Lin et al. (2012) and Schomers

et al. (2013) who have widely acknowledged the importance of property rights (i.e. their distribution, allocation, and social embeddedness) for PES effectiveness. Secure tenure rights allow the farmer to use it to invest in the land or using it as collateral for credit (Ibid). The research findings also agrees with OECD (2010) set out criteria that is essential to enhancing PES effectiveness which is clearly defined property rights and one of the ideal conditions for PES to flourish identified by the Forest Trends, the Katoomba Group, and UNEP (2008) which include clear resource/land tenure. Clear resource tenure ensures that the supplier has control over the area where the PES agreement is being implemented and this assures the buyer that the contract provisions of the deal are secure. Land tenure is important because it defines the enforceable property rights over the land under the PES scheme and thus influences land use decisions which affect the provisions of ecosystem services. Ownership of land creates emotional link and willingness to invest and maintain the status of land for current and future generation. This explain the significant effect of land tenure on EPES because a land user with secure land tenure would be willing to invest on land use practices that secure future productivity of land.

Several studies have established that defined property rights(ownership and /or use rights) to land in PES schemes provides confidence that those receiving payments have the right to engage in the prescribed land-use practices which are set as conditions in the contracts. A secured property right ensures that the actual owners of the land are the ones who are compensated. Property rights also play a crucial role in defining who holds the respective rights over ecosystem services, or the land and the natural resources which the services relate to and therefore can sell the specific ecosystem service. Only actors with the appropriate property rights will be able to

fulfill the obligations of and become a party to a PES contract (Wunder, 2013). With secure land tenure, the land user and buyer of ES are assured of reaping both short and long term benefits of land use practices implemented. Therefore the land user will be willing to continue implementing land use practices that provides the benefits and this in turn leads to sustainability of the program.

Watershed ecosystem services are linked to land use/management. Therefore, the buyer (downstream users) assumes that the services will result from particular land management practices and will in fact, pay directly for land management, not for service provision. Therefore property rights are important if the objective of a PES contract is a land management practice and not an ecosystem service itself (Geiber, 2009). This implies that the required management practice (action or omission) will take place on a piece of land to which the seller has to have appropriate property rights in order to legally fulfill the obligations of the contract (Wunder, 2013).

The study findings are in agreement with Coase theorem (Coase, 1960), which states that if the private property rights are clearly defined by enforceable contracts, then the providers of the ecosystem service and the beneficiaries of an externality can, through negotiations or bargaining, potentially reach an agreement that maximizes social welfare or is socially efficient in terms of adequate allocation of environmental resources. This is possible regardless of the initial allocation of property rights over assets (Muradian et al., 2010). The theorem proposes that in the case of environmental problems, as long as transaction costs are low enough and property rights clearly defined, then individuals, communities and national entities would trade their rights

away until a Pareto-efficient provision of environmental goods and services has been achieved (Muradian et al., 2010).

According to Muradian et al. (2010) property rights in the PES context is not limited to land ownership but also land use rights and rights to commercialize environmental services. In PES program therefore, service providers (land users) acquire contract obligations to undertake or maintain certain land use activities and as such buyers also get the right to trade in the services (Muradian et al., 2010). Therefore by making secure land tenure as conditionality for joining the scheme in the study area, it not only gave the right to upstream water users to sell ES to downstream users who are buyers but also the obligation to implement PES interventions.

5.3.2 Effect of Type of Land Use on Effectiveness of Payment for Ecosystem Services Scheme within the River Malewa Catchment

The diversified land use type (agro-pastoralism), which was a combination of livestock keeping and crop production was found to significantly affect the EPES than the other two land use types (crop production and livestock keeping). This is because diversification of land use type is important for the farmers in strengthening resilience to changes induced by climate, markets or policies. The significance is also attributed to compatibility of proposed land use practices under PES scheme with the farming system which combines livestock and crop production. Establishment of grass strip using napier grass (*Pennisetum purpureum*), cock's foot (*Dactylis glomerata*) and Elmba Rhodes grass (*Chloris gayana*) not only reduced runoff and erosion on steep slopes but also led to increase in fodder supply resulting in increased milk production. Fodder availability boosted livestock production while reduction of soil erosion and surface run-off improved soil fertility thus boosting crop production.

Research findings corroborate with study carried out by Nyongesa (2017) which established that fodder for livestock, soil retention, soil and water conservation were significant attributes that influenced choice of PES practice. This implies that every farmer is willing to undertake practices that increase yields and at the same time reduce land degradation. Planting native trees and high-yielding fruit trees and cover crops such as improved potato varieties, tree tomatoes and apples improved farm productivity through reduced runoff/erosion and brought in additional income. PES interventions enabled the farmers to achieve their main goal of food security and income (Nyongesa, 2017).

The significant effect of land use system on EPES is also attributed to the development of integrated crop /livestock / agroforestry system through PES scheme in the study site as this land management practices which created win-win-win solutions in that it aims at improving productivity (food, fodder, water quality and quantity), livelihood (income, food security and improved health) and ecosystems services (soil fertility, water quality and quantity and climate change resilience)

5.3.3 Effect of Famer Capacity Building on Environmental Practices on the Effectiveness of Payment for Ecosystem Services scheme

The majority of the farmers in the river Malewa catchment had very high levels of capacity building on environmental practices; this was due to the fact that the catchment had many organizations (Table 4.21) that were involved in capacity building of the households. Capacity building had significant effect on the EPES because capacity building provided not only increased awareness about the effects and consequences of sustainable soil conservation practices among farmers but

provided them with required knowledge and skills to implement PES interventions. This led to increase in quality of conservation actions and change in behaviour and thus achieving the desires program outcomes. The research finding is in agreement with TerrAfrica (2008 and 2009) that land users and communities are likely to invest in improving the land and its natural resources given good institutional support.

Training provided to farmers by several agencies (Ministry of Agriculture, Kenya Forest Service) through the PES scheme on issues such as: soil and water conservation techniques to boost farm productivity; use of improved fodder storage techniques; and use of new/higher-value crops such as improved potato varieties, tree tomatoes and apples boosted the implementation of the land use practices in the study site resulting in improved farm productivity and livelihood through additional income.

Effectiveness of the PES scheme in the study site was achieved because the land users were empowered since the program invested in training and building up of the capacity of land users and user groups (WRUAs). Multi-sectorial approaches used in the scheme contributed to the successful implementation of SLM practices because it brought together all the available knowledge and specialist in different disciplines, institutions and agencies including government, non-governmental and private sectors. The wide range of actors and institutions involved in the PES scheme in the study area enhanced implementation because they provided the required specialists and knowledge ranging from establishing an ecosystem services baseline, identifying appropriate land management interventions, negotiating, handling financial transactions, and undertaking monitoring, evaluation and review.

Several studies have established that schemes that supported feelings of relatedness may be more likely to crowd-in autonomous motivation by engaging with informal social networks (Gutiérrez et al., 2011) such as community organizations which in the study area were the WRUAs, with charismatic and popular leaders (Escobar et al., 2013), and leveraging cultural values (Atela et al., 2015). This enhances feelings of trust and reciprocity between communities and conservation organisations (Ezzine-de-Blas et al., 2015). This explains the significance of capacity building to effectiveness of PES in the study because the PES scheme was implemented through WRUAs as they are recognized legally (Water Act, 2016) and by the community and as such has fosters trust with conservation organizations and makes implementation of the scheme successful.

This is in agreement with previous studies that established that PES program success relies on establishing and maintaining functional institutional relationships (Ostrom, 2005), and strengthening institutional frameworks and ties (Legrand et al., 2013). Improved institutional coordination through the facilitation of WWF in this PES scheme facilitated and enhanced capacity building and technical assistance. Similarly several studies have emphasized on the importance of including intermediary partners to represent the local context and stakeholder views as their influence is substantial in causing decentralizing effect, in relation to local community oversight and fund disbursement. Intermediary partners can help reduce transaction costs, and supply expertise to draw-up contracts and monitor PES-related activities (Thuy et al., 2010; Huber- Stearns et al., 2013).

5.3.4 Effect of Mode of Payment for Environmental Services on the Effectiveness for Payment for Ecosystem Services Scheme

The mode of payment for the ecosystem services had a positive effect on the EPES. This could be attributed to the fact that the payment received was for a contract based on specific land management change which involves much less risk than a contract based on payments for ecosystem service such water purification, which might be affected not only by land-management changes but also by a drought or a major rainfall that could wash nutrients and soil into watercourses (FAO, 2007). Therefore, employing proxies for ecosystem service provision through land use interventions significantly reduce risk on the part of providers and thus enhance the effectiveness of the program in the study area.

In this study, the mode of payment was inform of voucher which is redeemed through purchases of agricultural inputs in selected agro-dealer shops and in kind payment which consisted of essential inputs such as seedlings, technical assistance, training and extension services. The agricultural inputs redeemed reduced the cost that the farmers would have incurred to purchase the inputs in the absence of the payment. On the other hand, the inputs provided by the program to the participants in form of fodder materials, agroforestry tree seedlings, technical support not only reduced the cost of implementation but enhanced their capacity to implement PES interventions thereby enhancing the level of effectiveness of the program in the study site. Research findings therefore are in agreement with several studies that have established that PES programs are more likely to fulfill their objectives when costs of operating and enrolling in a program are sufficiently covered; they are likely to achieve their objectives and thus become effective conservation tools (Alston et al., 2013; Torres et al., 2013).

To qualify for the payment, verification of farms to check implementation levels of soil conservation measures was done annually by PES coordinators, buyer and farmers. As such the scheme involved payments for land management changes that delivered indirectly but markedly positive impacts for water quantity, quality, and flow (Porras et al., 2008: 35). Management based PES is appropriate when the objective seeks to provide ES in bundles which ultimately increase the benefits (Kemkes et al., 2010).

The significance of mode of payment on effectiveness of the PES scheme in this study is also attributed to individual-level payments which have been found to stabilize conservation levels above critical thresholds by strengthening reciprocity-based behaviour, and thus crowding in pro-social dynamics (Narloch, 2011:121).

Even though Moxey and White (2014) have strongly emphasized that ideal PES system would be a result-based PES, where the payments relate to the achievement of a defined environmental result, this will not by itself address all the weaknesses of management-based PES such as spatial targeting, payment differentiation and monitoring. Result based PES may introduce insecurity for farmers since the ES outcome may occur at multiple scales, often higher than the farm (Rodriguez-Ortega et al., 2014) and a higher risk for the provider (farmers, in our case) because the ES generation is complex and not all influencing factors (such as weather) are under the control of farmers (Reed et al., 2014). This explains the significance of the mode of payment in this study which used management based PES.

5.4 Conclusions

The following conclusions were made from the study:

(i) The households within the upper catchment of river Malewa were found to have very high levels of Effectiveness for Payment of Ecosystem Services (EPES).

(ii) Socio-economic factors (age, sex, and land size) except land tenure had no statistical significant effect on the effectiveness of payment for Ecosystem services within the upper catchment of river Malewa.

(iii) Land use types (agro-pastoralism, crop farming and livestock keeping) undertaken by the farmers in the upper catchment of the river Malewa had statistical significant effect on the effectiveness of payment for Ecosystem services.

(iv) Farmer's capacity building on environmental practices was found to have a statistical significant effect on the effectiveness of payment for Ecosystem services scheme within the upper catchment of river Malewa.

(v) The mode of payment for environmental services was found to have a statistical significant effect on the effectiveness of payment for Ecosystem services within the upper catchment of the river Malewa.

5.5 Recommendations

Based on the study findings the researcher recommends

(i) Consideration of these factors (land use type, mode of payment, land tenure and capacity building) which affect the effectiveness of PES Scheme in the design and up scaling of such programs in future in Lake Naivasha Watershed and other areas.

(ii) Up-scaling of PES Scheme in Lake Naivasha Basin and integration of PES Concept in development of watershed conservation programs by the stakeholders implementing conservation programs within Lake Naivasha basin.

(iii) Appropriate and adequate capacity building of participants and non participants of PES Scheme to understand the benefits of sustainable land use practices as this would not only increase the adoption of sustainable land use practices but ensure sustainable provision of ecosystem services

(iv) Due to increase in a farm produce there is need to link farmers with markets for their produce so that they can get more income and this would motivate them to continue implementing sustainable land use practices and therefore enhancing sustainability.

(v) To widen financing options so as to accommodate more farmers interested in joining the scheme there is need to link PES scheme with REDD+ funding.

5.6 Recommendations for Further Research

The following are recommended to be done for further research within the upper catchment of the river Malewa:

(a). Determine the influence of female headed households on the management of the water resources of the river Malewa catchment.

(b). Using a developed WRUA capacity assessment tool to assess the institutional capacity of WRUAs and identify gaps for training to enhance WRUA capacity in water resource conservation.

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APPENDICES

Appendix A: Household Questionnaire

I am Eva Malel, a Master of Science student in Environment and Natural Resource Management at Africa Nazarene University. I am carrying out research as part of the requirement for the award of this degree. The topic of my study is **"Assessment of Factors Affecting the Effectiveness of Payment for Ecosystem Services Scheme in the Upper Catchment of River Malewa in Nyandarua County."** You are humbly requested to participate in this study by filling in the questionnaire below. Do not indicate your name or any identity anywhere in this questionnaire. Be assured that the study is purely academic and will not be used for any other purpose and confidentiality will be greatly upheld.

SECTION I: Background Information

Please put a "tick" in the boxes provided to indicate the most appropriate response for you in respect of the following:

1. Age in years: Under 25 [ ] 26-35 [ ] 36-45 [ ] 46-55 [ ] Above 56 [ ]

2. Gender: Male [ ] Female [ ]

3. Highest Level of education attained: Primary [ ] Secondary [ ] Certificate [ ] Diploma [ ] Degree[ ]

4. Which specific area to you stay or hail within the river Malewa upper-catchment? Kianjogu [ ] Wanjohi [ ] Upper Turasha [ ]

5. How long have you been living in this place?

Less than 10 years [ ] 11-20 years [ ] 21-30 years [ ] 31-40 years [ ] More than 40 years [ ]

6. What size of the land in acres do you have?

Less than 1acre [ ] 1-3acres [ ] 4-6 acres [ ] 7-9acres [ ] 10-13acres [ ] More than 14acres

7. Type of work you do in River Malewa upper-catchment: Teacher [ ] Business[ ] Farmer [ ] Public administrator [ ] Other (specify) [ ]

8. How long have you implemented PES program? Less than 1 year [ ] 1-3 years [ ] 4-6 years [ ] more than 7 years

SECTION II: Land use practices and effectiveness of payment for ecosystem services scheme

1. To what extent do you agree that the following are some of the factors that influence the implementation of PES scheme within River Malewa Catchment in Nyandarua. Please tick that best that describes your response

5 – Very high extent 4 – High extent, 3 – Some extent, 2- small extent, 1 – No extent at all

Items		**5**	**4**	**3**	**2**	**1**
1.	Nature of ownership and tenure of land					
2.	Size of land per individual owner					
3.	Type of activities done on land					
4.	Facilities and tools used in working on the land by owners					
5.	Land owners' education about environment					
6.	Level of poverty among the land owner					
7	Farm inputs(fertilizers, certified seeds, agrochemicals)					
8.	Conservation interest of the land owner					

2. To what extent do you agree that the following are some of the good land use practices that influence effectiveness of payment for ecosystem services scheme within River Malewa Upper-Catchment in Nyandarua? Please tick that best that describes your response

5 – Very high extent 4 – High extent, 3 – Some extent, 2- Small extent, 1 – No extent at all

Items		**5**	**4**	**3**	**2**	**1**
1.	Rehabilitation of the riparian lands					
2.	Grass-stripping					
3.	Terracing the riparian lands					
4.	Contour cropping					
5.	Undertaking agro-forestry on the farm					
6.	Use of certified Seed					
7	Crop rotation					
8	Reduced use of agro-chemicals and fertilizers in the farm					

3. Do you agree that following are some of bad land use practices that are a challenge/limit/hinder implementation of payment for ecosystem services scheme within river Malewa Upper-catchment? Please tick that best that describes your response

5 – Very High 4 – High, 3 – Moderate, 2- Low, 1 – Very Low

Items		**5**	**4**	**3**	**2**	**1**
1.	Having low number of trees on the farm					
2.	Having high number of animals on the farm					
3.	Cutting of trees along the banks of river					
4.	Lack of crop rotation					
5.	Cultivating along the river bank					
6.	Cutting away the native trees on the farm					
7	Un-controlled use of agro-chemicals on the farm					
8	Un controlled use of artificial fertilizers					
9	Leaving land without vegetation					

4. 4. To what extent do you agree that following are the specific challenges arising due to bad land use practices within the river Malewa Upper-catchment? Please tick that best that describes your response

5 – Very High 4 – High, 3 – Moderate, 2- Low, 1 – Very Low

Items		**5**	**4**	**3**	**2**	**1**
1.	Down-stream users will be getting polluted/dirty waters from River Malewa					
2.	There will be negative change in the bio-diversity level in the aquatic lives of river Malewa					
3.	Reduced Water volume in the river Malewa					
4.	The amount of food produced per acre will reduce					
5.	There will be a lot of soil erosion					
6.	There will be outbreak of pest and diseases					
7	I don't know anything that will happen					

SECTION III: Capacity building and Effectiveness of Payment for Ecosystem Services scheme

1. To what extent do you agree the following are effects of environmental education and capacity building on implementation of PES scheme within the river Malewa Upper-catchment? Please tick that best that describes your response.

5 – Very High 4 – High, 3 – Moderate, 2- Low, 1 – Very Low

Items		**5**	**4**	**3**	**2**	**1**
1.	Understanding appropriate land use practices for enhanced environmental conservation					
2.	Ability to use land properly along the banks of river Malewa					
3.	Having Skills and knowledge required to implement conservation measures					
4.	Good level of awareness of personal rights to claim clean environment among local residents					
5.	Changing culture in relation to land use practices along the banks of river Malewa					
6	Implementation of land use changes such as crop rotation, development of contours					
7	Understanding the effects of use of chemical and artificial fertilizers on environment					

2. To what extent do you agree that the following are the type of civic education and capacity building lessons local residents need in relation to boosting the effectiveness of payment for ecosystem services scheme within the river Malewa Upper-catchment? Please tick as appropriate.

   5 – Very High 4 – High, 3 – Moderate, 2- Low, 1 – Very Low

Items		5	4	3	2	1
1.	Rights of every person to clean environment					
2.	Education on tree establishment and management					
3.	Environment friendly crop and animal production techniques					
4.	Education on riverine protection					
5.	Education on water monitoring (quality & quantity)					
6.	Education on alternative sources of livelihoods					
7.	Education on soil conservation measures					
8	Education of farm products marketing and value addition					

3. To what extent do you agree that following is the preferred providers of civic education and capacity building lesson in relations to effectiveness of PES scheme due within the river Malewa Upper-catchment in Naivasha? Please tick that best that describes your response.

5 – Very High 4 – High, 3 – Moderate, 2- Low, 1 – Very Low

Items		5	4	3	2	1
1.	Kenya Forest Service					
2.	Religious organizations					
3.	Elected leaders					
4.	County government administrators					
5.	Ministry of Agriculture					
6.	Local Community leaders					
7	Civil Society Organizations e.g WWF, CARE,IMARISHA					
8	Water Resource User Associations					
9	Water Resource Authority					
10	Extension officers					

4. To what extent do you agree that the following is the right time for civic education and capacity building in order to increase effectiveness of PES scheme within the river Malewa Upper-catchment? Please tick that best that describes your response.

5 – Very High 4 – High, 3 – Moderate, 2- Low, 1 – Very Low

Items		5	4	3	2	1
1.	Continuous training program					
2.	Every three years					
3.	Every two years					
4.	Once a year					
5.	During the dry season					
6.	During the rainy season					
7	On need basis					
8	Before the start of the program					

5. How does the level of civic education and capacity building provided in PES scheme compare with those provided in other programs within the river Malewa Upper-catchment? Please tick that best that describes your response.

5 – Very High 4 – High, 3 – Moderate, 2- Low, 1 – Very Low

Items		5	4	3	2	1
1.	Don't compare					
2.	Averagely compare					
3.	Are the same					
4.	There is no capacity build on how to use the lands appropriately					
5.	Capacity building with river Malewa upper-catchment has changed the land use culture along river Malewa					

SECTION IV: The socio-economic characteristic and effectiveness of payment for ecosystem services scheme

1. To what extent do you agree that the following are the current social economic characteristics of the communities living within River Malewa Upper-catchment? Rate them as given below;

5 – Very High 4 – High, 3 – Moderate, 2- Low, 1 – Very Low

Items		5	4	3	2	1
1.	Livestock keepers					
2.	Peasant crop farmers					
3.	The middle class professionals (employed)					
4.	Mixed farmers(crop & animal production)					
5.	Business people					

2. To what extent do you agree that the following are the main social economic characteristics that undermine implementation of conservation measures for PES scheme within the river Malewa Upper-catchment? Please tick that best that describes your response.

5 – Very High 4 – High, 3 – Moderate, 2- Low, 1 – Very Low

Items		5	4	3	2	1
1.	Livestock keeping					
2.	Peasant crop farming					
3.	Commercial crop farming					
4.	Mixed farming (livestock& crop)					
5.	Horticultural commercial farming					
6.	Large scale animal and crop farming					
7.	Being Employed					
8.	Having a business beside farming					
9.	Lack of laborers					
10.	Lack of farm inputs					
11	Lack of conservation interest					
12	High cost of implementation of the conservation measures					
13	Lack of required skills and knowledge for implementation of conservation measures					

SECTION V: Mode of payment in relation to effectiveness of payment for ecosystem services scheme in River Malewa upper-Catchment

To what extent to you agree that the following are the best modes of payments in relation to effectiveness of PES scheme within the river Malewa Upper-catchment? Please tick that best that describes your response

5 – Very High 4 – High, 3 – Moderate, 2- Low, 1 – Very Low

Items		**5**	**4**	**3**	**2**	**1**
1.	The payments must be in form of cash money					
2.	The payments must be in form of cost-sharing					
3.	The payments must be uniform to all farmers					
4.	The payments must be negotiated at individual level based on implementation level					
5.	The payments must go beyond economic recognitions					
6.	The payments must be timely					
7	The payment must be in form of vouchers					

Thank you.

Appendix B: Interview Schedule for Key Informants

1) Land use Practices

a. Is the land that you are using freehold land?

b. Do you plant trees in addition to crops?

c. Is your land in good size enough for carrying out agricultural activities you want?

d. Do you carry out the planting of crops at the same time keeping of animals?

e. Do you leave some of your land to develop naturally?

2) Capacity Building

1. Do you have the necessary skills required for carrying out management and conservation of the environment?
2. Are you normally given the required training on regular basis on how to carry out farming practices which are in line with the conservation of the environment?
3. Do you have the required farm tools and equipment to be used in carrying out conservation practices?
4. Are you normally given farm inputs by supporting institutions so that whatever is planted in your farms aims at conservation of the environment?

3) Socio-Economic Characteristics

1. Do you rely mostly on farm produce for your basic income?
2. Is the size of your land big enough to allow for good agricultural practices without over-exhausting it?

3. If given a payment, will you be in a position to allow your land to be used in the conservation of the environment in whichever way it is thought to be applicable.

4) Effectiveness of PES Scheme

1. Do you think the payment for ecosystem scheme has been able to meet the expectations of the residents of River Malewa basin?

2. Are there any complaints from the residents regarding how the payment program is being carried out?

3. Since the payments began is the conservation practice among the local residents good enough to support availability of clean water in river malewa?

Thank you

Appendix C: ANU Letter of Ethics Approval

AFRICA NAZARENE
UNIVERSITY

12th June, 2018

RE: TO WHOM IT MAY CONCERN

Eva Chepkorir Malel 16SO1DMEV001 is a bonafide student at Africa Nazarene University. He/She has finished his/her course work and has defended his/her thesis proposal ***entitled "Assessment of factors `affecting the effectiveness of payment for ecosystem services scheme in river Malewa sub-catchment, Naivasha, Kenya.***

Any assistance accorded to him/her to facilitate data collection and finish his/her thesis is highly welcomed.

Prof. Rodney Reed
Deputy Vice Chancellor, Academic Affairs

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Appendix D: NACOSTI Research Permit

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: 240904

Date of Issue: 02/July/2020

RESEARCH LICENSE

This is to Certify that Ms.. Eva Chepkorir Malel of Africa Nazarene University, has been licensed to conduct research in Nyandarua on the topic: Assessment of Factors affecting effectiveness of Payment for Ecosystem Services In Upper Catchment of River Malewa in Nyandarua County, Kenya for the period ending : 02/July/2021.

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Appendix E: Field Photos

Small scale farms on steep slopes in the upper catchment of River Malewa. Photo: Eva 2019

A farm under PES Scheme with grass strip (Napier grass) for soil and water conservation with soil rod used to measure soil build up. Photo: Eva 2019