ASSESSING CONTRIBUTION OF CARBON MARKETS IN THE ENHANCEMENT OF CARBON SINKS AND COMMUNITY RESILIENCE TO CLIMATE CHANGE: A CASE OF KASIGAU REDD+ PROJECT, KENYA

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DECLARATION

This dissertation is my original work and has not been submitted for a degree course in any other university

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Abstract:

The services provided by ecosystems are critical in supporting humankind, and upon which all life depends. Over time, ecosystems have faced increasing degradation as a result of human activities. One of the major causes of degradation is lack of market value for ecosystem services. It is for this reason that carbon trading is emerging as a market based approach that translates external, non-market values of the environment into incentives to encourage continued provision of these ecosystem services by land owners and/or users. Carbon trading has attracted much interest in developing countries especially projects on Reducing Emissions from Deforestation and Forest Degradation (REDD+) and climate smart-agriculture. However, the contribution of carbon market to both conservation and livelihoods remains unclear.

This research evaluated the contribution of carbon markets through REDD+ to enhancement of carbon sinks, and community resilience to climate change, focusing on the Kasigau REDD+ project. Kasigau project was purposively selected since it is the only project at the time of the study that had received payments from the voluntary markets. Forests were used as a proxy for carbon sink, Carbon terrestrial sinks are seen as a low-cost option to fuel switching and reduced fossil fuel use for lowering atmospheric CO_2. this study used forests activities to create CO_2 offset credits a proxy. The objectives of the study were: 1) to assess the contribution of Carbon markets through REDD+ to the enhancement of carbon sinks, and 2) To assess the contribution of carbon markets to the enhancement of community resilience to climate change.

Geographical Information Systems (GIS) and remote sensing techniques were used to analyse forest cover change in the case study area, to ascertain whether the Kasigau REDD+ project had led to enhanced carbon sequestration by increasing forest cover in the project area. Forest cover

was used as a proxy measure of enhanced carbon sequestration as trees and hence forests are part of the natural carbon sinks. It was assumed that an increase in forest cover would lead to increase in carbon sequestration. Secondly, primary data analyzed to assess whether the Kasigau REDD+ project had led to an increase in income and hence enhanced resilience of households in the project area to climate change.

The main findings from this research are: 1) There has been an increase of about 40% in forest cover, hence carbon sinks, in the Kasigau project area that can be attributed to the Kasigau REDD+ project; 2) The Kasigau REDD+ project led to an increase in the household income reduced distances to social amenities such as schools and hospitals for households engaged in the project. These findings reveal that the Kasigau REDD+ project has had some other beneficial effects on the households engaged in the project. Further, this increased forest cover, hence carbon sinks in the project area can be attributed to the Kasigau REDD+ project. Thus it can be concluded that REDD+, if implemented at county level and national level, it can enhance household wealth and also contribute to environmental conservation.

This research recommends REDD+ as a win-win policy measure that could be adopted by both the National and County Governments as a measure to address deforestation and attain the ten percent forest cover provided for in the Constitution 2010. Further options of involving the private sector should be explored to increase their participation in the conservation sector. The study recommends further research on best benefit sharing options that would enable communities and participating stakeholders at the local level to maximize benefits coming from carbon markets as well as other multiple benefits.

LIST OF ACRONYMS

ASALs- Arid and Semi-Arid Lands

DA- Designated Authority

CDM - Clean Development Mechanism

CERS – Certified Emission Reductions

CoK – Constitution of Kenya

COP - Conference of Parties

CO2 – Carbon Dioxide

EIA - Environmental Impact Assessment

ES – Ecosystem Services

EPZ- Export Processing Zone

FCPF - Forest Carbon Partnership Facility

GHGs – Green House Gases

GIS- Geographical Information System

GLOVIS- Global Visualization Viewer

IPCC - Intergovernmental Panel on Climate Change

KIHBS- Kenya Integrated Household Budget Survey

LULUCF - Land Use, Land Use Change and Forestry

NCCRS – National Climate Change Response Strategy

NEP – National Environment Policy

NLP – National Land Policy

NGOs – Non- Governmental Organizations

ENVI- Exelis Visual Information Solutions

NW- North West

OC – Opportunity Costs

PDD- project design document

PES – Payment for Ecosystem Services

R-PIN - Readiness preparation Note

UNEP- United Nations Environment Program

USA- United States of America

USAID- United States Agency for International Development

UN – United Nations

VERs- Verified Emmissions Reductions

REDD+– Reducing Emissions from Deforestation and Forest Degradation, role of sustainable management of forest, forests conservation and enhancement of carbon stocks

R-PP - REDD Readiness Preparation Proposal

SBSTA – Subsidiary Body for Scientific and Technological Advice

SESA - Strategic Environmental Social Assessment

UNFCCC - United Nations Framework Convention on Climate Change

UN-REDD- United Nations Programme on Reducing Emissions from Deforestation and Forest Degradation

USGS -United States Geological Survey

VCS – Verified Carbon Standard

WW – Wildlife Works

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background of the Study

The United Nations Framework Convention on Climate Change (UNFCCC) was created to serve as the basis for a global response to meeting the climate change challenge. Since then, UNFCCC has brokered several agreements in a bid to stabilizing greenhouse gas concentrations in the atmosphere at a level that will prevent dangerous human interference with the climate system; reducing emissions of greenhouse gases. One of the key agreements is the Kyoto Protocol. Signed in 1997, the Kyoto protocol come into force 2005.

Central element of the UNFCCC's Kyoto Protocol is carbon trading mechanism a policy instrument of choice among governments. National and regional carbon trading schemes are operational in Europe, the USA, New Zealand and elsewhere. The Kyoto Protocol created three flexible financial mechanisms which make up the compliance market. These include (i) the Clean Development Mechanism (CDM) (which makes it possible for Annex 1 or industrialized countries to meet their emission reduction targets through investment in developing countries or non-Annex 1 countries) (ii) Emissions Trading (involving international transfer of emission allocations between industrialized countries) and (iii) Joint Implementation (where any industrialized country can invest in emission reduction projects in any other industrialized country as an alternative to reducing emissions domestically). The CDM is the only flexible mechanism that involves both industrialized and developing countries. Under the CDM, emission-reduction projects in developing countries can earn carbon credits, termed certified emission reduction credits (CERs) which are measured in tons of CO_2-equivalent. The Kyoto Protocol present the above platforms allowing acquisition of Certified

Emission Reductions (CERs) for each tonne of GHG that is prevented from entering the atmosphere as a result of a CDM project by actors in a developed country from a developing country. These CERS are used by developed countries to cover part of their emission reduction targets under the Kyoto Protocol.

The voluntary market is an alternative to the compliance market for developing countries, including in Africa. In the voluntary carbon market, voluntary emission reductions (also called voluntary emission units) can be acquired by public or private entities interested in voluntarily offsetting their emissions. The term 'voluntary' refers to the fact that players participating in this market are not necessarily constrained or inhibited by emissions targets (which may force them to trade for credits elsewhere); instead, they do so voluntarily to offset their emissions due to factors such as philanthropy, corporate social responsibility, investment in cleaner technologies, preparedness for eventual change in policies and ethically-informed management of climate-change impacts (Peters-Stanley and Yin, 2013).

Inter-Governmental Panel on Climate Change (IPCC) indicate that the cost of carbon sequestration through forests less expensive developing countries than developed countries (Rohit *et al.,* 2006). This trade of carbon offsets including carbon sequestration through forests represents the one of the new emerging markets for ecosystem services. Therefore, reducing emissions through forest present a win-win situation for developing countries such as Kenya that highly depend on forests and land for food supply, yet with dwindling forest cover and with widespread natural resource degradation. This is because they can achieve environmental conservation and also increase the opportunities for economic development for the poor. Therefore, carbon sequestration projects present a new opportunity for funding conservation and also raising the income level of locals. (Okidi *et al*., 2008).

Forests are also crucial habitat for biodiversity. Approximately 50 per cent of all biological resources are found in forests. In Kenya, approximately 4 million people living adjacent to forests depend on them for energy, food, medicine, and other non-timber products. However, over the past four decades Kenya has lost forest cover as a result of a combination of factors. Current estimates vary between 6.1 and 6.9 per cent of its land area, down from 12 per cent only 30 years ago (Okidi *et al.*, 2008).

Carbon sequestration not only presents an opportunity for the country to participate in climate change mitigation which will result in restoring the lost forest cover and preventing further deforestation, but it also presents an opportunity for carbon trading and financing which might impact individual household incomes who participate in the program.

Forest carbon projects have been gaining traction in recent years within the global environmental governance arena and particularly in Africa. Forest carbon projects are initiatives involving payments or funding from conserving, protecting and establishing forestry and agroforesty landscapes that captures and store carbon that lead to reduction in greenhouse gases (GHG). Forest carbon schemes are part of global efforts to mitigate climate change ((Peters-Stanley and Yin, 2013;).

In order to include conservation and forests management in the climate change financing mechanisms, Reducing Emissions from Deforestation and forest Degradation; conservation of forest carbon stocks; sustainable management of forests; and enhancement of forest carbon stocks (REDD+) was developed. This forest management mechanism encourage countries to recognize the value standing forest by valuing the carbon stored in forests, and shift incentives from deforestation and land use change to forest conservation and sustainability (Larson and Petkova, 2011).

1.2 Statement of the Problem

Decisions 2/COP13; 4/COP15; and 1/COP16 of the United Nations Framework Convention on Climate Change (UNFCCC;) negotiations formalized Reducing Emissions from avoided Deforestation and Forest Degradation (REDD+) as a cost-effective mechanism for protecting forests in developing countries with approximated potential of mitigating 20–30% of all carbon-dioxide (CO^2) emissions annually and support communities living in and around forests (UN-REDD, 2010). The design rules governing REDD+ identify emission reduction and improvement of livelihood two very important outcomes expected from implementing REDD+ (Atela, O. *et al* 2015)

As a party to the UNFCCC, Kenya has ratified several agreements including the Warsaw framework. The impact of these international policies (which automatically becomes part of the national policies as per The Constitution 2010) to local development through policy implementation need to be assessed. Implementation if these policies at national level calls for elucidation of decisions into activities in different parts of the country and geographical locations. (Leventon and Antypas (2012). In the context of REDD+, this calls for a country like kenya to identify the key areas driving deforestation and designing approaches that would reduce this rate and deliver on sustainable forest management and livelihood benefits (appendix 1/CP. 16). This national interpretation implementation however remains a key challenge in environmental governance with most policy decisions reached at international level but lack application at the national level. (Leventon and Antypas, 2012). This leads to initial goals of a policy not being met due to policy implementation gap, or lack of translation into action or the

policy is translated into action that is not properly implemented. In the context of REDD+, continued loss of forests and increasing emissions and lack of poverty alleviation (Atela, O. *et al* 2015).

The benefits of REDD+ projects remain unclear, given the nascent nature of the mechanism, as well as the varying designs of these projects. In particular, the contributions of REDD+ projects to environmental conservation through the enhancement of carbon sinks as well as improving household livelihoods of target beneficiaries remains largely unexplored. This work therefore seeks to analyze implementation of REDD+ in Kenya at a local level and it contribution to the global objective of climate change mitigation and development goal at the national and project level.

1.3 Objective of the study

The overarching objective of this research was to analyze the benefits of REDD+ as a PES mechanism. Based on this overarching objective, two specific objectives were pursued, namely:

i. To assess the contribution of carbon markets under REDD+ on environmental conservation through enhancement of carbon stocks
ii. To assess the contribution of the of REDD+ to the enhancement of community resilience to climate change through improved household income

1.4 Hypothesis

Two null hypotheses underpinned this research:

i. Carbon markets under REDD+ does not contribute to environmental conservation through enhanced carbon sinks (increased forest cover)

ii. Carbon markets under REDD+ does not contribute to enhancement of community resilience to climate change through improved household income

1.5 Justification and Significance of the Study

Human survival and well being depend directly on the status of the ecosystem goods and services from natural resources. These resources are rapidly deteriorating over time and is of great concern. Millennium Ecosystem Assessment report of 2005 which indicated that nearly two-thirds of the global environmental services are currently under threat. Furthermore, these ecosystem services do not have any market value thus experience market failures which include the presence of external effects, the public good nature of many ecosystem services, imperfect property rights as well as insufficient knowledge and information (Kemkes *et al.*, 2009; Wunder, 2005; Engel *et al*., 2008; Swallow *et al.*, 2007;USAID 2007).

Most of the ecosystem services are provided as a result of certain land use activities carried out by the land users. However, given the public nature of these services, the benefits from ecosystem services as well accrue both to the land users as well as others who do not bear the cost of providing the service, also known as positive spill-over or positive external benefits yet the land users do not get any compensation or incentives for the services they provide (Pagiola *et al.*, 2005; Wunder, 2005; Milder *et al.*, 2010; Farley *et al*., 2010). In most cases in developing countries, the land users who undertake these land use activities to ensure their sustainable provision in most cases are the poor people who depend more directly from the natural resources for their livelihood (Wunder 2005; Milder *et al*., 2010).

With developed countries party to the Kyoto Protocol having committed to emission reductions, there is increasing demand for emission credits from developing countries. The financial incentive to developing countries for the provision of the ecosystem service is being fronted as

being able to be help meet two objectives in developing countries, that is, environmental protection of the important critical ecosystem such as forests and also alleviate poverty (Lee, E. & Mahanty, S., 2009; Wunder *et al*., 2008).

With the current state of the forests in Kenya being on the decline largely due to over-exploitation and degradation, REDD+ mechanism presents an opportunity to address some of the challenge in conservation. The government of Kenya has committed to achieving at least a ten percent forest cover both under the national climate change response strategy of 2010, Kenya's Vision 2030 and Article 69(b) of the Constitution, it will be impossible to achieve this on public land. This is because out of the 3.6 million hectors of remaining forest, only one 1.2 million hectors is on public land and the remaining 2.4 million hectors being on community land and private firms. Therefore, having forests on both privately owned land and communally owned land this presents an opportunity to achieve this target of environmental protection for sustainable development. In addition, given that about 4 million people depend on forests to secure their reducing poverty levels in the country.

Understanding how carbon projects, and more specifically REDD+ projects contribute to both environmental conservation, through enhancement of carbon sinks, and improved household income will be critical in improving the design of these projects from the international to the project level. However, this issue has not been explored in much detail. It is in this context that this research seeks to contribute by analyzing, at the project level, how carbon projects contribute to the enhancement of environmental conservation as well as resilience of target beneficiaries (mainly communities) to climate change. The Kasigau REDD+ Project is the world's first x project to deliver verified carbon credits linked to REDD+ mechanism in the voluntary carbon market (Peters-Stanley *et al*., 2014).

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Introduction of Payment of ecosystem services

Payment for ecosystem services transactions operate as alternative motivation for the sustainable management of the natural resources and enhancement of livelihoods. This public policy approach acts a positive incentive to encourage public participation in conservation of natural resources around them without being forced, since they can partake of the benefits of conservation (Vonada *et al*., 2011).

This market based mechanism has four common features which make them distinct from other conservation approaches, these are, conditionality, additionality, leakages and permanence (USAID, 2007). First is that the financial payments to communities, government, or private entity delivering the ecosystem service are conditional on their continued performance. This implies that payments are only received if and only when they deliver measurable changes both in quality and quantity of the service. Secondly, additionality requires that the payment should lead to the yield of ecosystem services that would otherwise not have been realized without it. (USAID, 2007).

Leakage is when a land owner being paid for the provision of an ecosystem service directly or indirectly transfers the environmental problem in another geographical location proxy to the implementation area that is not under contract. This situation means that there is not any additionality thus it would be socially inefficient to make the payments. Lastly, permanence refers to the sustainability of environmental services, that is, long term supply of the services.

Ecosystems have been facing increasing degradation globally due to unsustainable human activities according to the Millennium Ecosystem Assessment report of 2005. The degradation of

these ecosystems directly affects the provision of ecosystem goods and services which are essential for human well being. Some of the ecosystem services that human beings rely on for their well being are climate regulations through carbon sequestration, biodiversity conservation and water protection among others (Vonada *et al.* 2011).

The ecosystem services which were previously provided for freely by nature are becoming increasingly threatened and scarce since decisions to convert or alter natural habitat toward market based activities fail to take into account the total costs of service loss (Sommerville *et al.*, 2009). From an economic aspect, one of the major causes of ecosystem service degradation is due to market failure associated with the nature of the ecosystem services being public goods in nature thus generating externalities (TEEB, 2010; UNEP, 2005). Consequently, the land users and/or owners fail to receive any compensation for conserving these ecosystem services thus do not incorporating them into their decision making which leads to socially sub-optimal land use change decisions (Wertz-Kanounnikoff, 2006).

Payment for Environmental Services (PES) also refered to as payment of ecosystem / ecological services is emerging as an approach to environmental management that applies compensation in form of cash or other payments as incentives to encourage ecosystem conservation and restoration for production/provision of environmental services or service (Milder *et al*. 2010). The incentives are meant to compensate those participating to deliver the environmental service or to incentivize those who would in the absence of the payment would otherwise not provide the service (Sommerville *et al*. 2009).

2.2 Significance of payment of ecosystem services

The proponents of this mechanism argue that most of the critical ecosystem services in developing countries are generated on rural lands owned and managed by the poor (Milder *et al*.,

2010). Furthermore, spatial analyses indicate that poor people inhabit many of the lands that generate key ecosystem services in developing countries (Milder *et al*., 2010). Therefore, as markets and payment schemes for ecosystem services are emerging, the poor (low-income) land stewards stand to benefit from the compensations, rewards or payments they receive in exchange to the ecosystem services these lands provide (Milder *et al*., 2010).

The schemes aim to provide a net gain for those participating through the positive incentives based on avoided costs incurred by changing a behavior that is affect negatively the service delivery, or for taking actions to increase and or restore service delivery are among those who are in support of the potential of PES to contribute to ecosystem management but feel that this function can be undermined if the same market based mechanism is used to also contribute to poverty reduction (Swallow *et al*., 2007).

One of the major concerns of scheme is its impact on the poor. However, PES approach was conceptualized as a mechanism aimed at improving the efficiency of natural resource management and not for poverty reduction (Pagiola *et al.*, 2005). Milder *et al*. (2010) indicates that various studies have assessed the extent to which the poor who are often sellers of ecosystem service, have benefited or have opportunities to benefit from PES. Different findings indicate that PES has the latent to provide vital livelihood benefits to communities especially the poor and at household or community level in the different forms including but not limited to cash payments, enabling the transition to more profitable and resilient land-use systems, secure land tenure or strengthening social capital and strong governing institutions (Milder *et al.*, 2010).

Payment for Environmental services targeting the poor is conceptually, appropriate to look at participation, effect on ecosystem seller and effect on non-sellers. This is what access to and

market share in this schemes can poor potential ecosystem service providers compete for, to what extent poor providers do get access, how does PES participation affect their livelihoods and finally how does PES affect poor people not selling ecosystem service? The poor seeking to become ecosystem service providers face challenges both in terms of PES access rules and underlying structural constraints (Wunder, 2005).

Grieg-Gran *et al.* (2005) in their study of six carbon and two watershed projects in Latin America found out that some PES access rules favored against small landholders who often lack key requirements such as formal tenure requirements in the form of tenure proof and included minimum area necessary for participation in such initiatives (Milder *et al*., 2010; Wunder, 2005). Smallholders continue to be inhibited from participation in the regulatory carbon market because of limitations perpetuated by intricate and expensive rules related to land tenure security rules governing the Clean Development Mechanism (Milder *et al*., 2010)

The underlying structural constraints identified by Wunder (2005) are mainly two. First, often poor local communities do not own legal title deed and hence do not control land as per many legislative regimes, they are ruled out as service providers since PES is largely geographical and area based. Most of the poor who control land use activities and provide ecosystem services often do not have formalized or fully secure tenure. Therefore, PES by its nature is more relevant to non-poor small landholders who as Milder *et al.* (2010) puts it offers some competitiveness in the provision of the ecosystem services, most often carbon sequestration.

High transaction costs are incurred when dealing with many smallholders centrally to when only a limited number of landowners. This is made worse by existence of alternate opportunities for economies of scale in service provision in at a final end fixed costs (Wunder, 2005). The fact that the poor often control small tracts of land, they are disadvantaged since they have higher

per-unit transaction cost compared to large landowners, who can deliver a greater volume of ecosystem services with little cost per transaction (Wunder, 2005).

Further limitation into the access to PES participation for the poor communities who provide the ecosystem service is, amounts of payment or prices placed on the service depends in part on their ability to negotiate a fair price which underscores the need to access and capacity to interrogate market information and having strong local institutions in order to improve the negotiating position of rural poor landowners and communities (Milder *et al.,* 2010). This capacity is lacking at community level hence having to deal with middle men. In addition, if the poor communities are providing an ecosystem service that is unique such as threatened biodiversity, negotiating start point will be favorable. On the contrary, ecosystem services that can be provided by many players such as especially forest carbon, prices are dictated by demand and supply forces, and communities particularly in rural and marginalized areas will have to go with the poor rate/ price offered, in some cases this lead to payments being less than the landowners opportunity costs leading to reversal to original negative activities in the longterm (Milder *et al.,* 2010; Wunder, 2005).

The impact of PES also depends on which scale the mechanism is operating. The demand side of ecosystem service has different buyers who may choose to operate at different scales (Milder et al., 2010). There are at least four categories of ecosystem service buyers, these are: a) Public sector buyer who protect the public goods of ecosystem services on behalf of their publics. They include local, regional and national governments, as well as multilateral agencies such as the World Bank; b) Private sector buyers under regulatory obligation these are businesses that are pushed by different laws either at national or international level or cooperate responsibility to offset their environmental impacts by laws e.g. greenhouse gas emission trading scheme; c)

Private sector buyers ;buyers who voluntarily purchase ecosystem services to support their business operations to maintain a clean and green image, or to adhere to principles of corporate social responsibility; d) Consumer of eco-certified products ; individuals who participate in ecosystem service markets by paying a premium for products produced in more environmentally friendly way.

If payments are made at a regional or central government, rather than at the community level, that is, individuals providing the ecosystem services, then attributing the positive incentive as the driving force for the provision of ecosystem service is not easy, although influence governments to participate (Sommerville *et al*., 2009). Such PES interventions at the county jurisdiction, may force the government to use a variety of compelling policies actions and measures to ensure the local ecosystem service providers comply. The issues of the scale and PES approach are particularly relevant to Reducing Emissions from Deforestation and Forest Degradation (REDD) architecture/design under the United Nations Framework Convention on Climate Change as emissions credit are likely to accrue at the national level (Sommerville *et al.,* 2009).

PES mechanism may be used to influence behavior towards a law or a change in legal enforcement approach. Pagiola's (2008) analysis of the Costa Rica Pagos por Servicios Ambientales (PSA) in English (Environmental Service Program) which is the most advanced PES initiative of its kind within a developing country established that the primary reason it was established was to ban deforestation on private lands to persuade land owners to cooperate. Under this situation, PES is not being used to drive the change in behaviours, nevertheless, it is vital for the achievement of social support that may ultimately strengthen compliance within the anti-clearance law (Sommerville *et a*l., 2009).

2.3 Application of payments

Deforestation and forest degradation are amongst the most important sources of emission of Greenhouse Gases (GHG) and contribute about 20 percent of total green house gas emissions annually and this has caused climate change (IPCC, 2007). The world's forests have become an important element in the global effort to combat climate change due to their ability to sequester carbon which is one of the valuable environmental/ecosystem services they provide (FAO, 2010). The free-riding on the public goods nature of the environmental services, in this case carbon sequestration by forests has led to underinvestment in management and protection of these natural resources (Farley *et al.,* 2010). This has resulted into a rapid decrease both in the quantity and quality of the ecosystem service as a result of deforestation and forest degradation. This is what has led to the accumulation of GHGs in the atmosphere resulting into global warming which has caused climate change (IPCC, 2007).

The challenge in creating a market for land-use-based carbon credits deliverable by rural poor communities due to challenges mentioned earlier in this report (Milder *et al*., 2010; Wunder, 2005). Despite the carbon markets being the most advanced market for ecosystem services, only a small fraction of this volume is from land use, land use changes and forestry (LULUCF) offsets, potentially affecting rural land stewards (Milder *et al*., 2010). Kyoto protocol Clean Development Mechanism (CDM) only allows credits from afforestation and reforestation. Out of 3542 project under CDM, Africa only boast of 72, which is only 2.03 per cent yet it has the potential for more project related to LULUCF. Under the CDM facility, Kenya so far has only five (5) CDM projects out of which only the Green Belt project focuses on afforestation and reforestation which falls under the LULUCF (Clean Development Mechanisms, 2011).

The Kyoto Protocol first commitment ended in 2012, and parties agreed on commitments in a second commitment period from 1 January 2013 to 31 December 2020. In this Parties agreed on

the need to allow LULUCF projects, principally by reducing emissions from deforestation and forest degradation (REDD). This has the potential to provide opportunities to increase the participation of low-income communities in these markets given that it is land use based (Farley et al., 2010). In 2010, the United Nations Framework Convention on Climate Change (UNFCCC) negotiations in Cancun Mexico came up with a framework for payments for REDD and intends to have it included in future frameworks (Westholm *et al.*, 2011). This means that REDD will be central to future international efforts to combat climate change.

REDD received substantial attention from the UNFCCC and the attending community at COP 13, December 2007, where the first substantial decision on REDD+ was adopted, Decision 2/CP.13: "Reducing emissions from deforestation in developing countries: approaches to stimulate action", calling for demonstration activities to be reported upon two years later and assessment of drivers of deforestation. Perhaps more interestingly, REDD+ was also referenced in decision 1/CP.13, the "Bali Action Plan", with reference to all five eligible activities for REDD+ (with sustainable management of forests, conservation of forest carbon stocks and enhancement of forest carbon stocks constituting the "+" in REDD+).

The call for demonstration activities in decision 2/CP.13 led to a very large number of programmes and projects, including the Forest Carbon Partnership Facility (FCPF) of the World Bank, the UN-REDD Programme, and a flurry of smaller projects financed by the Norwegian International Climate and Forest Initiative (NICFI), among many others. All of these were based on interpretation of the very scarce substantive guidance from the UNFCCC. Consequently, many of the projects were only marginally coincident with emerging guidance from the UNFCCC at later sessions.

In carbon trading just like any other market, buyers and sellers engage in buying and selling of carbon credits. These are units of carbon emissions reduced at source or units of carbon dioxide that have been absorbed by forests (Rohit *et al*., 2006). Carbon markets consists of two (2) types of transactions, namely, the project based transactions and trade in emission allowances. Project based transactions occur when buyers invest in a carbon emission reduction or sequestration project and is granted emission credits in return. Emissions reduction trading on the other hand , refers to commercial trading in carbon offsets(accumulated) under various regimes that have emerged in difference parts of the world (Rohit *et al*., 2006). These include the European Union Emission Trading Scheme under the Kyoto Protocol and voluntary markets.

There are two types of emissions reductions these are: Certified Emission Reductions (CERs) referring to carbon offsets generated by Kyoto-compliant CDM projects. And Voluntary Emission Reductions (VERs) -carbon offsets from voluntary projects (non-Kyoto compliant) are termed as (Rohit *et al*., 2006). There is no significant difference in prices of both CERs and VERs because countries can use them against their emission reduction targets under Kyoto. The maturity of a carbon market is therefore reflected by the relative proportion of trading in CERs as compared to VERs (Rohit *et al*., 2006).

Kenya is one of the few countries in Africa which are the beneficiaries of the carbon markets with at least five carbon projects being implemented under the CDM facility with only one falling under the sector of afforestation and reforestation. Kenya was also the first country to win a validation for REDD credits under Voluntary Carbon Standard and finally the country is now one of the REDD+ countries under the Forest Carbon Partnership Facility (FCPF) set up by World Bank in 2009.

The FCPF assists tropical and subtropical forest countries develop the systems and policies for REDD+ and provides them with performance-based payments for emission reductions. Kenya has already undertaken some of the preliminary steps in effort to benefit from the funds that will be given to member countries to implement REDD by developing the Readiness Plan Idea Note (R-PIN) and the REDD Readiness Preparation Proposal.

Carbon markets is one of those approaches seeking to support positive environmental externalities through the transfer of financial resources from beneficiaries for certain environmental services to those who provide these services (Mayrand & Paquin, 2004).

It is being argued that carbon projects offers major potential to raise funds for environmental conservation; target existing funds more effectively and in addition, secure environmental benefits that underpin business profitability, development initiatives and community livelihoods (Brink *et al*., 2011). However, it still remains unclear to what extent the objectives of environmental conservation, development and improved community livelihoods can be achieved simultaneously through market-based mechanisms.

2.4 Conceptual Framework

Payment for ecosystem services are one of those approaches seeking to support positive environmental externalities through the transfer of financial resources from beneficiaries for certain environmental services to those who provide these services (Mayrand, & Paquin, 2004). PES can therefore be presented as mechanism for the transfer of financial resources between conservator's who are social actors, which aims to create incentives to align individual and/or

collective land use decisions with the social interests in natural resource management (Muradian *et al*, 2010). Figure 1 below shows the conceptual framework.

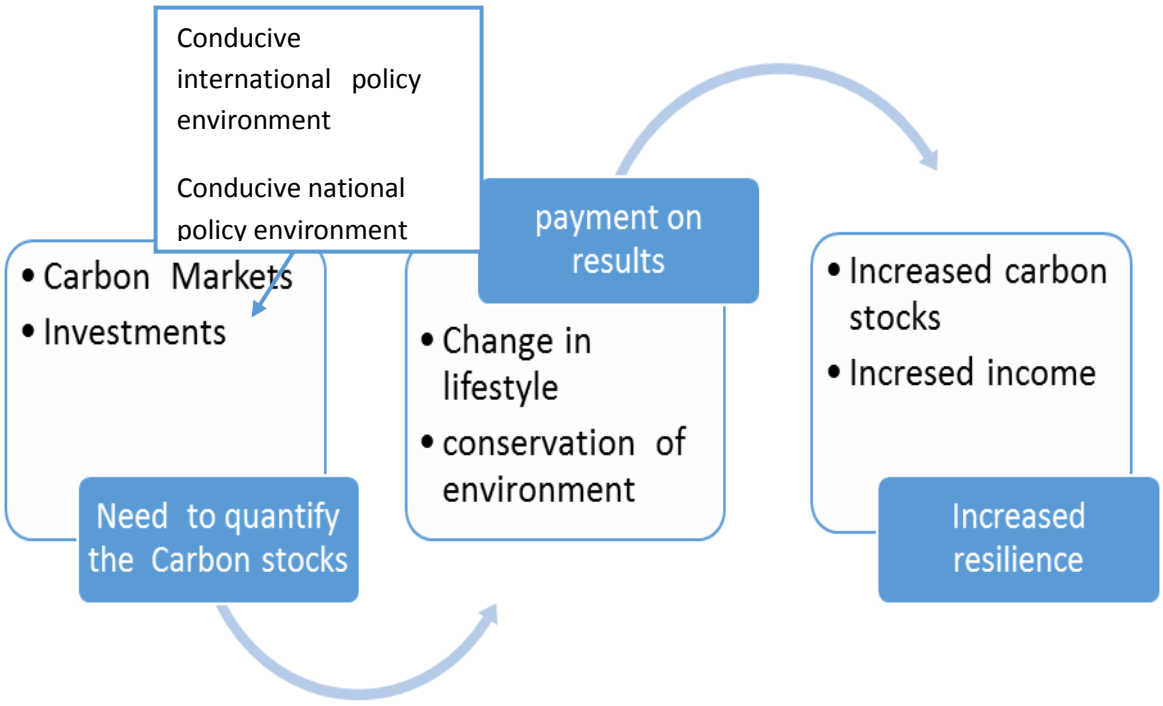

Figure 1 Conceptual Presentation of Carbon markets and resulting impacts as applies in this study (Source Author)

The research aims to evaluate the impact of REDD+ on both conservation and household income to find out if it really does make any difference. This has been done by identification and estimation of causal effects through use of a control and treated samples. The difference in the

two samples holding all factors constant may therefore be attributed to the REDD+ project. This method is relevant in quantifying and explaining the effect of an intervention in the evaluation of socio-economic development programmes.

The following figure 1 presents the thought process applied in conceptualizing this research. It is expected that with the right policy environment created by both international communities and the government (as presented by the Kyoto Protocol) this present and investment environment that with the right market mechanisms resources reach communities in form of projects such the Kasigau project. These investments trigger a change in lifestyle and appreciation of natural resources (eg forests) around communities largely influenced by attaching value to standing trees in the case of forests. Further these investments present alternative income and livelihood sources. These two benefits therefore contribute to improved livelihoods and conservation(increase in carbon sinks) which in the end present a conducive environment for communities and governments to continue creating more wealth hence adaptation to such shocks such as climate change.

2.5 Study area

The Kasigau Corridor REDD Project is located in South-East part of Kenya, about 150 kms North-West of Mombasa, Marungu Sub-location, Voi Division, Taita Taveta county. The area is made up of 13 forests conservation blocks of land owned by local community groups. Each of the 13 blocks holds a legal title deed. The total land covered by Phase I and Phase II, is 169,741 hectares. The area covered by the 13 blocks is 500,000 acres which made up of private forested land, community owned group ranches, and community trust lands. The project area is home to

the Tsavo East and Tsavo West National Parks South and East of Voi town (Wildlife Works Carbon (2011). The following figure 2 map shows the area covered by the Kasigau project.

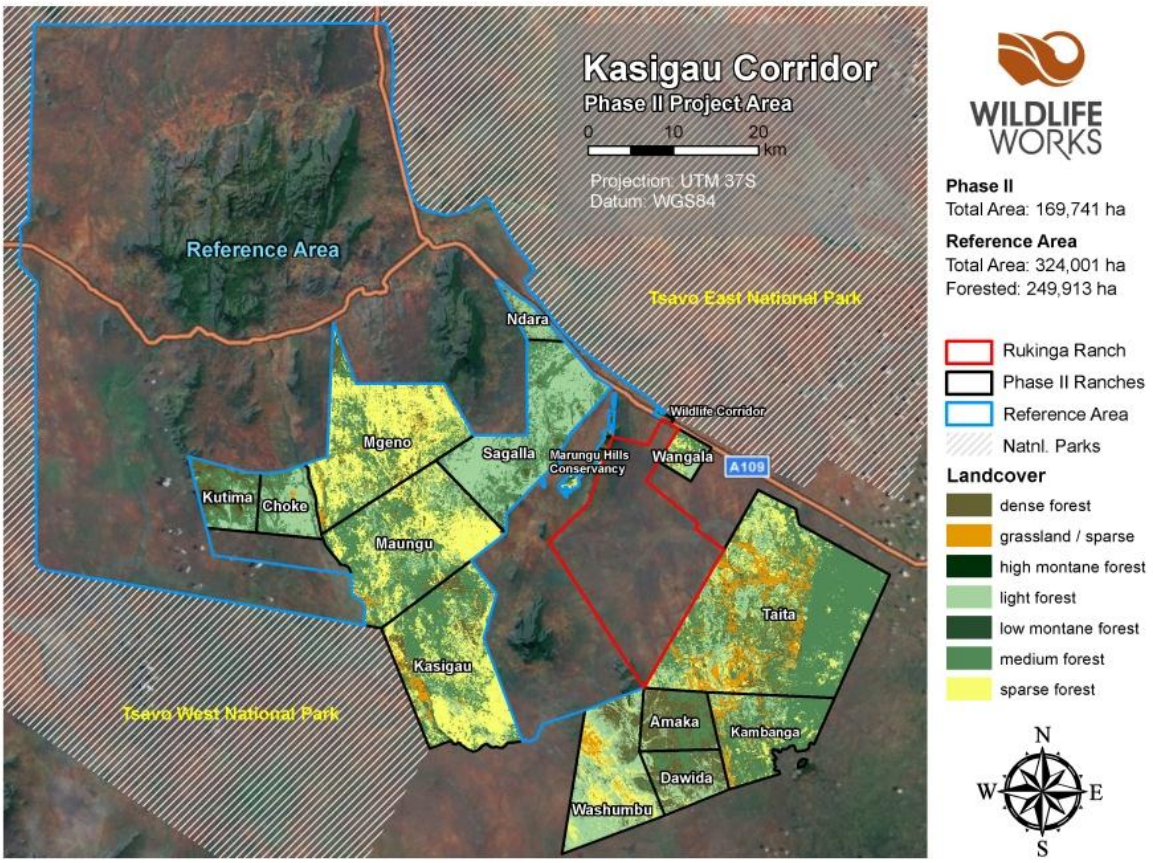

Figure 2 Map of Kasigau Phase 2, as adopted from the Project Design Document (Wildlife Works Carbon , 2011

2.5.1 Climate, Geology and Biophysical features

Kasigau is a semi arid area with average annual rainfall of 300-450mm per year. In the past rains occurred in December and April, locally known as the grass rains and the long rains respectively. In the past ten years, changes have been observed including prolonged periods of drought leading to rainfall only once an year.

Remnants of the Eastern Arc Mountains, that is Mt. Kasigau, Taita Hills, Sagalla, and the Marungu Range runs down the boundary of the project area. These hills are covered by patches of montane forest, and is home to several endemic species of bird and flora (Wildlife Works Carbon, 2011). The vegetation is thick Acacia-Commiphora Forest and few spots of grassland comprised of indigenous savannah grasses and shrubs. The slopes of the Marungu range from 2000-3500 ft elevation, that is the western boundary of the project area, covered by fragments of montane forest and forest fragments of the Taita Hills. The Kasigau area is predominately covered by the drought resistant species of Acacia-Commiphora dryland Forest (Wildlife Works Carbon, 2011).

2.5.2 Demographic features land use

About 100,000 people reside around a 5 km stretch of the project area boundaries. The project is within Taita Taveta County which according to the KIHBS of 2009, has a total population of 284, 657. The county covers an area of 17,084 Km^2 that is a population density of 17 people per Km^2. The poverty rate of the county is 54.8 per cent with 72.4 per cent of the population leaving in rural areas.

There are two communities living in the project area; the Taita and Duruma. The Taita tribe is majority. The Taita are crop farmers, they clear the dryland forest and plant maize. Before Wildlife works started working in the area, Taveta Sisal estate was the only formal employer in the project area. Other economic activities were service business, small shops and bars (Wildlife Works Carbon, 2011).

Communities here just like other parts of the country that hold community trust lands, maintained traditional land governance system in the land areas outside of the Group Ranches.

The Chief could allocate land to different families for farming. This family however held no legal right to the land allocated. In Kasigau with the immigration of the Duruma community, it increased the rate at which lad was cleared to pave way for agriculture, this led to increased deforestations and loss of forests in the area (Wildlife Works Carbon, 2011).

Land adjudication and subdivision for rural land schemes by the government commenced in the community trust lands with the aim of giving family's individual titles to land. The process of allocation of individual title to forested land has not been successfully completed. The land in the project area is owned by group ranches that are owned by public companies who have owned by local shareholders.

Given that the area is within the ASALs zone, most of the attempt to engage in agriculture has not been successful. In addition, given that most of the local communities do not practice large scale cattle ranching, the ranches have in the past few years experienced illegal charcoal trade. The remainder of the land is held in trust land and currently being subdivided into small farming plots(Wildlife Works Carbon, 2011).

There are no permanent water sources in the project area. The land was gazette 1970s as different Private Group Ranches for grazing land for of the Taita communities. However, given that they had no significant livestock, and therefore despite the formation of Taita Ranching Co. Ltd, holding a legal title granted by the post-independence government, the local population practiced small scale subsistence farming. Over time, several shareholders sold out and bought creating imbalances between the ranches as shown in Table 2 (Wildlife Works Carbon, 2011).

Table 1 List all Block under Kasigau REDD+ project and ownership

	RANCH	**AREA (ha)**	**OWNERSHIP**
1.	Amaka	5,998	Amaka Development Limited
2.	Sagalla	17,402	Sagalla Ranchers Limited
3.	Kasigau	21,186	Kasigau Ranching Company Ltd
4.	Wangala	2,023.5	Livingstone and Alphonce Ikonge,
5.	Kambanga	12,948	Kasigau Ranching Company Ltd
6.	Taita	35,612	Taita Ranching Company Ltd
7.	Mgeno	21,232	Mgeno Ranching Company Ltd
8.	Maungu	21,619	Maungu Ranching Company Ltd
9.	Choke	5,076	Raymond Joel Mwangola
10.	Kutima	5,076	Kutima Investments Limited,
11.	Dawida	4,046.86	Dawida Ranching Group Company Ltd.
12.	Washumbu	14,501	Washumbu (DA) Ranching Company Ltd.
13.	Ndara	1834.77	Eliud Timothy Mwamunga

CHAPTER THREE

3.0 DATA AND METHODOLOGY

3.1 Data, types and sources

The data needs for the study were both primary and secondary data under categories of socio-economic, farm level and institutional factors. GIS maps were downloaded from USGS, GLOVIS, Landsat 5 and 7 for 2000, 2004, 2008 and 2012. Primary data was collected from field visits, interview with key informants and desktop reviews.

3.1.1 Sampling procedure and data collection

The research applied a multi-stage sampling method. To determine patterns of change within Kasigau for forest cover change; namely areas under forest and shrub land, The time period investigated was from 2000 to 2004, 2004 to 2008, 2008 to 2012. These years were selected to detect the trend before the REDD+ project and after the REDD+ project. Dates of the images were purposively chosen and acquired within the dry season in a year. The wet season images were avoided to eliminate temporary land cover occurring during the wet season. Cloudiness was considered especially in the area of study to ensure more clear images of the area.

Purposive sampling was applied where the ranches in Taita Taveta County were indentified since there already exists a PES project being implemented in 13 ranches. The next stage involved a random identification of one ranch (Maungu) that would be used as the treated ranch from the 13 ranches. Within the identified ranches which were acting as the treated group, three villages were identified out of five villages within Maungu ranch. The sampling of the households which were interviewed within the treated group were randomly selected using simple random sampling.

On the other hand, the sampling procedure for identification of a control group was random given that the 13 ranches where the PES project is being implemented in Taita Taveta are boarded by other ranches. The control group was randomly selected from the ranches that neighbours the project area and that had similar characteristics to the identified treated group. The sampling of the villages and households within the control group was done in a similar way as in the treated group, that is, randomly identified three (3) villages as well as the households to be interviewed. However, to ensure that there was almost an equal proportion of gender interviewed, stratified random sampling was applied at the household level.

The project area has an estimated population of 350,000 people, that is, within the 13 ranches where the PES project is being implemented. It is estimated that 100,000 people live within the five kilometers of the project boundaries. This includes the control group subjected to this study. Therefore, the total estimated population within the project area and in adjacent ranches is 450,000 people. From the 2009 household census survey, it indicates that the average household size in Taita Taveta is four (4), therefore, the total average household from a population of 450,000 is approximately 112,500 households.

To determine the sample size for the households, the Cochran method (1963:75) was used with a confidence level of 95%.

$$n_0 = \frac{Z^2 pq}{e^2}$$

Where n_0 is the sample size, Z^2 is the abscissa of the normal curve that cuts off an area α at the tails ($1 - \alpha$ equals the desired confidence level such as 95%), e is the desired level of precision, p is the estimated proportion of an attribute that is present in the population, and q is 1-p. The value for Z is found in statistical tables which contain the area under the normal curve.

From this method, the result was a sample size of 383 which was to be distributed equally between the control and the treated group. However, due to limited financial resources, only 300 households was sampled and was divided equally between the control and treated group. The questionnaires used for data collection were coded, to distinguish between those used in the control and treated groups. Data collection was done with the assistance of experienced research assistants from the area.

3.2 Data Analysis

Data analysis in this project was split into two main parts, based on the two main research objectives. First, forest cover change in Kasigau area detection for Land Sat TM and land sat ETM+ was established using ENVI ex. ENVI ex is an image processing and analysis software. It was applied since it is containing the friendliest implements to read, explore, prepare, analyze, and share information extracted from different and almost all types of imagery. Selection of two similar images of a scene with similar number of classes at a four year interval. The software recognized difference between the two images and with a resulting classification image. Thematic change vectors were saved to shape file and statistics on image change was saved as thematic change statistics and opened in a Microsoft excel spreadsheet. The results were then examined and analyzed for forest cover change before, during and after the REDD+ project implementation.

Secondly, in determining whether the Kasigau REDD+ had contributed to community resilience to climate change through improved livelihood, primary data obtained from the field was entered into the computer statistics software, cleaned and coded for analysis. The quantitative raw data from the field was converted to numerical codes representing attributes or measurements of

variables, which is, coding. After coding, the data was analyzed using statistical packages which yielded descriptive and inferential statistics – the use of both Statistical Package for Social Science (SPSS) and STATA software for data analysis was applied. STATA was used as it is a general-purpose statistical software package used in research, especially in the fields of economics, sociology, political science, biomedicine and epidemiology.

CHAPTER FOUR

4.0 Results and Discussions

4.1 Effect of Kasigau REDD+ Project on Carbon Sinks

This analysis explored whether the Kasigau REDD+ project had contributed to an increase in forest cover in the area covered by the project. This is important because increasing forest cover and conservation is the overarching objective of the REDD+ mechanism, and subsequent REDD+ projects.

Interviews conducted with the wildlife works and key informants including area administrative representatives found out that the area had experienced continued forest loss as a result of increased demand for agricultural land. As a result, dry land forest historically existing in the area had been cleared to pave way for small scale farming. The following figures 3,4 and 5 obtained from Wildlife Works illustrates how the fragile dry land forest in Kasigau changed over time due to agriculture and charcoal burning in the area.

Figure 3 Part of an intact Kasigau Dry land forest (Part of the Tsavo West Park) source: Wildlife works, 2008

Figure 4 Cleared part of the dry land forest to pave way for subsistence farming (Source Wildlife works 2008

Figure 5: Many portions of cleared forest land in Kasigau, source wildlife works 2008

From the figure 3 to figure 5 above there is clear trend and indication that demand for agricultural land contributes to clearing of forest and ultimately destruction of carbon stocks. It is this trend that lead to Wildlife Works investing in the REDD+ project in Kasigau. In 2008 Wildlife Works began to look at REDD, when VCS announced support and produced a project design for phase 1. Conservation Easements agreed upon with the 13 ranch owning companies and 170,000 Ha of the Kasigau Corridor conserved in Phase 2. From the interviews, it was

reported that the project contributed conservation-related income to over 4,300 Kenyan landowners, and 100,000 community members living in the project area.

These findings indicate that Kasiagu area suffered similar drivers of deforestation as those at national level as indicated in the Kenya's readiness proposal and Plan; unsustainable utilization of forest products, demand for land for agriculture, settlement and other developments.

Kasigau REDD+ project commenced in 2008, in order to identify the forest cover change in the project area as a result of the REDD+ project, GIS maps for a period before the project and after were used. Using year 2000 as the base line year and a four years interval, three images/ maps were developed. These are 2000-2004, 2004-2008, and 2008-2012. The main objective for selecting year 2000 to 2004 (period) was to get a baseline / benchmark upon which to conduct subsequent analyses. The period 2008 to 2012 was the period during the Kasigau REDD+ project was implemented and received the first payment in 2012. To contribute to the first objective, the period 2008-2012 GIS image was selected so as to assess the change in forest cover, whether positive or negative, could be attributed to the Kasigau REDD+ project. The following Maps show loss of forest cover from the year 2000 to 2004, 2004 to 2008. (Figures 6 and 7

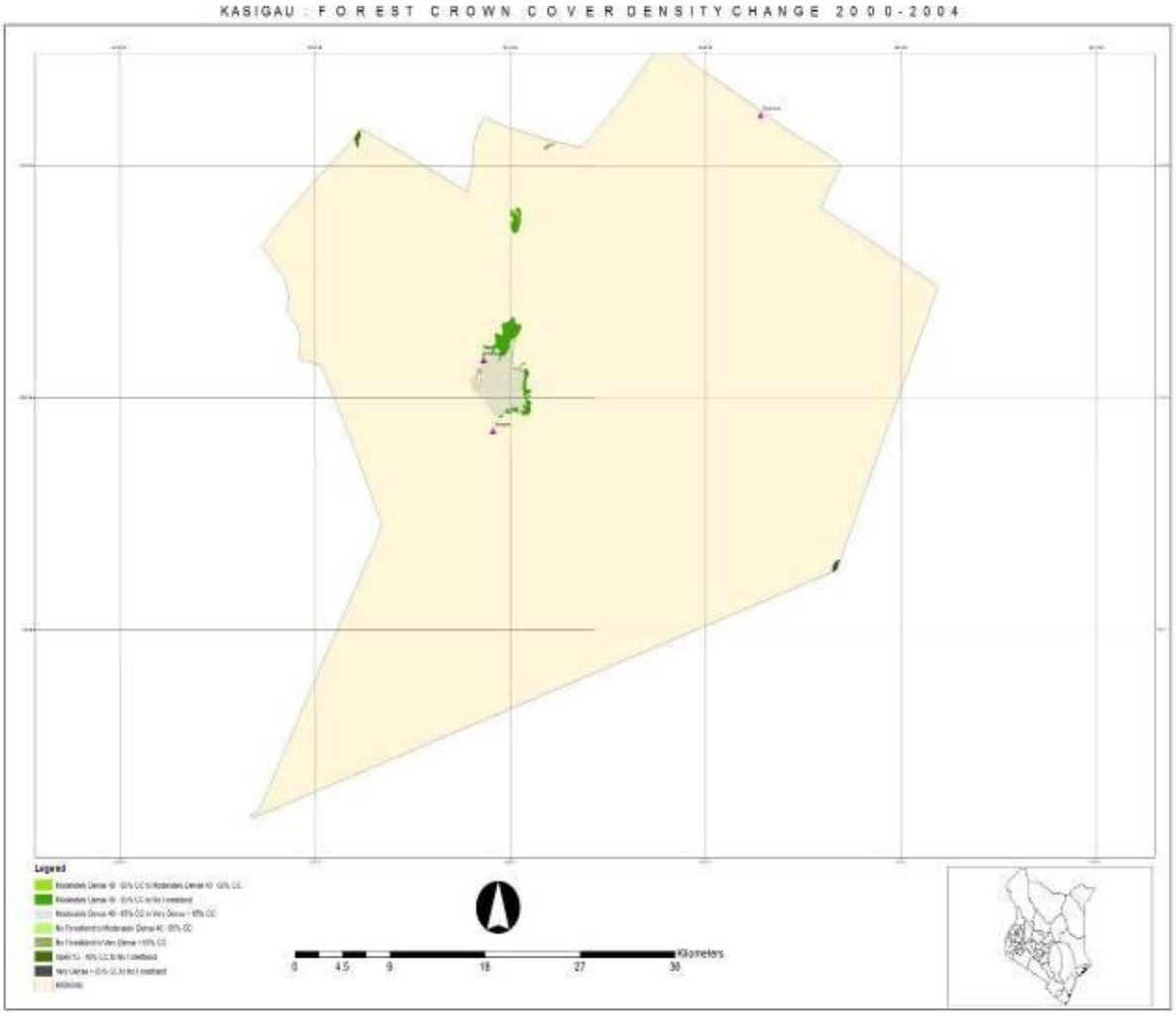

Figure 6 Forest cover change (2000 2004)

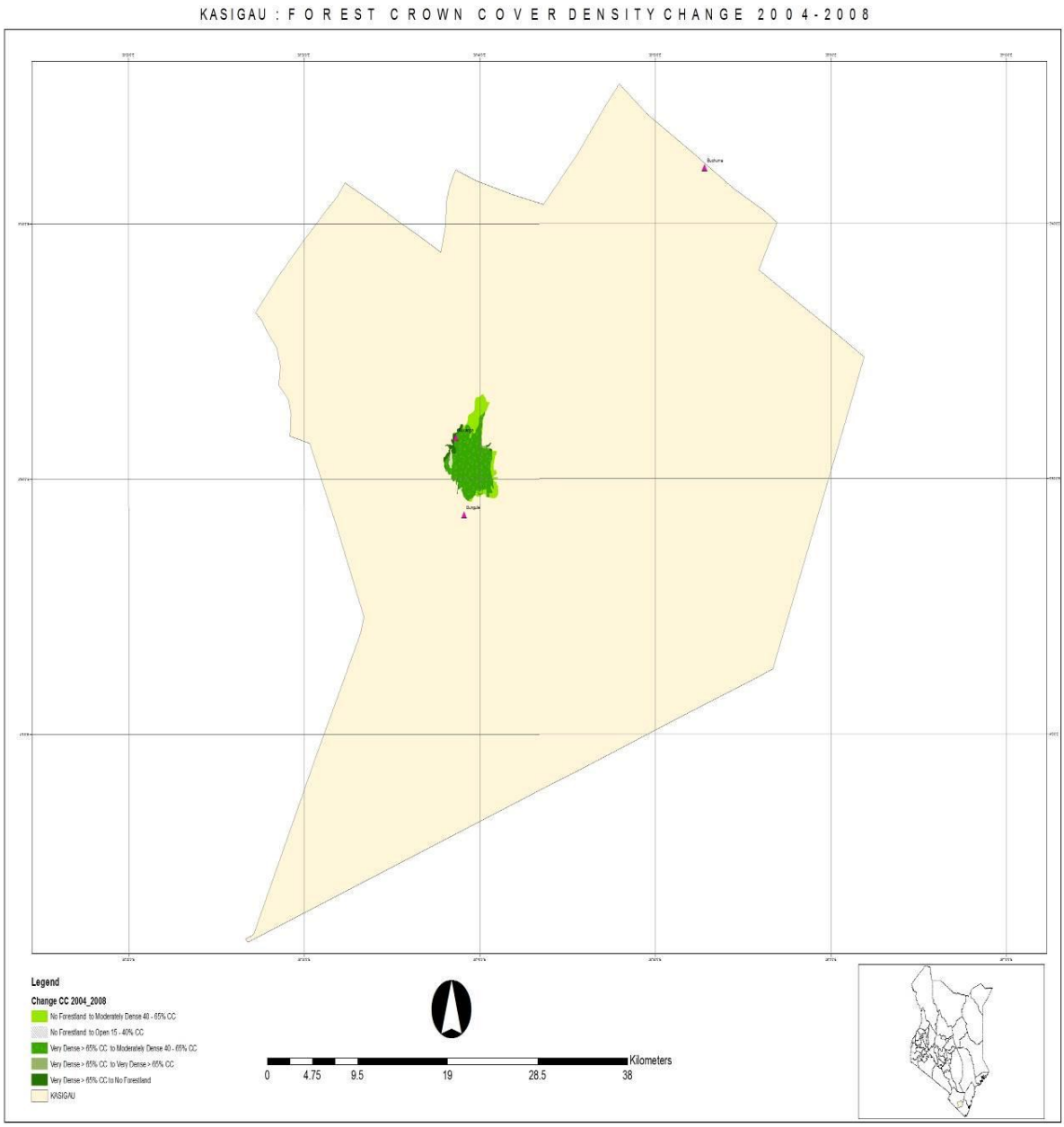

Figure 7 Forest cover change in Kasigau (2004-2008)

From this map it is noted that some areas covered with forest in in the year 2000 to 2004, the dark green area North East of the map 2004 to 2008(fig 5) had lost upto 65% forest loss had no forest cover in the year 2004-2008 while in the period 2000-2004 the area had lost up to 40% of the forest cover. This tread however change in the subsequent Map 2008-2012 as shown on figure 8 below.

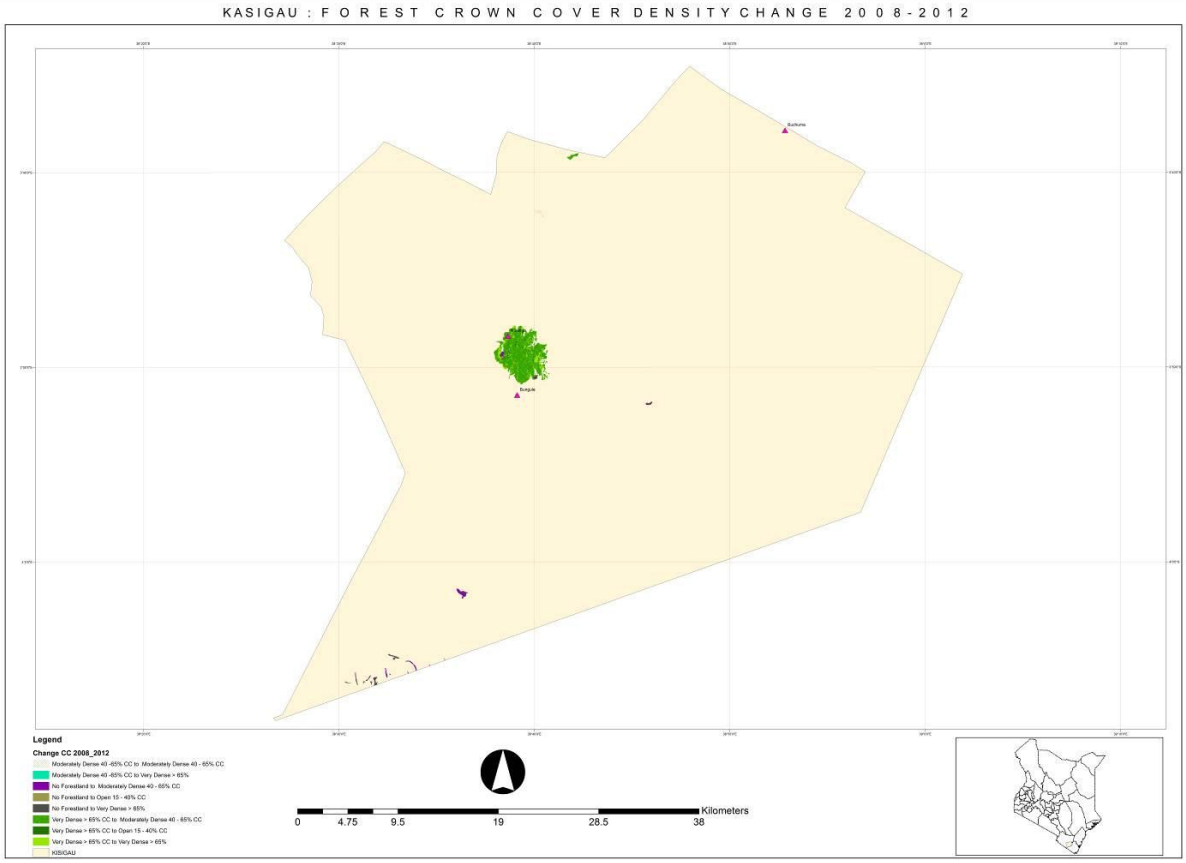

Figure 8 Forest cover change in the period between 2008 to 2012

From these maps it is noted that a positive forest cover change is observed. It is observed that there are some areas in the first two maps that were had lost the forests but in the 2008 to 2012, a change up to 40-65% is observed presented in purple. The figure below presents the three maps for ease in reference.

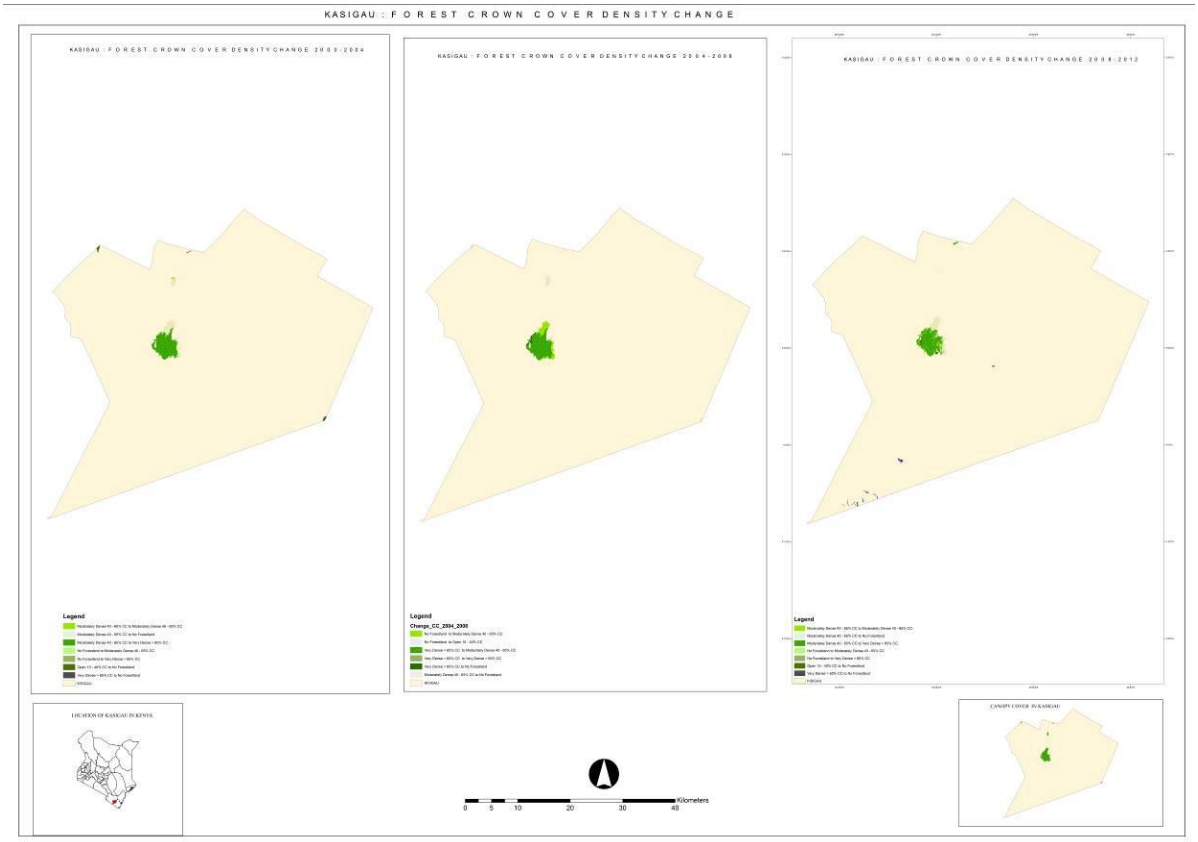

Figure 9 Combined maps for forest cover change from 2000 to year 2012

Further discussions with the Wildlife Works found out that by employing alternative sources of income to communities in the project area had seen reduction in charcoal burning and increased reforestation activities.

Kasigau REDD+ project has two phases, the analysis for the carbon reduction was conducted under the phases under Voluntary Carbon Standards (VCS) and Climate Community and Biodiversity Standard (CCBS). In the first phase, 300,000 tonnes carbon were delivered under the Kasigau REDD+ project, while 49,000,000 tonnes of carbon were delivered under the second phase of the project.

Based on the above carbon reduction amounts, the amount of revenue generated by the carbon removal by the project, the price negotiated by the Kasigau REDD+ project developers was US$ 5.7 per carbon credit. Using this price, in 2012, only 600,000 VCS units were sold. In calculating the benefits accrued, a benefit sharing was as depicted in the table below.

Table 2 Kasigau REDD+ proceeds allocation formula

Activity/ Recipient	Amount (US$)
Operation costs (US$ 2.5 million)	
Management, validation, verification, rangers, tree plot fees (local)	1 million
Direct cost, greenhouse, construction, employment	1.5 million
Resources shared with communities and the land owners	
Community based organizations (CBOs)	0.5863 million
Private local owners	1 million
Total	3.5863 million

While these figures are provided in the project reports, a quick calculation on the figures the total cash received as per the price is 3.420 million, a difference of 0.1663million is observed.

From the verification reports submitted to the two standards, it has been expected that the business as usual scenario (without the project), Carbon loss was 100% of above ground biomass and 1/3 of soil carbon. Implementation of this project as reported abatement of 49,300,000 tons of carbon hence the payments as indicted above.

With this findings the research rejects the null hypothesis 'carbon markets under REDD+ does not contribute to environmental conservation through enhanced carbon sinks (increased forest

cover' and instead accepts the alternate 'carbon markets under REDD+ contributes to environmental conservation and leads to enhancement of carbon stocks. This has been demonstrated by both payments received as well as GIS maps indicting increased forest cover in the project area.

4.2 Impact of Kasigau REDD+ Project on Community Resilience to Climate Change

This section presents results analysis based on the second research question exploring whether the Kasigau REDD+ project had led to enhanced community resilience to climate change by enhancing livelihoods, measured by household income and proximity to social amenities.

From the $ 3.5863 million realized from sale of 600,000 VCS units sold. With direct costs accounting for 2.5million and 0.5863million being shared with the communities through the committees. The unexplained difference of 0.1663million is however not the focus of this study but the impact resources spent on communities in this project area.

From interviews conducted with the Wildlife Works and local communities, the following were the direct and community costs: employment of community rangers to conduct daily monitoring (86 employed), organic tree nurseries, building and improving local schools and providing bursaries, sustainable Eco- charcoal production, dryland crops: Jojoba, Mega to micro community projects, EPZ and Eco-Factory with direct to consumer in the US and Europe (Puma), Ecotourism and Bio-enterprises: Tsavo Soap Company and Aloe. With these resources and investments in the area, the study sought to find out the contribution of these resources to improvement of livelihoods of communities under the project area.

The difference of distribution of income between the two groups a density curve and boxplots were employed as shown in figure 10 and 11 below

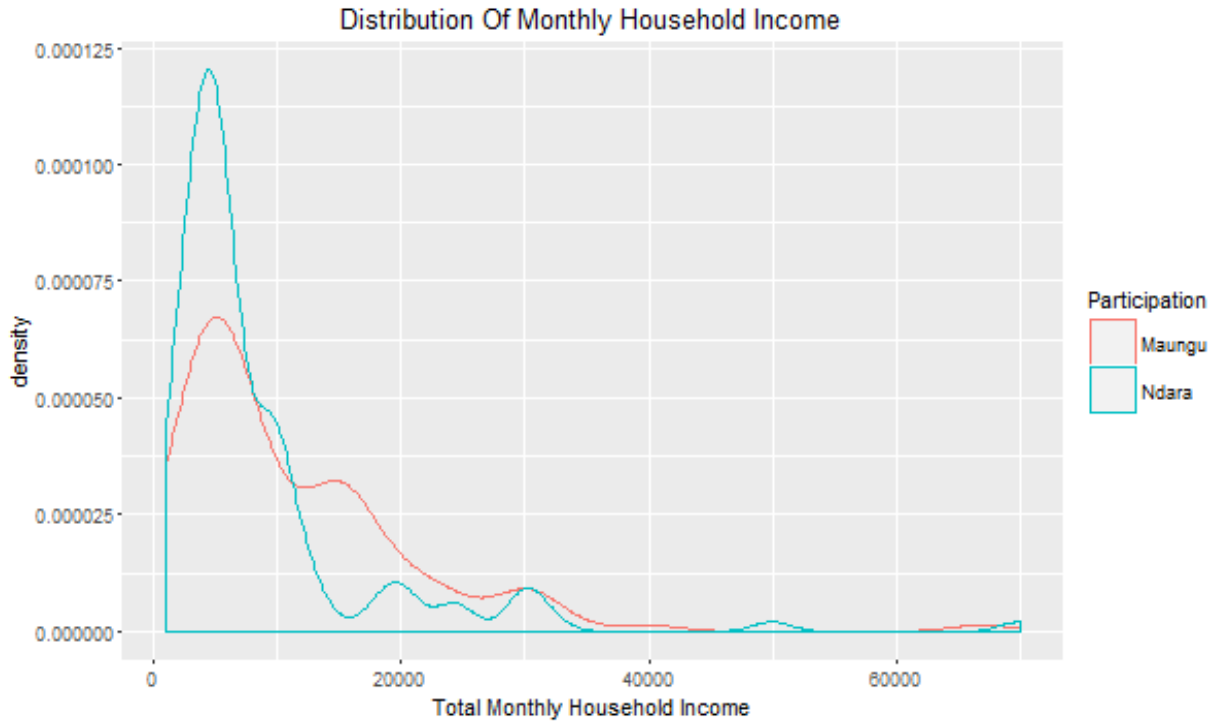

Figure 10 Mean and standard deviation of house hold income

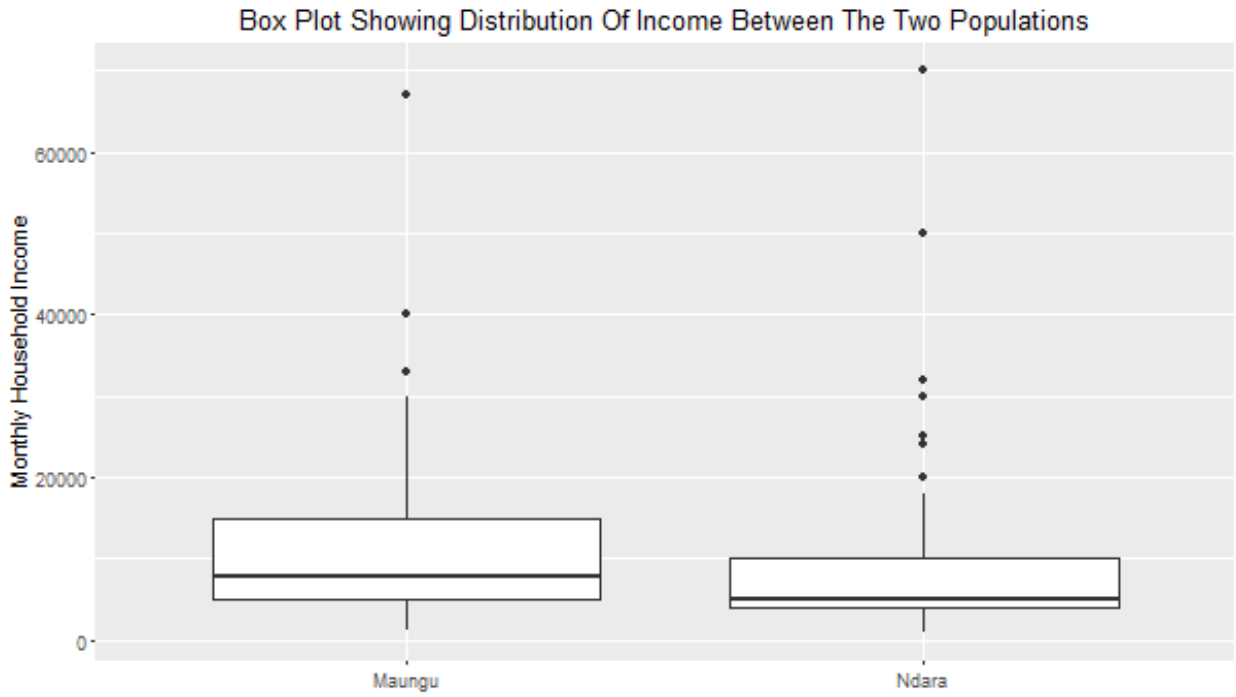

Figure 11 Box plot showing the distribution of income between the two populations

A t-test was further carried out to determine the significance of the difference. Below is a section of the output. t = 2.1259, df = 233.18, p-value = 0.03456 with this the alternative hypothesis is true since the difference in mean is not equal to 0. Further, at 95 percent confidence interval the sample estimates in Mean in Maungu is 11235.96 and mean in Ndara is 8568.00. The p-value is low (0.03456) hence we can confidently reject the null hypothesis, and conclude there is significant difference between the means of the two groups.

Comparing the median difference between the treated and control population, the following was depicted:

Table 3 Median and standard deviation of the two populations

Statistics	Ndara B Ranch (N=124)	Maungu Ranch (N=124)	Overall (N=248)
Median	5,000	6,500	9,758.92
Std. Deviation	9,509.05	9,876.97	9,746.68
Minimum	1,000.00	0.00	0.00
Maximum	70,000.00	67,000.00	70,000.00

From the table above, the median of the household income in the two sample areas is depicted, and shows that Maungu Ranch, where the Kasigau REDD+ project is being undertaken, is higher than the household income in Ndara Ranch, which is the control. A measure of median was used, as opposed to mean, since the former has less statistical elasticity and is more representative of the measure being sought. These results indicate that household income in the location of the REDD+ project were comparatively higher than those of the location without the REDD+ project.

Charcoal production has been identified as a key driver of deforestation both nationally and also in the area of study. From further analysis on the source of income for house hold wealth, charcoal production forms part of the livelihood of six percent (6%) of the total 248 sampled households from both Maungu Ranch and Ndara B Ranch. The percentage of the sampled households that engage in charcoal production by deforestation is 2.5% and 9.4% for Maungu Ranch (Treated) and Ndara B Ranch (Control) respectively. This low percentage of charcoal production is lower in the treated group since their participation in the REDD+ programme, is compensated for avoided deforestation and forest degradation by Wildlife Works from the sale of carbon. These incentives from the REDD+ program are aimed at changing the behavior of the

households towards land use change of converting forests into agricultural land or for charcoal production. This acts as an alternative source of income for the participants within the treated group which the control group does not get.

To further identify the difference in income in the area could be attributed to REDD+ program in the two ranches, the level of education was assessed. This is informed by an assumption that if the area has a high number of population educated past secondary school level, then chances are that they may have relocated to other urban areas and would be sending money home particularly with the Mpesa facility available to most Kenyans. The area under research is under (Taita Taveta district), now County which has a very low literacy level. This can either be attributed to having high poverty levels or very few schools in the area which hinders access to good education. From the overall sample, 53% of the households have attended school up to primary level; 24% got to the secondary level of education; 19% did not attend school at all thus have no formal education, while only 4% of the sampled households have studied up to the tertiary level. This indicates the low level of education or literacy for the residence of the area.

The difference in the level of education between the two ranches is evident as shown in figure 12 below which shows that Ndara has a higher literacy level compared to Maungu Ranch.

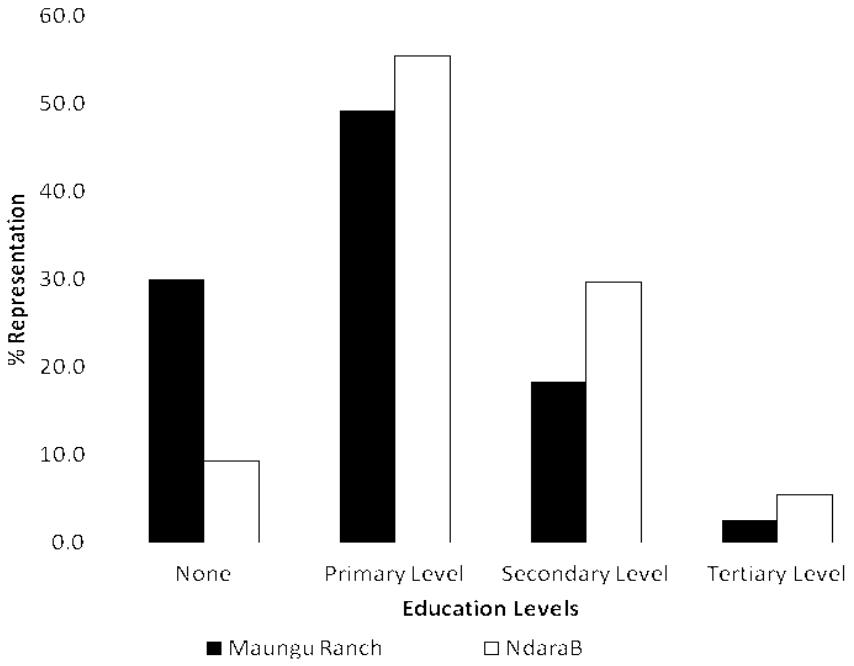

Figure 12 Distribution of the level of education of the Respondents

This finding therefore eliminates chances of having external income from family in urban areas since the treated area Maungu has lower education levels but with higher house hold income as compared to Ndara ranch. Communities in the treated area (Maungu) are investing the part of their resources received from the REDD+ project on education bursaries. It is expected that over time the numbers as indicated in this figure 12 will change, having a higher number of persons past secondary level in Maungu.

A density plot and boxplots were also used to visualize difference in distances from health centers between the two groups. As shown in the figures 13 and 14 below, the distance to health facilities.

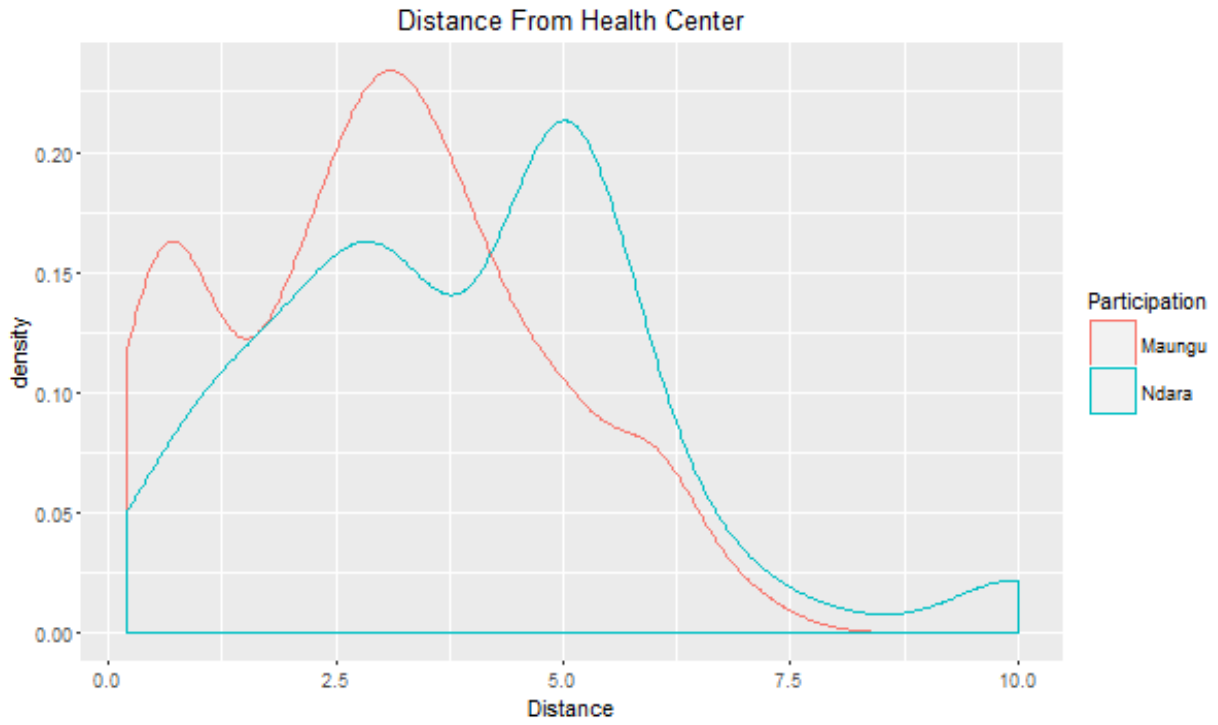

Figure 13 Distance to health facilities in both Maungu and Ndara Ranch

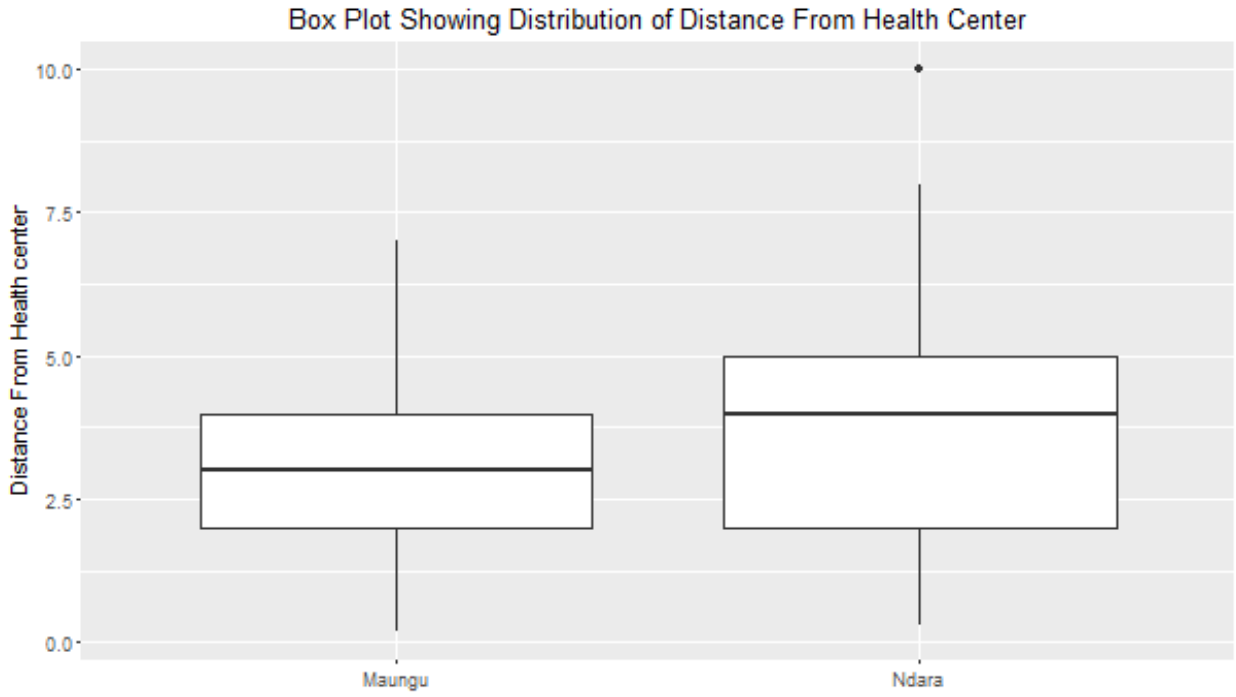

Figure 14 Box plot showing distribution of distance to the health centers in both Maungu and Ndara

Further, a t-test was also conducted, the output of the t-test is t = -3.7608, df = 239.96, p-value = 0.0002129, with this results it shows the difference in means is not equal to 0 since the mean in group Maungu is 3.001261 while that of Ndara is 3.926772, At 95 percent confidence interval of -1.4102936(Maungu) and -0.4407287(Ndara) respectively. The p-value is very low (0.0002129) hence we can confidently reject the null hypothesis, to conclude that there is significant difference in the distances to health centers for residents in the two areas, which could be attributed to the REDD+ project.

To determine if there was difference in distance from schools between the two groups a density plot and boxplots were also used for visualization. The figures 15 and 16 shown below depict the distances to school facilities in the both Maungu and Ndara ranch.

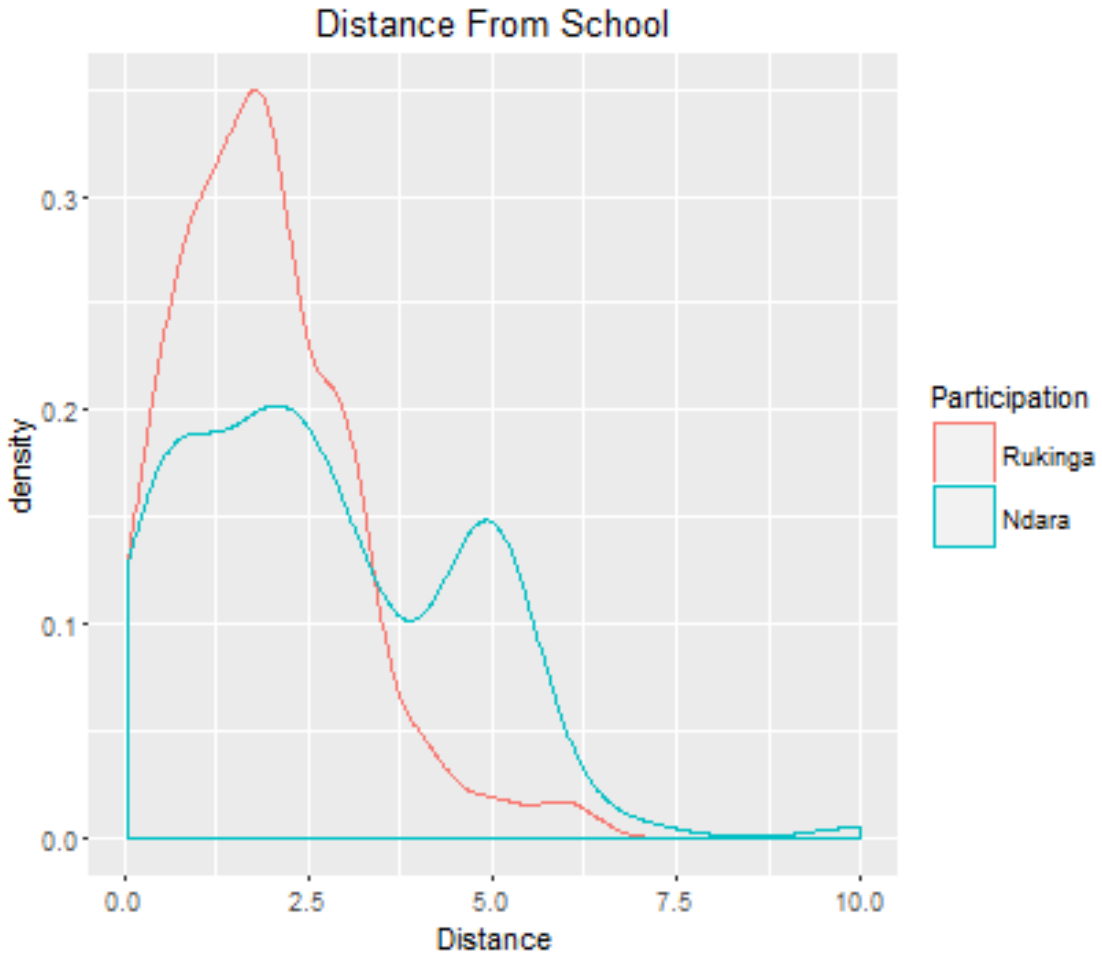

Figure 15 Distance to schools in Maungu and Ndara

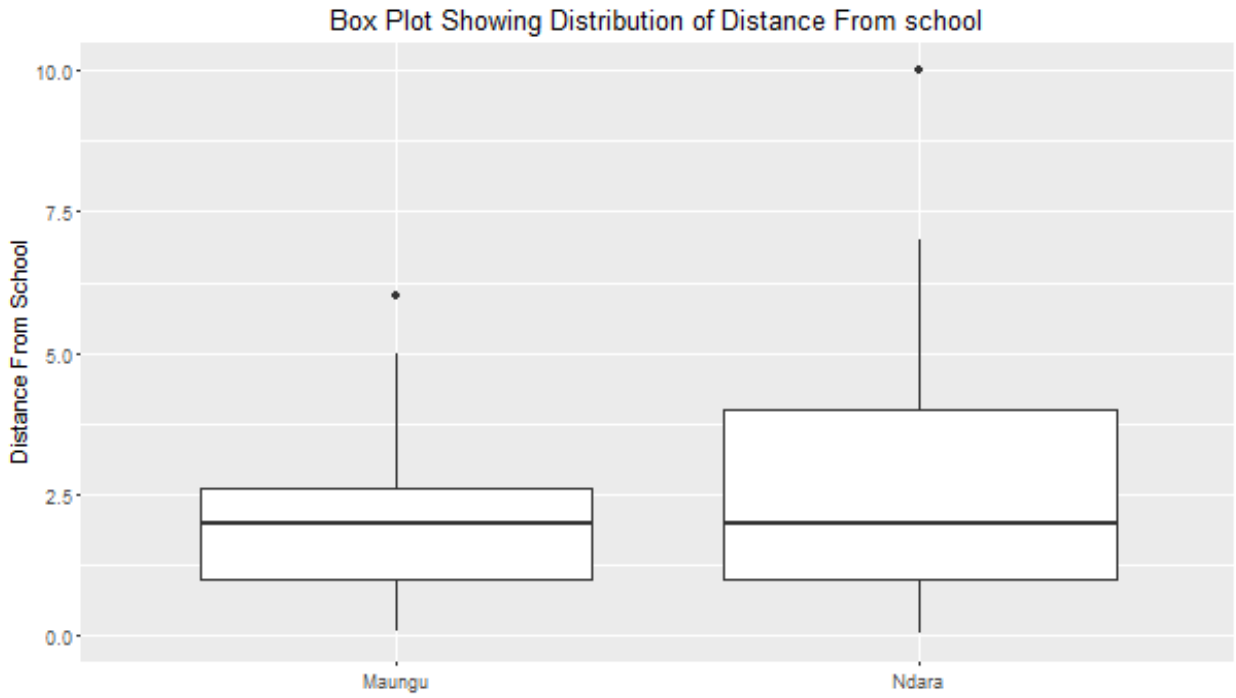

Figure 16 Box Plot of the distance from schools in both Maungu and Ndara ranches

Output of the t-test shoe t as -3.8941, df = 213.56, and the p-value being 0.0001318 since the difference in the means is not equal to 0 and at a 95 percent confidence interval, -1.1657075 and -0.3821893 for Maungu and Ndara respectively, Mean distance to schools in Maungu is 1.880417 while the mean distance to schools in Ndara is 2.654365. The p-value was very low hence evidence of a significant difference between the mean distance from hospitals of the two groups

As regards community benefits from the REDD+ project, which in turn enhance the community's resilience to climate change change, proximity to social amenities for the two groups of ranches under study was undertaken. From this analysis, households living in Maungu Ranch had closer proximity to schools (mean of 2.65) as compared to Maungu Ranch (mean of

1.88), meausred in kilometers. Further, the proximity to health centers was closer for residents of Maungu Ranch (mean of 3.00) than those living in Ndara Ranch (mean of 3.93), measured in kilometers. However, proximity to shopping centers was closer for residents of Ndara Ranch (mean of 4.25) as compared to those of Maungu Ranch (mean of 4.69).

A number of benefits have been reported accrued by households living in Maungu Ranch, the location of the Kasgiau REDD+ project as shown in figure 17 below. The greatest benefits reported were the education bursary scheme, energy saving jikos (stoves), employment and water project, in their respective descending order.

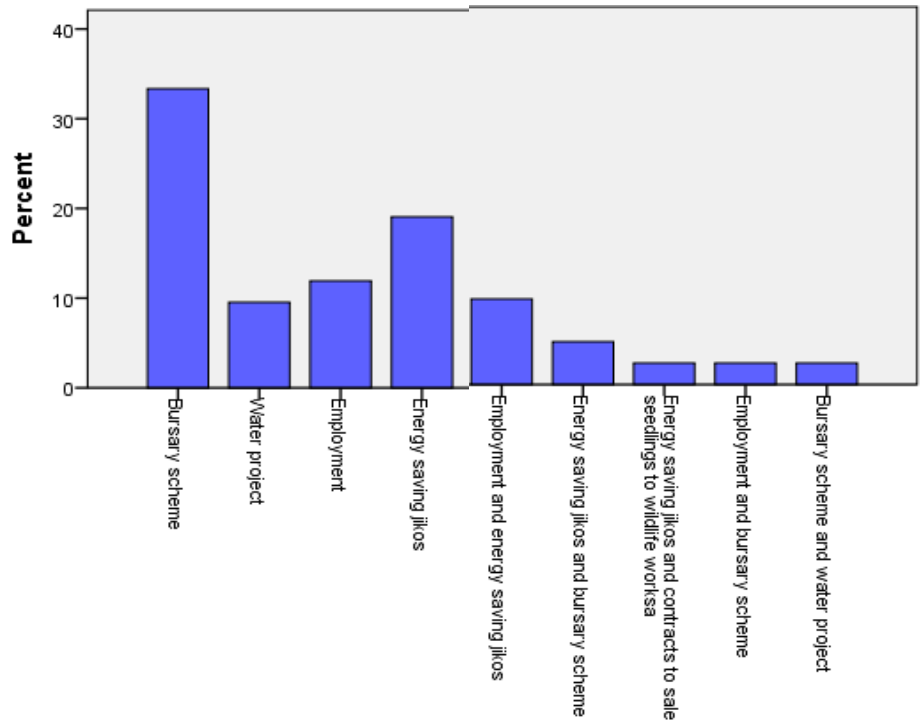

Figure 17 Benefits received since inception of REDD+ project

The main socio-economic activity in the research area, was found to be agriculture (subsistence) and livestock farming though on small scale. The area has experienced the impacts of the global phenomenon of climate change in the form of frequent droughts and unreliable rainfall. 37 per

cent of the sampled households attribute the declining trend in their average monthly income to climate change while 9 per cent of them attribute the decline to land use changes, that is, deforestation for expanding agricultural land and charcoal production. In total, 48% of the sampled households attributed the decline in their average monthly income to climate change which they largely attribute to land use change, mainly deforestation for agricultural land and human settlement. Another indicator of climate change in the area is human-wildlife conflict which affects 2.4 per cent of the sampled households.

Based on the above results, the study rejects the Null hypothesis that "Carbon markets under REDD+ does not contribute to enhancement of community resilience to climate change through improved household income' and instead accepts that carbon markets under REDD+ contributes to enhancement of community resilience to climate change through improved household income. The study has shown that implementation of REDD+ can indeed increase the household wealth of those participating in the program. As shown participants in this case receive payments directly through community institutions e.g. associations, they use the financial proceeds to either pay school fees, development of water project among other development initiatives.

Other benefits from participation are, employment, receiving an energy saving jikos or contracts with Wildlife Works to supply seedlings. All this together impact on the disposable income of the households participating thus are able to invest in other income generating activities or other uses. Availability of water projects in this area often experiencing droughts goes a long way in enabling communities in dealing with the hazard.

CHAPTER FIVE

5.0 CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

Evidence provided by this research shows that carbon markets under REDD+ provide an extraordinary opportunity to use the power of the global carbon marketplace as a source of new and significant conservation finance to preserve some of the most biodiversity-rich primary forests on the planet, preserving entire ecosystems, while enhancing the quality of life of forest communities and providing an economic return to governments and landowners.

Reducing emissions from deforestation and forest degradation, and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks (REDD+) - an international climate change mitigation mechanism which seeks to compensate governments, communities, companies or individuals in developing countries for actions taken to sustainably manage forests or enhance carbon stocks within forested areas can indeed provide an avenue for resilience enhancement. As REDD+ seeks to create value for the carbon stored in forests.

While REDD+ seeks to support sustainable forest management and conservation through policy initiatives and countrywide actions that among others: Prevention of conversion of forest lands to agriculture, settlements and related infrastructural developments, Protecting important forest ecosystems and enhancing their sustainable management ; Promoting energy conservation and energy efficient technologies ; Building the capacities of local communities to enhance their participation in forest management and conservation activities, Increasing afforestation and establishment on woodlots on private land to reduce the current national timber deficit and Increasing agricultural productivity in areas that have been opened up for agriculture, its success is highly dependent on community participation and ownership.

The Kasigau project has contributed to increased household income and has received support from communities and stakeholders in the area. It is of importance to highlight that communities in the project area have been involved in decision making and particularly on how and where to invest the community part of the proceeds (USD 0.5863 million). Through the committees formed at the community level, communities living in this area invest in social amenities as well pay school bursaries for their children. It should be noted that this creates ownership of the natural resource (forests) in Kasigau and attachment of economic value to standing trees. If the same is adopted at the national level, results form this study show it could lead to reduced rate of forest degradation and deforestation. As indicated by the study on drivers of deforestation in the country, poor public participation and little or no benefits from conservation work has contributed to the increasing deforestation and forest degradation.

As indicated by the Stern Review on the Economics of Climate Change (2006), that at a national level defining property rights to forestland and determining the rights and responsibilities of land owners, communities, and loggers is essential to effective forest management for carbon sequestration.' They further mention the need to involve local communities in forest management and to respect informal rights and social structures, work with development goals and reinforce the process of protecting the forests. The Kasigau REDD+ projects has demonstrated that if and when communities are provided an opportunity to make decisions on properties affecting them they prioritize on where to invest for their own benefits and acan hence protect the forests around them .

5.2 Recommendations

Past attempts to increase forest cover and address the problem of deforestation and forest degradation in the country have not been very successful undermined by among others increasing demand for land for agriculture, settlement and other developments, high energy demand and inadequate funding to support investments in the forestry sector. Unresponsive policy and Poor governance in the forestry sector have often in the past compounded the problems. REDD+ presents an opportunity to reverse the negative trend by providing incentives that support implementation of a comprehensive strategy that effectively supports sustainable management and conservation of existing forested areas.

Like other major mitigation options, realizing the potential of REDD+ to contribute to climate change mitigation at the national level will require the development and implementation of national development strategies to transform the relevant sectors, building on past experience. Kasigau project forms part of the experiences that Kenya will look into while developing the national strategy.

To inform the national strategy, assessment of land use, forest policy and governance should be conducted to identify sustainable charcoal production and use mechanism at the national level. As one of the major drivers of deforestation and forest degradation at the national level; as observed at Kasisgu, mechanisms and policies on energy saving jikos should be explored . This could be included as part of REDD+ strategy formulation process, to contribute towards identification and promotion of viable options that address sustainable production and consumption of charcoal in the country. However, lack of policy attention in the past means that

critical baseline data is missing in addition to structural governance deficits, which is a major requirement in a REDD+ mechanism as well as a carbon markets.

As the government of Kenya advances the REDD+ readiness work, and working towards the Warsaw pillars in preparation of the UNFCCC financing mechanism, it would be useful to look at the following lessons exhibited by this research:

Partnership between the private sector, government and communities will facilitate a positive gain in sustainable management of forests and poverty reduction at the same time. As presented by the sustainable development goals, investment in reducing greenhouse gases emissions mechanisms including in the forestry sector is inevitable. Partnership between the Wildlife Works (the private investor) and communities in Kasigau is a good case example.

Institutionalization of payment of ecosystem services in climate change and sustainable land management through country policy framework is required at the national level. Further study on this is recommended. Committees at Kasigau project area have come up with their institutions that will contribute to this at their local level. This model could be included in the Benefit Sharing Bill 2014, currently in Senate or the Forest Bill 2015.

A benefit sharing formula in forests conservation could be considered. This will institutionalize benefit sharing for community forest associations and other forest dependent communities participating in conservation of forests either under National and County Government jurisdiction.

For a national project implementation, appropriate and equity financial products should be developed to reduce risks and project transaction costs. This is key in managing the final cash benefits available for participating stakeholders in a REDD+ project.

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Appendix 1:

Questionnaire

INTERVIEW SCHEDULE

TITLE OF STUDY: Assessing contribution of carbon markets to enhancement of carbon sinks and community resilience to climate change: A case of Kasigau corridor REDD project, Kenya

PART 1: INFORMED CONSENT

Instruction to Enumerator: The following statement must be read to every household head/ respondent.

MS. Ndichu Judy Mukami a Master of Science student climate change at the University of Nairobi is conducting a study on (*Refer to the title above*). The information is being collected for academic purposes only and therefore no personal benefits or risks to your participation. The information received will be handled with utmost confidentiality; therefore, the only identifier on the questionnaire will be the questionnaire code. The interview will take approximately thirty-five (35) minutes and I will appreciate if you can answer all the questions. For more information about this study, please contact the researcher on the following number (0720297876) or email (mukami.judy@gmail.com).

1. Consent Granted: YES (proceed with interview)

   NO (thank person and look for next respondent)

The enumerator is required to keep this questionnaire whether the respondent agreed to participate or not.

2. Questionnaire Code: _____

3. Interviewer Name _____

4. Interview date _____Time:_____

5. Name of the Village _____

6. Are you participating in the REDD+ Project: YES:_____ NO: _____

Note: Collect all information in this questionnaire for both participating and non-participating households

PART 2: IMPACT ON HOUSEHOLD WEALTH (INCOME)

A: DEMOGRAPHIC INFORMATION:

Q.	**QUESTIONS**	**RESPONSE**
1.	Age of Respondent	{ }Years
2.	Sex	Male : { } Female: { }
3.	Marital Status	Single { } Married { } Widow/Widower { }

4.	What is the highest level of education attained?	• Not attended Any { } • Primary School { } • Secondary School { } • Tertiary { }
5.	What is the House-hold size	
6.	Are you from the indigenous community or an immigrant?	i. Indigenous { } ii. Immigrant { }
7.	Accessibility to the Education: How far is it to the nearest School ((i) Primary (ii) and Secondary (iii) College)	
8.	Accessibility to Health Care Facility: How far is it to the nearest Health Centre	

B: SOCIO-ECONOMIC INFORMATION

Q.	**QUESTIONS**	**RESPONSE**
	How far is your homestead to from the nearest town centre of shopping centre in Km?	
1.	What are your sources of income/ likelihood	i. On-going REDD project { } ii. Crop Farming { }

		iii. Livestock Farming { } iv. Charcoal Production { } v. Out-off Farm/Ranch { } vi. Tourism Ventures { } vii. Others- (Pls indicate) { }
2.	How much is your average monthly income earning from each of your sources of income stated above (No.1) since start of the REDD project	**(Amounts in Kshs**.) i. On-going REDD project {Kshs_____} ii. Crop Farming {Kshs_____ } iii. Livestock Farming {Kshs_____ } iv. Charcoal Production {Kshs_____ } v. Out-off Farm/Ranch {Kshs_____ } vi. Tourism Venture {Kshs_____} vii. Others- (Pls indicate) {Kshs_____ }
	NOTE: QUESTION 3, 4 AND 5 SHOULD BE ASKED SPECIFICALLY TO HOUSEHOLDS PARTICIPATING IN THE REDD PROJECT ONLY	
3.	Has there been any increase or decrease on your household income level since 2006 to date?	i. Increase { } ii. Decrease { } No Change { }
4. a)	If there has been an increase in 3 above, how much or by what percentage has it changed?	

4.(b)	If there has been a decrease in 3 above, how much or by what percentage has it changed?	
5.(a)	Which economic activity can you attribute to have contributed to the increase, decrease or stagnation in household income level? (Increase in income level)? Please list them in the order, from the most likely cause to the least	i. On-going REDD project { } ii. Crop-Farming { } iii. Livestock Farming { } iv. Charcoal Production { } v. Out-off Farm/Ranch { } vi. Tourism Venture { } Other Factors (List 2/3) { }
(b)	Brief Explanation to 5 (a) above:	
8.	**Human Capital**	
(a)	Have you been employed or any member of your family employed by the initiative	Employed: Yes { } No { } No. of Family Members Employed: { }
(b)	How many members of your family provide labour that contributes to the household income?	

9.	Do you belong to any association e.g. Farmers Association	YES { } NO { } State the main function of the association:
10.	What are the financial capitals you have received since the start of the project?	
(a)	Benefits from projects – Types and year benefited e.g. water project, bursary schemes, development of health facility	
(b)	Have you been able to access credit facilities?	YES { } NO { }

NOTE: (To Capture the behavior Change of the Communities on Conservation)

What are some activities you are undertaking that are linked to conservation? How has it benefited you?

C. ASSETS, SOURCE OF INCOME AND ATTRIBUTION TO REDD+

Q.	**QUESTIONS**	**RESPONSE**
1.	What is estimated area of land owned by your household in acres or hectares?	
2.	How much area of your land has been placed under: a) REDD Project? (acres/	

	hectares)	
	(b) Other income generating initiatives mentioned in (B.1) above?	i. Livestock Farming { } ii. Crop Farming { } iii. Livestock Farming { } iv. Charcoal Production { } v. Out-off Farm/Ranch { } vi. Tourism Ventures { } vii. Others- (Pls indicate) { }
3.	What is the type of land ownership?	i. Private property (title deed) { } ii. Community land { } iii. Leasehold { } iv. Inherited/Ancestral Land { }
4.	What is the process of decision making on land management?	
4.	What are the current land use activities?	i. Grazing { } ii. Crop farming { } iii. Charcoal burning { } iv. Tourism venture { } v. Others (list) { }

PART 3: IMPACT ON CONSERVATION

IMPACT OF PAYMENT FOR ECOSYSTEM SERVICES ON CONSERVATION (Target Interviewees – Wildlife Works Company & Other Researches in the Area)

Q.	QUESTIONS	RESPONSE
1.	What is the total area of land under the REDD project? i.e. Phase I (Acres or Hectares)	
2.a)	What has been the total amount of carbon sequestrated in the area under the project over the following years?	• 2005 – { } • 2006 – { } • 2007 – { } • 2008 – { } • 2009 – { } • 2010 – { } • 2011 – { } • 2012 – { }
b).	What has been the total amount of carbon sequestrated in the adjacent ranches outside the project area for a similar period as above?	• 2005 – { } • 2006 – { } • 2007 – { } • 2008 – { } • 2009 – { }

		• 2010 – { } • 2011 – { } • 2012 – { }
3.	What has been the changes in percentage tree cover in Rukinga Ranch since the inception of the project	
4.	What factors may have contributed to the situation in 3 above and 2(a) above	
5.	How much does Wildlife Works receive from the REDD project (Conservation) under the Voluntary Carbon Market per Year	
6.	How is the amount mentioned in 5 above shared? (Contractual Arrangements) – (what percentage goes to the community)	
7.	How is the amount in 5 above channeled to the beneficiaries(communities)	
8.	Apart from monetary benefits what are the other benefits to the community resulting from the REDD project? (list at least 5)	
9	What was the total population of the project area at the beginning of the project	
10	What is the population today 4 years after the	

	certification of the project	
11	Have you observed immigrants to the project area for different reasons eg *business venture* and to what extent can you attribute this to the project as a pull factor	

ANNEX 2

DEFINITION OF TERMS AS USED IN THE DISSERTATION

Carbon market: A market that is created from the trading of carbon emission allowances to encourage or help countries and companies to limit their carbon dioxide (CO_2) emissions. This is also known as emissions or carbon trading. Carbon emissions trading is a way of reducing greenhouse gases produced developed countries.

Additionality: It is a determination of whether an intervention has an effect, when the intervention is compared to a baseline. This refers to emissions reduction or conservational benefits that have occurred due to an intervention.

Leakage: Used to describe the situation that may occur if, for reasons of costs related to climate policies, businesses transfer production to other geographical areas which have no or laxer constraints on greenhouse gas emissions. This could lead to an increase in their total emissions.

REDD+ activities: Refers to the following activities agreed on by the United Nations Framework Convention on Climate Change (UNFCCC) a) Reducing emissions from deforestation. (b) Reducing emissions from forest degradation. (c) Conservation of forest carbon stocks. (d) Sustainable management of forests. (e) Enhancement of forest carbon stocks