POTENTIAL PAYMENT FOR ECOSYSTEM SERVICES (PES) SCHEME IN LAKE OL BOLOSSAT NYANDARWA COUNTY

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DECLARATION

This research project is my original work and has not been presented for a degree in any other university.

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APPROVAL

This research project has been submitted for examination with my approval as a University Supervisor (Department of Environmental Planning and Management)

Signature ……. Date ……..

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DEDICATION

I dedicate this project to my beloved parents MR. & MRS Cyrus Mbote Mburu for their great love and support through the project.

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I wish to thank the Almighty God for seeing me through the whole time I undertook the project

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I wish to thank Kenyatta University: Department of Environmental Planning and Management for offering this unit, providing us with an opportunity to have an in depth understanding of our environment and its impact on livelihoods.

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ABSTRACT

The state of the world's waters remains fragile and the need for an integrated and sustainable approach to water resource management is as pressing as ever. Available supplies are under great duress as a result of high population growth, unsustainable consumption patterns, poor management practices, pollution, and inadequate investment in infrastructure and low efficiency in water-use. Wetlands which considered biologically diverse areas are sources of water that are also under threat and Lake Ol Bolossat is one of them-It serves as a catchment for Ewaso Nyiro River, the marshes and swamps that form 85% of the lake ecosystem filter and purify the water. The wetland was noted to have been diminishing due to human encroachment and his subsequent activities. Several initiatives have been undertaken in the past to address these issues. However these initiatives have been largely ineffective due to several factors, which include fragmented and sectorial approach in initiation and implementation, limited scope and objective, weak interagency linkages, inadequate stakeholder involvement and lack of a financial structure that funds conservation. The overall weakness has been lack of a framework that integrates and guides these initiatives to achieve the overall environmental conservation and development targets. Researchers argue that of the five mechanisms available for ensuring the provision of ecosystem services – prescription, penalties, persuasion, property rights and payments – only payments are likely to be effective at the global level. Payments for Ecosystem Services (PES)-is the practice of offering incentives to farmers or landowners in exchange for managing their land to provide some sort of ecological service. These programs promote the conservation of natural resources in the marketplace and the researcher aimed at determining the potential of establishing a Payment for Ecosystem Services (PES) Scheme in Lake OL Bolossat. A sample size of 60 people and 30 CBOs officials was taken to represent the entire population in the area using proximate representative estimation. Simple random sampling was then used and snowball sampling was used in CBOs interviews to identify the respondents. Findings were analyzed using Statistical Package for Social Sciences (SPSS) and Microsoft excel and represented in the form of bar graphs and pie charts. The study looks forward to giving recommendations on the way forward in the setting up of a PES scheme in the area to help in conserving the ecosystem.

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ABBREVIATIONS

PES- Payment for Ecosystem Services

IPES- International Payment for Ecosystem Services

WWF- Wild Wide Fund for Nature

USAID- United States Agency for International Development

WRUA- Water Resource Users association

CBOs- Community Based Organizations

GDP- Gross Domestic Product

NGO- Non- Governmental Organization

UNEP- United Nations Environment Programme

CHAPTER ONE: INTRODUCTION

1.1 Problem Background

The state of the world's waters remains fragile and the need for an integrated and sustainable approach to water resource management is as pressing as ever. Available supplies are under great duress as a result of high population growth, unsustainable consumption patterns, poor management practices, pollution, and inadequate investment in infrastructure and low efficiency in water-use. The water-supply-demand gap is likely to grow wider still, threatening economic and social development and environmental sustainability. Integrated water resource management will be of crucial importance in overcoming water scarcity. The Millennium Development Goals have helped to highlight the importance of access to safe drinking water supplies and adequate sanitation, which undeniably separates people living healthy and productive lives from those living in poverty and who are most vulnerable to various life-threatening diseases. Making good on the global water and sanitation agenda is crucial to eradicating poverty and achieving the other development goals (UNEP, 2007).

There are various sources of this water which include wetlands which considered biologically diverse areas. According to the Millennium Ecosystem Assessment Report (2005) there are twenty-four specific ecosystem services. These are food production (in the form of crops, livestock, capture fisheries, aquaculture, and wild foods), fibre (in the form of timber, cotton, hemp, and silk), genetic resources (bio-chemicals, natural medicines, and pharmaceuticals), fresh water, air quality regulation, climate regulation, water regulation, erosion regulation, water purification and waste treatment, disease regulation, pest regulation, pollination, natural hazard regulation, and cultural services (including spiritual, religious, and aesthetic values, recreation and ecotourism). Notably, however, there are a "big three" among these 24 services which are currently receiving the most money and interest worldwide. These are climate change mitigation, watershed services and biodiversity conservation, and demand for these services in particular is predicted to continue to grow as time goes on.

Researchers argue that of the five mechanisms available for ensuring the provision of ecosystem services – prescription, penalties, persuasion, property rights and payments – only payments are likely to be effective at the global level. However, while a number of international Payments for Ecosystem Services (IPES) schemes exist, their impact on ecosystem services remains negligible (European Commission DG Env., 2012). Payments for Ecosystem Services (PES), also known as Payments for Environmental Services (or Benefits) broadly defined, is the practice of offering incentives to farmers or landowners in exchange for managing their land to provide some sort of ecological service. These programs promote the conservation of natural resources in the marketplace. The main four types of the environmental services that have been sold were Carbon Capture/Sequestration Services, Biodiversity Protection, Protection of Landscape Beauty, and Watershed Protection (Wunder, 2007).

The growth of watershed based PES has been mainly in Latin America, although China has a major Programme. There are some 'cap and trade' water quality trading systems in the US, Ecuador and Australia, but these are demanding in terms of administrative and enforcement capacity. The main examples of Payment for Biodiversity, landscape beauty and 'bundled' ecosystem services are in Brazil and the USA (European Commission DG Env, 2012).

Regionally WWF and USAID have been working to establish a functioning Equitable Payment for Watershed services scheme in the Mara River Basin which is trans-boundary shared by Kenya and Tanzania (J. Wakibara, A. Mwakaje, C. Mung'ong'o & D. Ong'are, 2011). WWF has been broadly involved in PES in Kenya and they have seen through the establishment of one scheme between the Lake Naivasha Water Resource Users Association (WRUA) and the Kinangop WRUA.

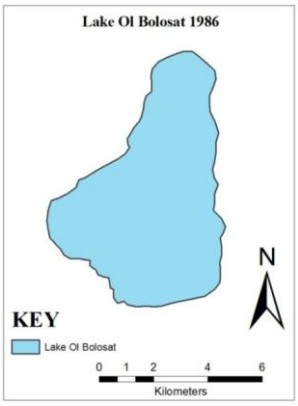
1.2 Statement of the problem

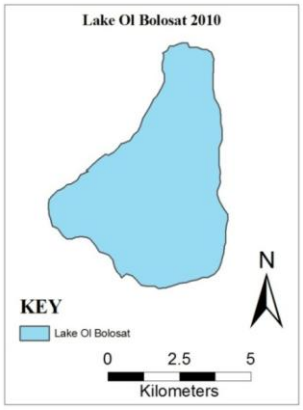
Lake Ol Bolossat has been recognized as an important wetland. The lake is an important bird area it being a stopover for migratory birds from as far as Australia, Europe and Egypt. It also serves as a catchment for Ewaso Nyiro River and supports important functions and lifestyles of communities living in the arid and semi-arid parts of North

Eastern, Eastern and Rift Valley provinces. The marshes and swamps that form 85% of the lake ecosystem filter and purify the water. The streams that feed the lake provide water for domestic use and irrigation. However, the wetland was noted to have been diminishing due to human encroachment and his subsequent activities.

Plate 1.1 Image of the Lake in 1986. Plate 1.2 Image of the Lake in 2010.

Plate 1.3 Map of the Lake in 1986. Plate 1.4 Map of the Lake in 2010.





Source: Field Survey, 2014.

Area coverage of changes in Lake Ol Bolossat

Date	Area in Km^2
1986	8. 40
2010	6.99

Source: Field Survey, 2014

The two land cover satellite imageries for 1986 and 2010 above were used to detect changes within the Lake. The Lake was noted to have significantly shrunk between the periods of study. Farmlands were noted to have increased owing to the rapid rise in commercial and subsistence agriculture favored by the humid tropical climatic conditions of the highland. Upstream deforestation lost some of forest area and floodplains reduced with a majority of the area being gradually turned to farmland. Built-up area generally increased as a result of settlement of some Post election violence victims in the riparian zones(Olang Luke, March 21, 2013).Several initiatives have been undertaken in the past to address these issues. However these initiatives have been largely ineffective due to several factors, which include fragmented and sectoral approach in initiation and implementation, limited scope and objective, weak interagency linkages, inadequate stakeholder involvement and lack of a financial structure that funds conservation. The overall weakness has been lack of a framework that integrates and guides these initiatives to achieve the overall environmental conservation and development targets.

PES practices offer incentives to farmers or landowners in exchange for managing their land to provide some sort of ecological service and in this way promote the conservation of natural resources in the marketplace. PES will see the conservation of the catchment prioritized while and also improve the livelihoods of the local community.

1.3 Research questions

1. What ecosystem services exist in the lake?
2. Which PES mechanism will yield the desired socio-economic and ecological outcomes?
3. Who are or can be the potential buyers in the PES scheme?
4. Which PES scheme is preferred by the community?

1.4 Research objectives

The broad objective of this research is to Identifying Ecosystem Service Prospects and Potential Buyers in a PES scheme in Lake Ol Bolossat.

1. Assessing the ecosystem services in Lake Ol Bolossat
2. Determining a PES mechanism for use in Lake Ol Bolossat
3. Identifying potential buyers who benefit from the services.
4. Assess the community's consideration on whether to sell as individuals or as a group.

1.5 Premises

1. There are ecosystem services in Lake Ol Bolossat.
2. There are various PES mechanisms that can be used in Lake Ol Bolossat.
3. There are various buyers in a potential PES mechanism.
4. There are CBOs that can be used to sell the ecosystem services.

1.6 Justification of the study

According to the Integrated Management plan for Lake Ol Bolossat (2008-2013), the lake is located in Nyandarwa North District of Central Province – Kenya. It is rich in biodiversity and is habitat for numerous species of water birds some of which are rated as rare and / or threatened. Several species of Pale-arctic and afro-tropical migrant water bird species have been recorded at the lake that also harbors a large number of hippos. The lake catchment and basin are important for local and national socio - economic development especially agriculture. The escarpment that fringes the lake to the west creates beautiful scenery. The central location of the lake with respect to the national tourist circuit and its proximity to the equator confer the site an added advantage. The potential for tourism development is high but remains largely unexploited. The lake was as placed as the 61st bird watching area in Kenya as of 2008. Agriculture which is the main economic activity around the lake is posing a great danger to the survival of the lake and this also happens to be the case with the biodiversity hence the need to seek alternate sources of income to the community to supplement some of the income from agriculture.

The potential of the lake if not well exploited to benefit the community as well as protect the lakes ecological integrity will see the lake end on its death bed in no time and for this reason it's important to carry out a study to determine the potential of other practices to promote conservation while at the same time offering economic value to the communities.

1.7 Significance

The lake ecosystem is a source of water for Nyahururu Municipality that serves a population of over 15,000 and the communities living downstream. It is also an important livestock dry season grazing area. There is a thriving tourist industry in Samburu, Shaba and Buffalo springs National Reserves is made possible by the flow of the Ewaso Nyiro River whose origin is from the Lake Ol Bolossat. The lake itself being a bird watching site is also a tourist attraction in the area. Tourism is an important contributor to the Kenyan GDP and a driver of the economy which is one of the pillars in Vision 2030; the others are the Political pillar and the Social Pillar where the Environment falls. The constitution of Kenya 2010 has seen devolution taking stage in the country, there is need for this government to gain income from all the available opportunities and the tourism potential of Lake Ol Bolossat is an opportunity for Nyandarwa County. The potential for tourism in the area is very high and the use of ecotourism as a mechanism for payment for ecosystem services in this case would contribute to alternate income generation to the farmers whose agricultural practices are the main threat to the wetland and thus saving this important ecological and economic asset of the county and country.

Anthropogenic disturbances such as catchment degradation, siltation, overgrazing, introduction of alien species, fires, encroachment on the riparian land, pollution and water abstraction are threatening the lake ecosystem values, functions and ecological integrity. Given the increasing human population in the lake basin and its catchment, the pressure on the natural resources is high and is anticipated to increase. The current trend in land use practices in the lake basin and its catchment demands for an integration approach to the conservation of natural resources in the overall local community development needs. Conflicting interests such as the need to settle landless citizens on the

riparian land and the commitment to conserve natural resources are set against each other at the lake basin (Lake Ol Bolossat Integrated Management Plan).

The project aims at bringing together all stakeholders to ensure that the lake is conserved as well as promote the growth of the local community by utilizing the resource at their disposal in a proper way.

1.8 Scope and limitation of study

The study is aimed at determining the potential of a PES scheme specifically identifying Ecosystem Service Prospects, the Potential Buyers and the community's consideration for participating in the scheme so as to protect the integrity of Lake as a resource and the people's interests. The study will be around Lake Ol Bolossat.

The time allocated for the research was very limited and with the vast area to carry out the study it was a challenge for the study. The study was expensive since the researcher had to meet all the costs involved in carrying out the study.

1.9 Operational terms

Payment of ecosystem Services (PES) – also known as **payments for environmental services (or benefits)**, are incentives offered to farmers or landowners in exchange for managing their land to provide some sort of ecological service.

PES programs- they involve contracts between consumers of ecosystem services and the suppliers of these services. However, the majorities of the PES programs are funded by governments and involve intermediaries, such as non-government organizations.

Ecosystem services -have no standardized definition but might broadly be called "the benefits of nature to households, communities, and economies" or, more simply, "the good things nature does."

Wetland encroachment-is a term used to describe the advancement of structures, roads, railroads, improved paths, utilities, and other development, the placement of fill, the removal of vegetation, or an alteration of topography into such natural areas as

floodplains, river corridors, wetlands, lakes and ponds, and the buffers around these areas. These encroachments cause impacts to the functions and values of those natural areas, such as a decline in water quality, loss in habitat (both aquatic and terrestrial), disruption of equilibrium (or naturally stable) conditions, loss of flood attenuation, or reduction of ecological processes.

Conservation – This is a planned or thoughtful protection of wetlands against those activities that leads to its degradation in order to maintain its natural state. It seeks to harmonize wetlands with human activities to lessen its destruction.

CHAPTER TWO: LITERATURE REVIEW

2.0 Introduction

There are various sources of water which include wetlands which attract a lot of attention because they are important for conservation education (Fanshawe and Bennun, 1991) and also serve as critical areas of research, play an important role in hydrologic regime, acting as a reservoir of biodiversity, biomass storage, maintenance of the nutrient cycle/food web and providing a crucial flyway for migratory water birds (Goodwin and Niering, 1974), essential to the maintenance of various fish and invertebrate stocks while freshwater wetlands are essential spawning grounds for many fish, amphibian and invertebrate species. Wetlands also support a range of large fauna; provide a habitat for beneficial insects such as pollinators. Pollination is an essential aspect of the lifecycle of flowering plants (Feinsinger, 1987) which are, in turn, an important source of food for human beings and herbivores. Owing to their aesthetic appeal wetlands are associated with a range of recreational activities such as wildlife safaris, bird spotting, sailing, swimming and picnics (Emerton, 1998).Wetland vegetation foliage and dense roots also help to brake the speed of floodwaters thereby limiting the detrimental effects of floods and controlling soil erosion (Uluocha and Okeke, 2004). Wetland vegetation purifies water by up taking nitrates, phosphates and toxins from the water flowing through, thereby lowering the nutrient load (Verhoeven and others, 2006).

They are therefore considered biologically diverse areas. According to Agenda 21 fragile ecosystems are important ecosystems, with unique features and resources and they include deserts, semi-arid lands, mountains, wetlands, small islands and certain coastal areas.

2.1 Ecosystem Services

Ecosystem services have no standardized definition, but might broadly be called “the benefits of nature to households, communities, and economies or, more simply, “the good things nature does.” Twenty-four specific ecosystem services are identified and assessed

by the Millennium Ecosystem Assessment, a 2005 UN-sponsored report designed to assess the state of the world's ecosystems. The report defines the broad categories of ecosystem services as food production (in the form of crops, livestock, capture fisheries, aquaculture, and wild foods), fibre (in the form of timber, cotton, hemp, and silk), genetic resources (bio-chemicals, natural medicines, and pharmaceuticals), fresh water, air quality regulation, climate regulation, water regulation, erosion regulation, water purification and waste treatment, disease regulation, pest regulation, pollination, natural hazard regulation, and cultural services (including spiritual, religious, and aesthetic values, recreation and ecotourism). Notably, however, there is a "big three" among these 24 services which are currently receiving the most money and interest worldwide. These are climate change mitigation, watershed services and biodiversity conservation, and demand for these services in particular is predicted to continue to grow as time goes on

2.2 PES Schemes and Mechanisms

2.2.1 PES Schemes

What makes PES-PES is that in any payment arrangement those who pay are aware that they are paying for an ecosystem service that is valuable to them or to their constituencies -and those who receive the payments engage in meaningful and measurable activities to secure the sustainable supply of the ecosystem services in question. Three types of possible PES schemes – private PES schemes, cap and trade schemes and public PES schemes – need to be distinguished (Smith, de Groot, Bergkamp 2006):

2.2.1.1 Private PES

Private PES are self-organized schemes between private entities which involve;

- Direct payments by service beneficiaries to service providers for the protection or restoration of watershed services;
- Cost-sharing among involved private parties;
- Purchase of land and lease back to former owner with the objective to ensure watershed services originating from the land in question; or
- Purchase of development rights to land which are separated from property rights.

2.2.1.2 Cap and trade schemes

These are tasked to;

- Establish a cap (an aggregate maximum amount) for water pollution or abstractions.
- Allocate pollution or abstraction permits which divide the allowable overall total among water users.
- Allow trading of permits between those who do not need permits and those who need more than their allocation.

2.2.1.3 Public PES

Public PES are government driven schemes which involve public agencies and include user fees, land purchase and granting of rights to use land resources as well as fiscal mechanisms based on taxes and subsidies.

2.2.2 PES Mechanisms

2.2.2.1 Payments for watershed protection services

Water use has increased at twice the population rate for the last hundred years, while erosion has increased the scarcity of clean water. Watershed PES can be for water quality, flood prevention and (dry season) water quantity, although propositions about the role of forests in these services often lack a proven scientific basis. There are a range of public and private mechanisms for watershed PES involving a diversity of institutional arrangements. Public or state-mediated schemes are currently much more important (over $2 billion globally) than voluntary market-based schemes (less than $5 million). The growth of watershed based PES has been mainly in Latin America, although China has a major Programme. There are some ‘cap and trade’ water quality trading systems in the US, Ecuador and Australia5, but these are demanding in terms of administrative and enforcement capacity.

Table 2.1: below summarizes some strengths and weaknesses of watershed PES.

Strengths/benefits	**Weaknesses/constraints**
Beneficiaries or users are easy to identify and are often willing to pay for forestry interventions – even though there may be weak scientific evidence	Hydrological impacts of forest interventions are largely site- specific and additionally are hard to prove. If buyers are unsure they are getting what they are paying for, sustainability is doubtful.
Investments in watershed management are cheaper than treatment or new water supplies, e.g., in the US, it is estimated that each $ spent on watershed protection saves $7-200 in new filtration and water treatment facilities.	In state managed programs, additionally or cost-effectiveness is problematic, e.g., in Mexico's Programme, the forests most at risk have received only 10% of payments; tendering schemes are needed to reduce over-payments
There is high win-win potential in developing countries since upper watershed farmers are usually poor, e.g., the Rewards for Upland Providers of Environmental Services (RUPES) Programme in Asia has built up collective action institutions and consolidated tenure.	Common equity constraints are insecure tenure, weak local institutions and inequitable public enforcement capacity; strong donor/NGO support has therefore been key to positive or neutral equity impacts.
Watershed PES works best when there is a scarcity of clean water, and water users have capacity to pay, e.g., urban citizens, companies.	Beneficiaries are often poor and/or unwilling to pay for a 'free good' or their basic right to water, and it is difficult to exclude beneficiaries who won't pay.
For private or market-based mechanisms, there is good potential for leverage of federal or municipal finance.	'Cap and trade' mechanisms are demanding of administration and compliance, and tend to rely on high external support

Table 2.1': Sources: Scherr et al (2006), Bishop et al (2006), Chomitz et al (2006)

A study by Asquith et al, 2007 reveals considerable optimism for pro-poor watershed PES. Based on a review of watershed PES in six countries tradeoffs can be minimized with appropriate design and implementation, and that these projects tend to involve transfers of wealth (from wealthier urban areas to poorer rural areas) and can empower the poor by explicitly recognizing them as valued Service providers. On the other hand, an earlier review (Landell-Mills and Porras, 2002) identifies some demanding preconditions for effective and equitable watershed PES projects, including:

• Secure property rights of local stakeholders, including over the ecosystem service.

• Collective institutions for both sellers and buyers are normally needed to defray transaction costs and ensure equitable negotiations.

• A range of support services, including: legal, financial, insurance and business management support and advisory services; credit provision; independent verification; and inter-sectorial knowledge sharing and coordination.

• Effective and equitable public enforcement regimes.

• Reliable measurement and monitoring of the hydrological impacts of land use change.

2.2.2.2 Biodiversity, landscape beauty and 'bundled' ecosystem services

Carbon and water benefits from forest management or conservation are fairly tangible or measurable benefits in comparison with biodiversity and aesthetic or landscape beauty benefits. The measurement difficulties have not however prevented the emergence of a range of potential PES mechanisms for compensating biodiversity and aesthetic benefits.

Some of these are listed in Table 2 with their perceived strengths and weaknesses

PES mechanism	**Strengths/benefits**	**Weaknesses/constraints**
Eco-labeling or certified forest products	Fast-growing demand driven by concerns about illegal imports; potential to move to landscape level certification.	The 'green premium' is rarely paid by consumers resulting in weak incentives for certified SFM
Regulatory and voluntary biodiversity offset	Self-financing and relocates development to lower biodiversity areas without constraining national development objectives	Can give 'license to destroy' unique habitats – offsetting biodiversity and livelihood impacts is complex and 'second best' to avoidance
Conservation easements and land trusts	International NGOs are able to target biodiversity hotspots through management contracts for habitat/species Preservation	Not market based or self-financing; opportunity cost compensation may be high; unsuitable for state and community tenure.
Conservation concessions	Similar to logging concessions – compensates foregone timber profits; suitable for state and community tenure	Not market based or self-financing; too expensive for primary forest – more viable for 'logged over' forest
Bio prospecting	Over 50% of drugs are derived from natural products; the Costa Rica in Bio model shows potential of raising pharmaceutical funds, but little replication to date.	Unrealistic expectations: there are substantial business risks; 'bio piracy' risk; transparency and public accountability concerns
Ecotourism, including	Huge market – up to 20% of	Most benefits go to urban-

sport hunting and fishing	all tourism; potential for participatory approaches; new ecotourism certification standard proposed by Rainforest Alliance; participatory CAMPFIRE Model being adapted in luangwa National Park, zambia.	based companies; forests have shy and elusive wildlife; faces a fickle market – tourism fashions can change; sport hunting requires game animals and strong regulation
Entrance fees to national parks	Emerging cooperative revenue sharing agreements with local communities.	Previous free entry makes people reluctant to pay; few benefits to local stewards to date.

Table 2.2: Sources: Scherr et al (2006), Bishop et al (2006), Chomitz et al (2006), Karsenty (2007)

Regulatory biodiversity offsets are one of the higher potential mechanisms, since they offer a market-based alternative to the 'command and control' approach. It involves a 'cap and trade' system, the 'cap' being in terms of a number/size of tradable emission permits or in the form of legislation restricting biodiversity degradation. The main examples are in Brazil and the USA. But a drawback is that it is problematic for state or common pool tenure since communities and/or the state cannot easily trade land use rights for financial compensation (Karsenty, 2007). Some biodiversity PES mechanisms, like eco-labeling and conservation easements, as well as the state-mediated PES programs, effectively capture the value of a 'bundle' of ecosystem services, even though biodiversity or water may be the lead service. The importance of bundled PES is that a single compensated ecosystem service can be less than the opportunity cost of forest retention. Bundled PES approaches are particularly relevant for the landscape level; for example, Eco-agriculture Partners are developing methods to assess PES opportunities for ecosystem services in agricultural landscapes, including payments for wild products, eco-labeling and market infrastructure (Scherr et al, 2006). But a limitation is the

difficulty of establishing ‘additionally’: buyers are often reluctant to pay for more than one ecosystem service.

2.3 STAKE HOLDERS IN A PES SCHEME

In order to come to an agreement on a PES scheme (e.g. Watershed PES), the right parties have to be involved in the planning, negotiation and implementation processes. The following categories of stakeholders can be distinguished (Porras et al. 2008; Smith, de Groot, Bergkamp 2006).

• Donors

Donors provide the funds for the provision of water-related ecosystem services, and most commonly are:

- Government – providing municipal and national government funding;
- Private sector – making voluntary and required payments for water-related ecosystem services;
- Private individuals – paying household and agricultural fees for use of water;
- Charitable foundations – making donations from their assets.

• Beneficiaries

Beneficiaries are private or public entities who have a demand for the provision of watershed ecosystem services. Beneficiaries and donors will often overlap.

• Suppliers

Typical suppliers of water-related ecosystem services, in order of prevalence, are:

- Private landowners – individual owners with clear and undisputed property rights.
- Communal landholders – farmers living on or drawing their livelihood from communal property.
- Private reserves – whether an individual or group, private entities registered as reserves and committed to ecosystem conservation are the third most common supplier of watershed services.

- Governments or non-governmental organizations (NGOs) – land owned and managed by governments or NGOs for conservation purposes.
- Informal occupiers of public lands.
- Farmers living on public property oftentimes designated as a protected area, who may have long-standing rights to the land.

• **Intermediaries**

Intermediaries (governmental entities, international agencies or NGOs) may link donors, beneficiaries and suppliers of water-related ecosystem services, and aid in the development, administration or operation of a PES scheme. Specific roles for intermediaries comprise:

- Scientific advice to project developers, particularly regarding the identification of expected downstream services.
- Design of payment mechanisms, feasibility studies, management plans and monitoring systems.
- Facilitation of negotiations among all stakeholders.
- Land management capacity-building.
- Collection of hydrological data.
- Contract administration, allocation of funds and payments.
- Provision of buying and selling services as an intermediary.

2.4 Drivers and Considerations for Community Participation

2.4.1 Drivers

Drivers of any PES schemes, or incentives for positive ecosystem management, may be demand, supply, or solution-led. All three drivers are capable of creating the initial interest for a PES scheme. (Thomas Greiber, 2009)

• **Demand-led**

Downstream water problems serve as a demand-led driver for PES. When downstream users are willing to pay, landholders are incentivized to change land management in exchange for compensation.

• **Supply-led**

Supply-led drivers occur when there are threats to upstream natural or protected areas or the upstream land use is unsustainable. Payments from downstream water users can provide funds to meet the need for upstream resource management changes that benefit both the downstream water users and the threatened upstream ecosystem(s).

• **Solution-led**

A solution-led market driver is an external organization seeking to identify situations where a PES scheme would be ideal and feasible.

2.4.2 Considerations

The community's consideration on how to participate gives rise to their property rights either as an individual or as a community. Property rights regulate the relationship among people as individuals or groups with respect to a determinate thing, which can be any physical or intangible entity (e.g. land and its natural resources which provide ecosystem services). As a general concept property rights comprise ownership and a sub-set of rights which follow from the ownership. There are many different types of property ownership. Traditionally, ownership implies the right to possess, use and enjoy, for example, a piece of land and its natural resources, coupled with the right to exclude others. Rights following from ownership can be distinguished as follows (FAO 2002):

• Access and use rights which give the right to access the land in order to use its natural resources;

• Control rights which give the right to make decisions how the land and its natural resources should be used; and

• Transfer rights which give the right to sell, to convey or to mortgage the land to others through contracts, to transmit the land to heirs through inheritance, and to reallocate access, use and control rights.

These rights can be inseparably attached to the right of ownership or exist as separate, transferable rights. Certain rights, like the right to use a piece of land can be further split into more specific use rights, such as use rights for natural resources but also ecosystem services. Different forms of transferring property rights exist. One possibility is to transfer the whole bundle of rights from one person to another. This happens, for example, by means of sale or inheritance, and requires the seller/decedent to have all property rights at his disposal. More complicated situations comprise the transfer of only parts of the bundle of rights (e.g. by means of easements/servitudes, licenses, permits, or concessions).

Depending on a country's legislation, property rights can be:

• Public – i.e. held by the state;

• Private – i.e. held by a natural or legal person;

• Communal – i.e. held by each member of a community; or

• Openly accessible – i.e. not assigned to anyone.

Property rights as such are generally recognized by the constitution of a state. Their specific conditions and characteristics are further laid out in the state's legislation (e.g., the civil code).

Property rights play a crucial role in the creation of PES schemes. The object of a PES contract could be an ecosystem service, such as the purification of water. A downstream user enters into a contract, paying for this service. In this constellation, the question arises as to who can actually sell the specific ecosystem service. To give an answer, it is

necessary to determine the property rights (ownership and/or use rights) over the ecosystem service.

2.5 Theoretical and Conceptual Framework

2.5.1 Theoretical Framework

PES are economic instruments based on the economic Coasean theorem by which, as long as transaction costs are low and property rights are clearly defined, the social optimum (for the allocation of resources) might be attained via bargain among the parties. Therefore, the creation of markets for trading environmental services becomes the "solution" for the correction of negative externalities.

2.5.2 Conceptual Framework

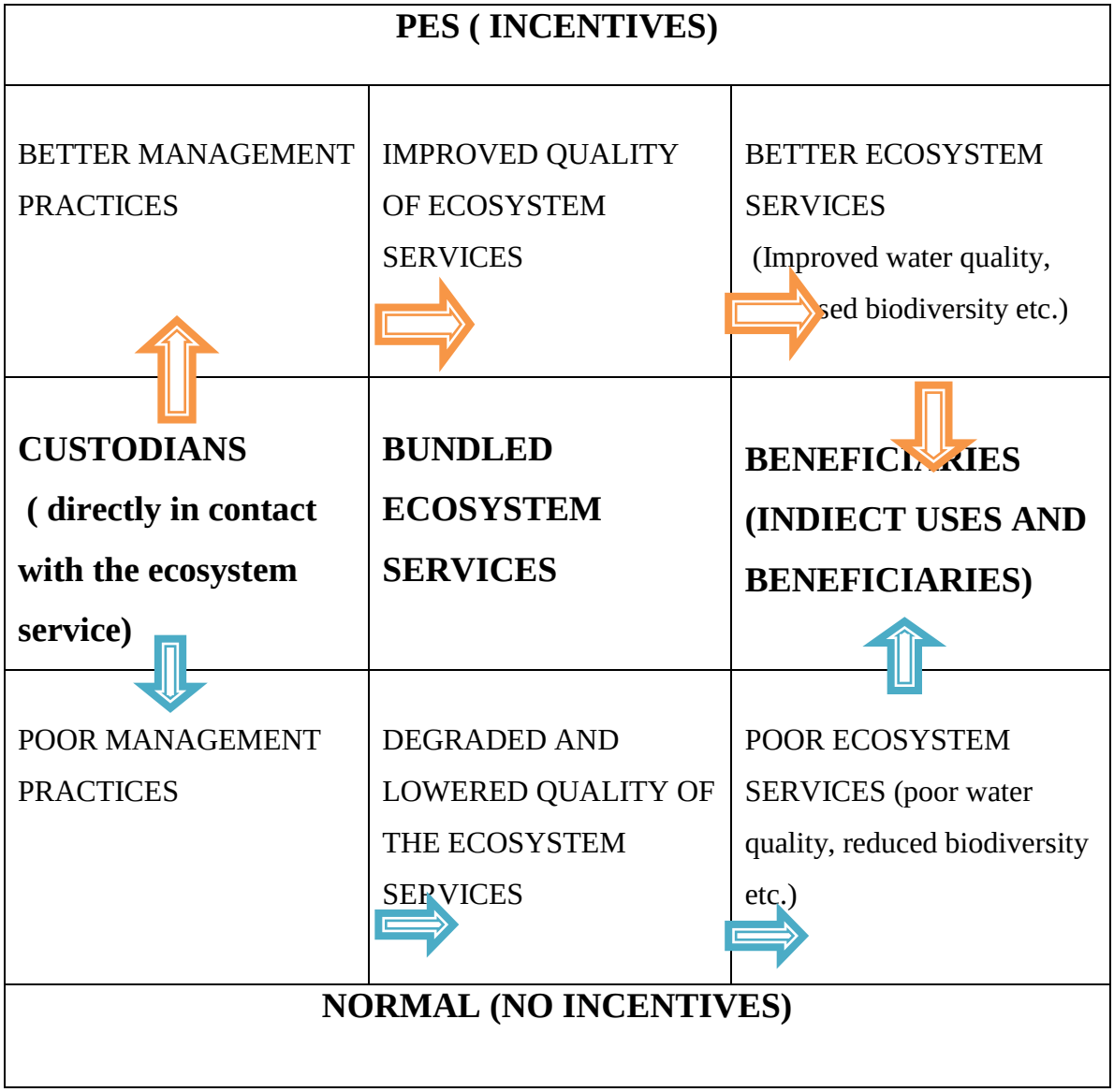


Figure 2.1: Source: Field Survey, 2014.

Flow with PES practices

Flow in Normal Practices

CHAPTER THREE: AREA OF STUDY

3.1 Introduction

Plate 3.1: Map of AREA of STUDY

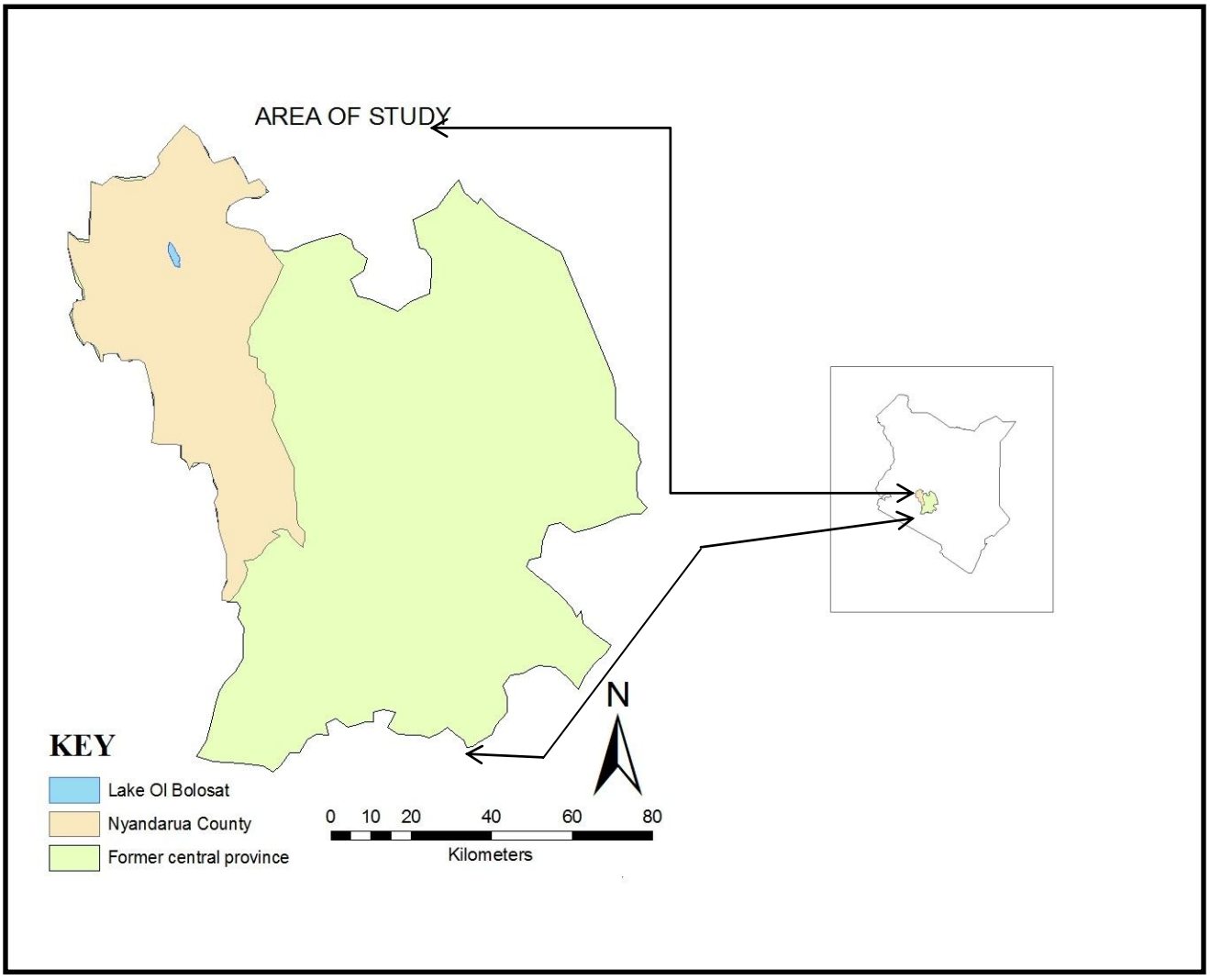


Plate3.1: Source: Author, 2014.

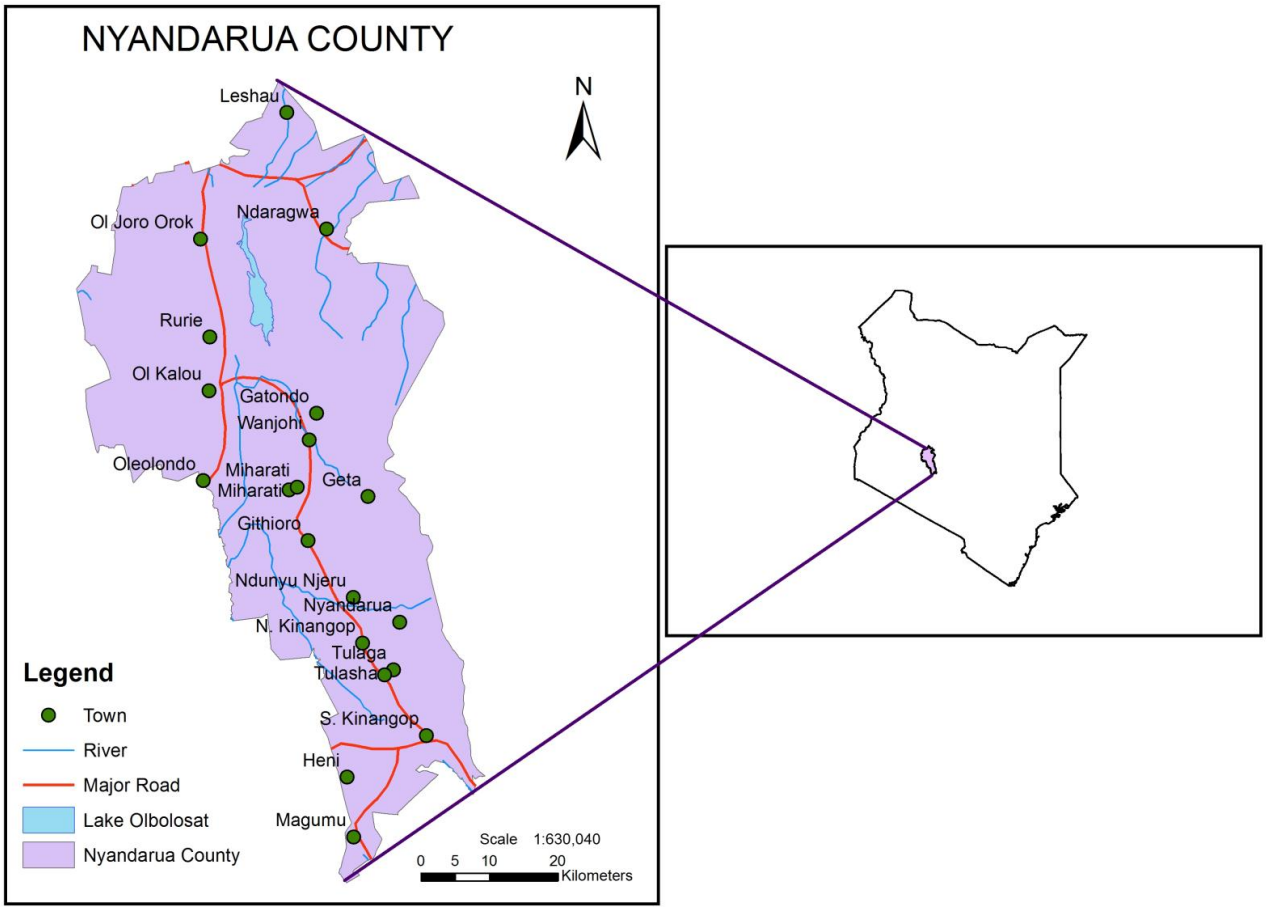
Known as the only lake in the former Central Province of Kenya as shown in the map above, Lake Ol Bolossat with an area of approximately 43km^{2}is a fresh water lake situated on a flat plain northwest of the Aberdare Range in Nyandarwa County located within the Ewaso Nyiro North basin. The lake and its catchment provide a variety of

important habitats that include, open waters, floating swamps and mashes, savannah and riverine forests and feeder springs. It is a bio diversity heaven and hosts numerous species of the threatened watersheds. Since 1998, water bird species consisting of 64,935 individuals have been recorded in Lake Ol Bolossat (Kenya Wetlands Atlas 2012).

3.2 Description of the Area

Lake Ol Bolossat; located in Nyandarwa County is a rich biodiversity area and a habitat to numerous species of water birds, some of which are rated as rare and or threatened. Several species of pale arctic and afro tropical migrant water bird species have been recorded at the lake that also harbors a large number of hippos. The Lake Catchment and basin are important for local and national socio - economic development, especially agriculture. The central location of the lake with respect to the national tourist circuit and its proximity to the equator confer the site an added advantage (Nyandarwa District Development Plan 2008 -2013).The map below shows Lake Ol Bolossat in relation to satellite towns in Nyandarwa County and its position in the country:

Plate 3.2 :Map of Nyandarua County



Source: Field Survey, 2014.

3.3 Physical Setup

3.3.1 Physical setup- location and extent

Lake Ol Bolossat is approximately 195 Km north of Nairobi is located on latitude $0^0$09'S and longitude$36^0$26 'E in Nyandarwa County. It is situated in Ndaragwa, Ol Joro Orok and Ol Kalou administrative divisions. The lake with an area of 43.3 Km^2 lies at an average altitude of 2,340 m above sea level in a wedge shaped rift valley floor sloping eastwards and northwards.

3.3.2 Topography

Lake Ol' Bolossat is an internal drainage basin whose swamps have a high salt content possible due to high evaporation rate and partly due to nature of sediments that constitute the area (Krhoda, 1992).

Lake Ol Bolossat lies in a wedge-shaped (fault) valley known as Ongata Pusi. The lake is one of a series of rift valley benches aligned on a north-south direction at a higher elevation than the other Rift Valley lakes (2,340 m above sea level). On the eastern side, the lake borders the steep Satima escarpment (2,550 m). The faulting activity in the area resulted into a complex drainage system that separates major drainage basins and contributes greatly to subsistence and irrigation agriculture.

3.3.3Drainage

The catchment area of Lake Ol Bolossat is approximately 4800 km^2. The area encompasses Nyandarwa range, Satima escarpment, and Ndundori Hills. The water from the basin flows northwards, through Thomson's Falls into the northern Ewaso Nyiro River.The hydrology of Lake Ol Bolossat is influenced by the effects of long-term and seasonal variations in climate and water inflow from the surrounding highlands. The lake water level is highest during the rains, especially in July. The mean water depth in the lake is 1.0 m varying from 0.73 m in the south, through 1.20 m in the central part to 1.83 m in the northern part. Lake Ol Bolossat drainage system comprises of the springs and streams along the Satima escarpment, open water, Wellmont, Ol Joro Orok and Ol Bolossat swamps, Ewaso Narok river, the numerous springs along the upper reaches of Ewaso Narok river, and springs and streams on the western side of the catchment.

The springs and streams from the Satima escarpment and to a lesser extent by streams that flow from the Ndundori hills on the western side recharge the lake. Most streams flow for a distance and then disappear underground recharging the lake as sub-surface flow. The main streams are Nduthi to the east, Simba and Maji Chemka to the west. Lake Ol Bolossat however, is seasonal with open water appearing as a series of pools separated by emergent macrophytes. The system loses water through the continuous flow of Ewaso Narok River and evapotranspiration. Evapotranspiration from the abundant swamp vegetation also contribute to this seasonality. The lake water is moderately saline with electrical conductivity varying from 150 to 300 x 10^6 us/cm, while pH varies from 6.7 to 8.3 at 20^0 C. The physic-chemical characteristics vary with season. Conductivity and alkalinity are elevated during the dry season due to evapotranspiration, with dilution in the wet season. The lake water is unsuitable for both domestic and irrigation due to the high alkalinity.

3.3.4 Geology

Lake Ol Bolossat basin is bound by weak faulting to the west, which becomes increasingly developed to the south and to the east along the Satima escarpment. Kipipiri hill to the southeast rises to one thousand meters above Ol Bolossat plain. To the west the land is broken by faults forming a complex of shallow horst and grebe structures. The Ol Bolossat plain near Ol Kalou is bounded to the west by a series of tilted fault blocks separated by more than a dozen fault scarps.

3.3.5 Soils

The Satima escarpment is composed mainly of igneous rocks with a few areas having metamorphic rock strata. The soils on the Satima escarpment are grey loams dominated mainly by andosols and phaeozems and in the lake basin the soil is of black cotton soils, which are poorly drained, dominated by nitosols and xerosols. On the western side there are andosols and phaeozems.

3.3.6 Climate

The climate is sub-humid and is strongly influenced by local topography due to the surrounding highlands. The mean annual rainfall, recorded at Nyahururu at the northern part is 975 mm increasing southwards and westwards. Rainfall is bimodal with peaks in April–June and October–November which are also the planting seasons. The instability of the air near the equator causes rain especially from July to September between the sub-humid periods of April–June and September. Over 60% of the annual rainfall is received in the first wet season. The mean temperature is 23.5^0 C. There are major diurnal variations resulting in incidences of frost in January and September.

3.4 Ecological Setup

3.4.1 Vegetation and Wildlife

The area is rich in flora and fauna, with over 200 plant species, over 180 bird species and over 15 species of mammals. There also species of fish, reptiles and amphibians.

3.4.1.1 Vegetation

Lake basin and its catchment has six general categories of natural vegetation comprising of open grassland, acacia forest, cedar forest with thicket under growth, reed and swamp grass and aquatic floating macrophytes.

Tall trees of indigenous species are sparse. The main tree species projecting out of the escarpment were *Juniperusprocera*, *Cussoniaspicata*, *Euphorbiacadelabrum*,*Acaciatortilis*and *Crotonmegalocarpus* which were actively cut for fuel wood (charcoal) and other domestic uses by the local farmers. Except for the gallery forests much of the escarpment is devoid of trees. A few exotic tree species such as *Eucalyptus, Cupressus*and *Grevillearobusta*have been planted on farmlands at the bottom of the escarpment.

The open water has a wide range of floating and submerging macrophytes, nitiritus aquatic weeds have also invaded the lake. Submerging macrophytes occur in areas of the lake with clear water (Millennium Ecosystem Assessment, 2005).

There are human induced changes in the structure and composition in the natural vegetation. The escarpment is currently dominated by grasses and shrubs such *Grewia*species, *Scutia*species, *Rhusnalatensis*and *Buddleyapolystachya* which has replaced the natural vegetation.

Frequent burning of the escarpment has reduced the density of shrubs and grasses are dominant in certain parts, especially in the north and south.

3.4.1.2 Wildlife

3.4.1.2.1 Birds

The Lake and entire surrounding areas including Satima Escarpments, Aberdare Forests and National Park, Marmanet Forest Reserve, agricultural lands and urban centers has over 350 species of birds.

Water birds are the most conspicuous wildlife on the lake where over 87 species of water birds have been recorded. Among the waterfowls, the most abundant groups are Afro tropical ducks and geese, rails, gallinules and coots. Several Pale arctic and Afro tropical migrant species have also been recorded in the African-Eurasian Water bird Agreement (AEWA) under the Bonn Convention on Migratory Species.

The lake is a breeding site for Red-knobbed Coot, African Jacana, Blacksmith Plover,African Snipe, and Yellow-billed Duck among others(Wamiti *et al* 2007).

A bird survey carried out in seven sites (Kianjata North, Kianjata South, Manguo/Kibathi, Kanguo, Gatumbiro, Kasuku and Rurii), on the western riparian

grasslands on terrestrial species confirmed the presence of Kenyan endemic and endangered Sharpe's Long claw and the east African endemic and near-threatened Jackson's Widowbird. Interesting species observed during the survey includes Gabar Goshawk, Black-bellied Bustard and Capped Wheatear. This survey recorded 91 species from 40 families.

The National Liaison Committee on IBAs led by Nature Kenya, on 26 March 2008, listed Lake Ol' Bolossat as Kenya's 61st Important Bird Area. Other species of conservation concern recorded during the survey and previously are shown below (Oyugi&Owino 1998, 1999).

Key: EN = endangered, NT = Near-threatened, CR = Critical and VU = Vulnerable.

Great (White) Egret (*Casmerodiusalba)*	VU
Maccoa Duck (*Oxyuramaccoa)*	EN
Saddle-billed Stork (*Ephippiorhynchussenegalensis)*	VU

3.4.1.2.2 Mammals

According to Nature Kenya, on 26 March 2008 the number of hippos recorded at Lake Ol Bolossat from 1987 to 1989, ranged from a mean minimum of 89 and a mean maximum of 176. The maximum number coincided with wet seasons while the minimum number coincided with dry seasons. The distribution of hippos on the lake is dependent on biomass distribution of green herbage on the riparian area. It has been argued that there a notable destruction of most of agricultural farms by hippopotamus, especially those farms bordering the lake

3.4.1.2.3 Fish

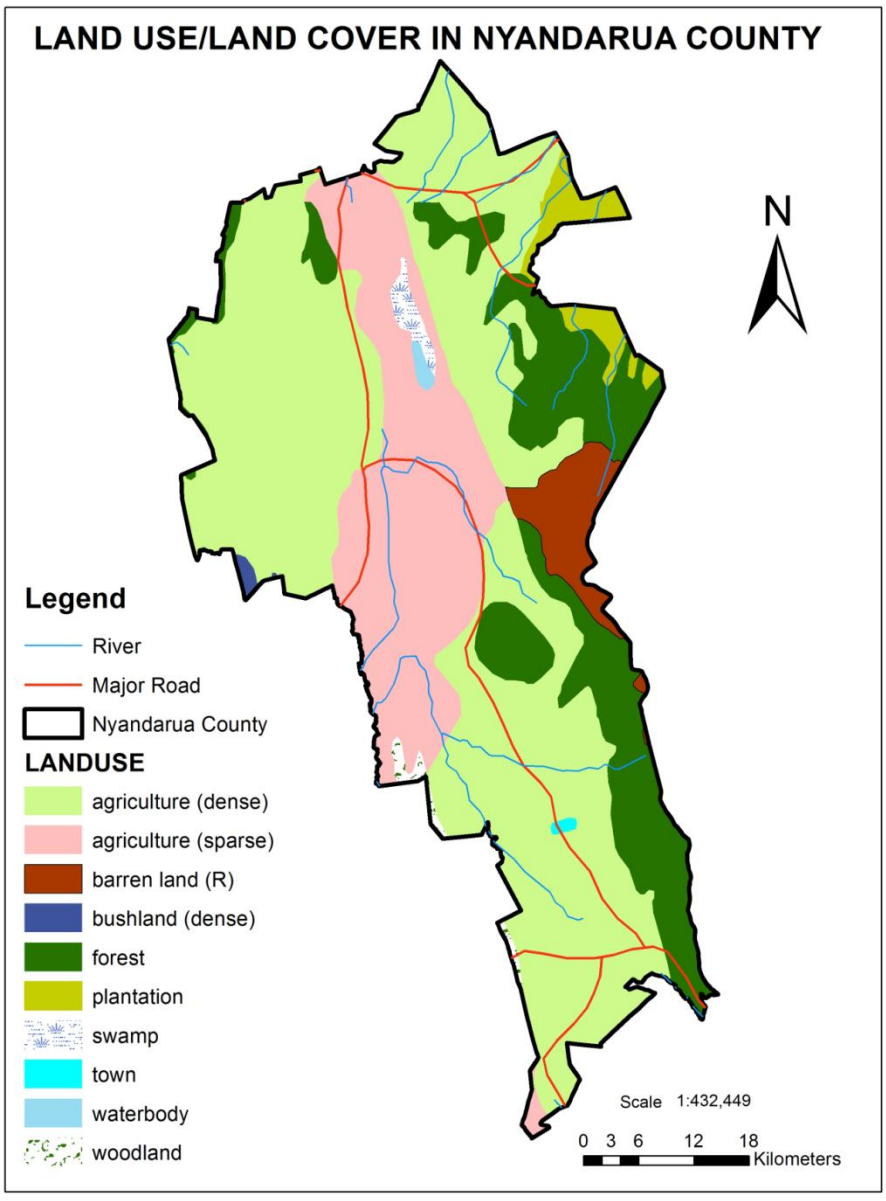
The marshes and swamps around the lake are known to support catfish. Several dams in the plan area are also stocked with various fish species. However, the community around the lake keeps tilapia and common carp in their ponds and dams.

Not very many people have fishing gears; instead they rely on hired seine net. This to some extents limits exploitation of the lake as a fisheries resource.

3.5 Economic setup

Land use in the lake basin is strongly influenced by land size and fertility, availability of water and pastures. The main land use practices are as shown on the map below.

Plate 3.3: Land Uses in Nyandarwa County



Source: Field Survey, 2014.

3.5.1 Agriculture

The lake Ol Bolossat area is fertile agricultural area classified as Agro-ecological zone UH3IV on upper highland division; Agriculture is mainly rain fed with some fields under irrigation. The initial allotments were 5-acre plots. Crops grown include maize, wheat, pyrethrum, potatoes and a wide range of vegetables. Wheat is the main cash crop mainly grown in Ol Joro Orok division. The acreage under pyrethrum was constant between 1992 and 1994 due to drought but; with an extensive education comparing by the pyrethrum board and agricultural extension personnel, the acreage and yield have been steadily rising. Ol Kalou division in the plan area has been producing over 50% of all the maize produced and has the highest output of horticultural produce.

The springs and streams that drain into the lake are the main sources of water for domestic and irrigation uses. Water is continuously transferred from the steams and springs that feed the lake for growing crops such as carrots, potatoes and peas. Farmers control pests using commonly used pesticides; however, some pesticides have been reported burned for use in the area.

3.5.2 Livestock production

The livestock production department endeavors to achieve the national strategic plan for effective facilitation and efficient management of livestock production in .Nyandarwa County.

The Ol Bolossat Lake Basin forms an important area as a source of pastures and other cultivated livestock feeds more so during the dry period. As a result, its ecosystem is vulnerable to mismanagement in terms of overstocking, leading to overgrazing and subsequent land degradation. The department ensures proper advice on stock management and control is given to residents mainly as concerns stocking rates.

3.5.3 Forestry

Indigenous forest cover in the plan area has declined tremendously due to human settlement, deliberate fires and indiscriminate felling of trees for firewood and other uses. However; farmers in the plan area practice agro-forestry and farm forestry on a limited scale. Currently, there are local initiatives to establish tree nurseries but these are

hampered by lack of suitable seeds and sites for putting up nurseries. The restoration of the forest on Satima escarpment is vital since it is the catchment area for the lake.

3.5.4 Fisheries

The lake still does not support commercial fisheries, but there is subsistence fishing particularly in the northern part of the lake. Nonetheless, the aquatic weeds that infest this part of the lake hamper exploitation of the fisheries potential. The situation is made worse by the absence of fish in the open waters of the lake due to the high alkalinity of the waters.

In addition, communities around the Lake practice fish farming which is mainly characterized by tilapia and cold carp. The figure below shows fish farming as practiced by communities around the lake.

Plate 3.4: Fish farming by community around the lake

Source: Field Survey, 2014.

3.5.5 Wildlife Conservation

The plan area is important for wildlife conservation with a variety of wildlife species that include hippos, birds, occasional leopards, Thomson gazelles and small mammals. Lake

Ol Bolossat basin is important for the conservation of hippos and birds. Hippos require a substantial amount of riparian land for grazing. However, this riparian grazing land for hippos has been greatly reduced due to human settlement and encroachment. Consequently, there is competition between hippos and livestock for the pastures. The number of hippopotamus is regulated by occasional problem animal activities driven by the need to minimize crop and property damage. From the years 1984 to 2000, 47 hippos were killed in problem animal management operations.

Abundant waterfowl, inhabiting the open water and the marshes, make the lake popular for bird watching and duck shooting. The Lake Ol Bolossat bird-shooting club coordinates game bird shooting. Some of the proceeds from bird shooting are ploughed back for local development projects.

3.5.6 Tourism

Lake Ol Bolossat falls in the central tourism region circuit, Nyeri - Nakuru, Naivasha - Maralal -Baringo and Nanyuki – Baringo, however the tourism potential in the lake basin has not been fully exploited. The diversity of birds and scenic beauty are the main attractions. Local and international tourism is restricted to Thomson Falls to the north of the lake.

Tourism in the area can be linked to Thompson Falls and Aberdare National Park. The flow of tourists through Nyahururu is high and visitors on transit would consider a diversion to the lake to see birds, hippos and the beautiful landscape. It is important to encourage tourism in the lake for economic, educational and conservation purposes.

3.5.7 Mining

The local community mines sand for building in the dry parts of the lakebed and clay soil for pottery and brick making. This however, leads to destruction of the riparian zone.

3.6 Social setup

3.6.1 Population

According to Kenya census 2009, the human population density in the lake basin and the lake's watershed is approximately 202 per km^2. The population as per division of the area is as shown in figure 5 below.

Fig 3.1: Population of the Area by Division

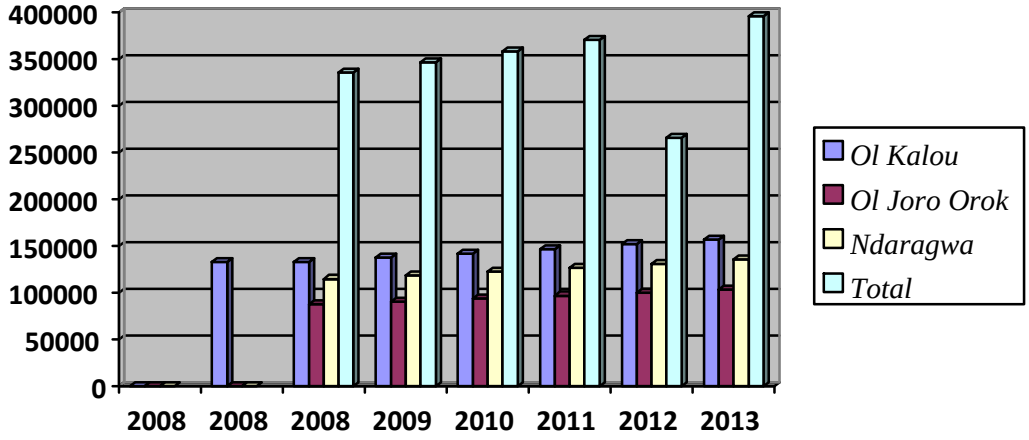


Table 3.1: Population Projection of Lake Ol Bolossat Basin (2008 - 2013)

Division	2008	2009	2010	2011	2012	2013
Ol Kalou	132975	137436	142047	146813	151738	156829
Ol Joro Orok	87786	90731	93776	96922	100174	103534
Ndaragwa	114724	118573	122551	126663	130913	135305
Total	335485	346740	358374	370398	265825	395668

Table 3.2: Age Structure of the population

Age Group	2008		2009		2010		2911		2012	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
6-13	41170	39122	42551	40434	43979	41791	45454	43193	46979	44642
14-17	18131	16671	18739	17230	19368	17808	20028	18405	20689	19023
15-25	37243	38694	38492	39992	39784	41333	41118	42720	42498	44154
15-49		78059		80678		83384		86182		89073
15-64	80495	88618	83195	91591	85986	94664	88871	97840	91853	101123

KEY

- Age group 6-13 years Primary going children
- Age group 14-17 years Secondary going children

- Age group 15-25 years Youthful population
- Age group 15-49 years Females in reproductive age
- Age group 15-64 years The labor force

Source: Kenya bureau of statistic report 2012 population projections of Kenya by district and Kenya census report 2009.

3.6.2 Sex Ratio

97:100 that is, 97 males for every 100 females; this shows that there are more female engaging in productive small scale agriculture than males. This is mostly in subsistence crop farming and irrigation practices.

3.6.3 Literacy Levels

83.3 % of the population can read and write and hence able to carry out conservation practices as provided by various stakeholders.

CHAPTER FOUR: RESEARCH DESIGN AND METHODOLOGY

4.1 Introduction

This chapter describes the methodology that will be used to determine the potential payment for ecosystem services (PES) scheme in Lake Ol Bolossat, Nyandarwa County. It describes the study design, the study sample, and the tools and procedures that will be used. It explains how the data will be collected and analyzed; the validity and reliability of the research instruments and the ethical considerations.

4.2 Research Design

This research study will employ a descriptive survey design by utilizing a number of techniques to meet the objectives of the study. The methodology will entail collection of both primary and secondary data from the field and other sources respectively.

4.3Nature and Sources of Data

4.3.1 Nature of Data

With a view of achieving the objectives of this study, data from primary and secondary sources are to be used. The primary data will consist of the community consideration on whether to sell as individuals or as a group in a potential PES scheme. Such data will be retrieved from interviews with the individuals and the administration of questionnaires. Other sources of primary data include interviews with CBO's to that will build on the individual interview and questionnaires and observation sheets and checklists to check on the ecosystem services present within the area of study.

Secondary data to be used in the study area will include published and unpublished information on water and sanitation services in the various institutions in the water and sanitation sectors. It is from secondary data that background of the study has been developed and the areas that need improvement identified.

Table 4.1: The nature of data collected to achieve each objective is summarized in below.

Objective	**Nature of data**	**Sources of data**	**Type of data collection technique**
To Assess the ecosystem services in Lake Ol Bolossat	Secondary and Primary data	Nyandarwa CDIP, Visual observation, Photographs	Observation checklist, photography and literature review
To Determine a PES mechanism for use in Lake Ol Bolossat	Secondary data	Books, journals, reports	Literature Review
To Identify potential buyers who benefit from the services	Secondary data	Books, journals, reports	Literature Review
To Assess the community's consideration on whether to sell as individuals or as a group.	Primary data	Local community, CBOs officers	Administer questionnaires and interviews

4.3.2Sources of Data

4.3.2.1 Primary Data

This will entail all the firsthand information gathered from the field though the administration of the questionnaires, interviews, checklist, and observation sheet used during the study. Such information will be collected from members of the community and Community based organizations in the area.

Data gathered from residents will include socio-demographic data and consideration on whether to sell as individuals or as a group in a potential PES scheme which will be crucial for the study. In the institutional interview, the main data that will be sought for will be in line with the community's consideration on whether to sell as individuals or as a group in a potential PES scheme. The observation sheet and checklist will be mainly used in recording various ecosystem services in the area. This will help in giving informed recommendations after data analysis.

4.3.2.2 Secondary Data

The data will be obtained from both local and international documented sources on PES. These sources include reports, journals, internet sources, newspaper cuttings and district development plans in the country. Such information will be obtained from government agencies such as Kenyatta University Post Modern Library and internet sources. Some preliminary data in line with the research objectives has been acquired and documented in the literature review. It provides general information on PES in general at global, continental and national scale. References at the tail end of this report display the variety of secondary sources used.

4.4 POPULATION DESCRIPTION

4.4.1 Target Population

The principle subjects of this research process who are the primary source of our data included:

4.4.1.1 Local Community

This involved the residents within the area of interest (AOI).This not only included locals who practice farming but also the business community.

4.4.1.2 Community Based Organizations (CBOs)

CBOs are an important part of the study since they are the alternative to individual participation in a PES scheme in the area upon implementation.

4.4.2 Description of the target Population

For the local population an analysis of the population had been done in the previous chapter on area of study under the social set-up.

According to a survey carried out in August 2007 by the Kenya Wetlands Forum in conjunction with the Lake Ol Bolossat Conservation Network on the local organizations CBOs represented 58% of the organizations out of the 247 organizations recorded and most of them are involved in welfare activities with the aim of development in their communities. This put their number at around 148 and due to the amount of time that had passed since the survey had been done there was no assurance that all of them still existed.

4.5 SAMPLING METHODS

4.5.1 Sample Size

The sample population comprised of residents of areas around the Lake. The sample size of 60 households was used and 30 CBO officials. The sample size was selected due to the vast extent of the area to be covered for the study and the limited budget which could only suffice a small sample size. The study area was categorized into three; the eastern, western and southern parts of the Lake and each part got an equal representation in the sample used. The random administering of questionnaires commenced at the shopping centers in the area.

4.5.2 Sampling Techniques

There are various sampling techniques that are to be embraced. They will include:

4.5.2.1 Simple Random Sampling

This technique will be used in households which each member of the population will have an equal chance of being selected as a subject. The entire process of sampling will be done with each subject selected independently of the other members of the population. In this case, the study samples in the residential households will be selected in this manner. This will translate into minimum bias and prejudice when identifying households experiencing inadequate water and sanitation supply.

4.5.2.2 Snowball sampling

This technique will be used in community based organizations since it provides the avenue to access an otherwise difficult research study population since most of these organizations in such rural settings have no offices. It will employ the presumed social networks that exist between members of the target population to build a sample.

4.6 Data Collection Methods

The following are some of the data collection methods that will be employed during the study:

4.6.1 Questionnaires

Questionnaires will be administered to the area residents who will be selected randomly. The design of the questions will be such that it meets the objectives of the study.

4.6.2 Interviews

Personal interviews will be conducted with a leader of the community based organization to determine their consideration on whether the community to sell as individuals or as a group.

4.6.3 Observation Sheet and Checklist

These instruments will help in recording firsthand information about the ecosystem services that exist in the area. This will be of use especially in determining a PES mechanism for use in Lake Ol Bolossat and identifying the potential buyers who benefit from the services.

4.7 DATA ANALYSIS AND PRESENTATION

4.7.1 Methods of Data Analysis and Presentation

Qualitative and quantitative methods will be incorporated to analyze the information gathered from the respondents through calculation of means, percentages and even mode. Respondents' expressions and perceptions, events, questionnaires, behavioral observation, records will be analyzed. Percentages, proportions and averages will be employed to reach the conclusions. Data presentation will be done through pie charts, graphs, photographs and maps.

Processing and analysis will involve:

- **Sorting data:** this will entail ordering of questionnaires and other field records for the purpose of subsequent processing and analysis. The questionnaires will be numbered and arranged systematically.
- **Quality control check**: This will involve analysing the validity and feasibility of data collected using various selective criteria.

4.8 Constraints to Data Collection

4.8.1 Financial Constraints

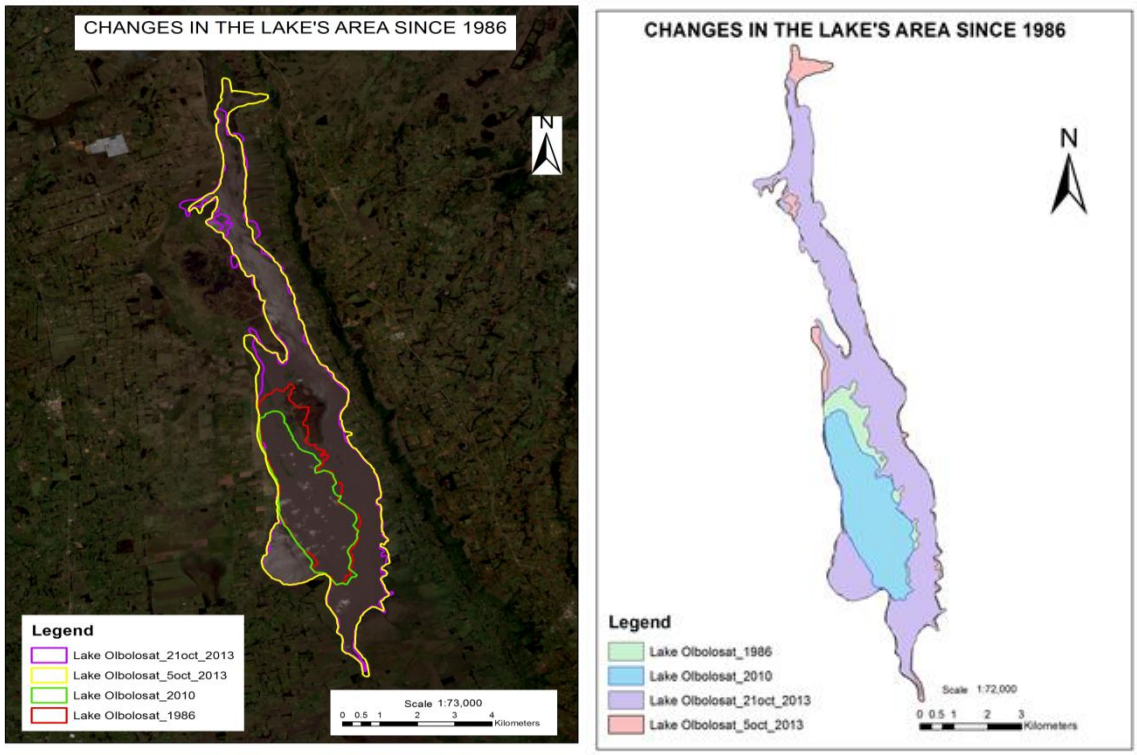
Production of the preliminary research concept paper to the final research report will consume a lot of monetary resources. The travel distance to the study area, the vast extent of the study area and print expenses on research instruments such as questionnaires and interview schedules will also be high. This will eventually dictate a smaller sample size that is within the budgetary allocation.

CHAPTER FIVE: DATA ANALYSIS AND DISCUSSION

5.1 Introduction

This chapter presents the analysis of data collected from a research conducted around Lake Ol Bolossat. The main purpose of the study was to determine the potential for a payment for ecosystem services (PES) scheme in Lake Ol Bolossat, Nyandarwa County. Further the study is aimed at: determining what ecosystem services exist in the lake; Which PES mechanism will yield the desired socio-economic and ecological outcomes; who are or can be the potential buyers in the PES scheme; what is the Community's consideration; is it to use Community Based Organization (CBOs) or individuals to sell the services. Lastly, the findings can be relied upon as a step towards the formulation and implementation of PES as a conservation measure in the County. Study findings show that the Lake has undergone changes in both volume and area coverage over a period of time as indicated on the maps below:

Plate 5.1: Change in Area Coverage of Lake Ol Bolossat Since 1986



Source: Field Survey, 2014

Table 5.1: Area coverage of changes in Lake Ol Bolossat

Date	Area in Km^2
1986	8. 40
2010	6.99
October 5th 2013	27.96
October 21st 2013	26.35

Source: Field Survey, 2014

According to the image presented above, Lake Ol Bolossat recorded its lowest level in 2010. On October 5th 2013 it recorded the highest water volume which reduced by October 21st 2013 by a small margin. Although the highest water mark was and is not established the factor that the water levels have increased since 2010 shows that the Lake was once bigger maybe even than its size as of October 2013.

5.2 Analysis and Discussion

5.2.1 Ecosystem services available and their status

From the observation checklist (Appendix 3) the following ecosystem services were observed;

1. Food production (in the form of crops, livestock, capture fisheries, aquaculture, and wild foods)
2. Fibre (in the form of timber, cotton, hemp, and silk),
3. Genetic resources (bio-chemicals, natural medicines, and pharmaceuticals)
4. Fresh water,
5. Air quality regulation,
6. Climate regulation and Climate change mitigation
7. Water regulation and Watershed services
8. Erosion regulation
9. Water purification and waste treatment
10. Disease regulation, pest regulation, pollination
11. Natural hazard regulation
12. Cultural services (including spiritual, religious, and aesthetic values, recreation and ecotourism)

13. Biodiversity conservation

The major types of ecosystem services that have been sold to date according to a primer by UNEP and the Katoomba group (2008) include:

- Carbon storage and sequestration
- Wetlands conservation
- Watershed protection (including soil protection)
- Species, habitat, and biodiversity conservation

Even though all these ecosystem services are existent as evidenced from the data collected their efficiency is greatly reduced due to various factors some of which can be identified from these photographs below.

Plate5.2: Invasive Species in Lake Ol Bolossat that threaten species, habitat and biodiversity conservation

Source: Field Survey, 2014.

Plate5.3: Brick making on the Riparian Zone that affects watershed protection

Source: Field Survey, 2014.

Plate5.4: Subdivision and reclamation of forest lands that reduces Carbon storage and sequestration

Source: Field Survey, 2014.

The situation at hand depicts ecosystem services that are under immense danger and that require immediate attention to arrest the situation before it escalates. There is therefore need to identify the land management actions that "deliver" the ecosystem service and that is the focus of the PES scheme.

5.2.1.1 Community Assessments of previous conservation measures

From the questionnaire the researcher found out from all the 60 respondents that there have been previous conservation activities in the area and that some of them took part in one way or the other as shown below.

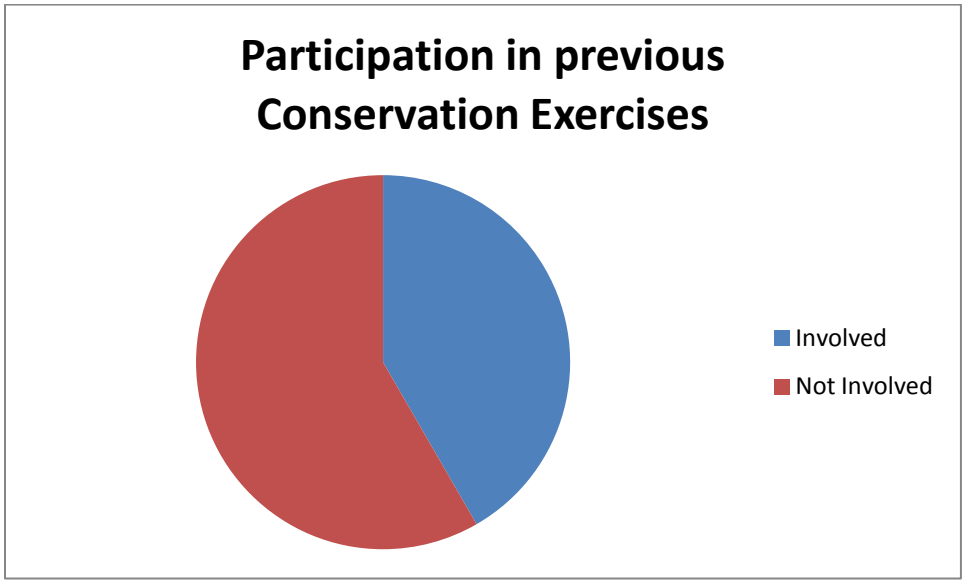


FIG5.1. Showing participation of respondents in conservation exercises

Of those who took part all of them participated individually. The respondents had divided opinions on the success of those previous exercises as shown in below.

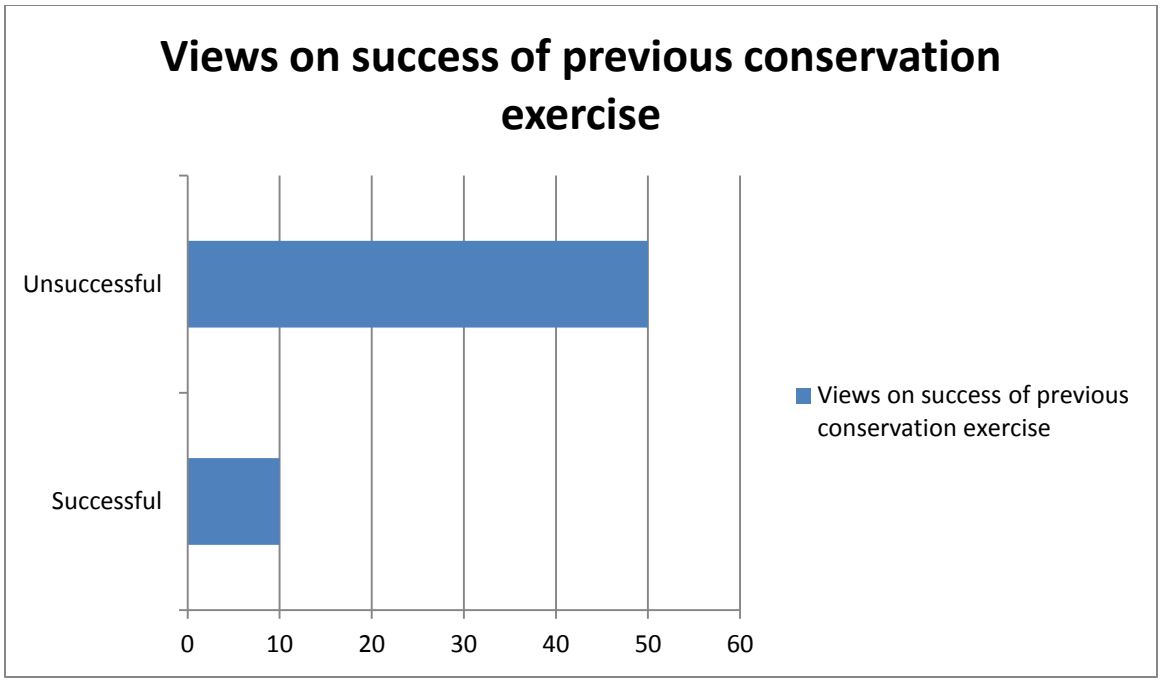


Table 5.2: Reasons attributed to the failure of the previous conservation exercises.

Reason for failure	No. of respondents of the same view
Fragmented and sectorial approach in initiation and implementation	10
Limited scope and objective	5
Inadequate stakeholder involvement	48
Lack of a financial structure that funds conservation	44
Failure to integrate conservation and the developmental needs of the people	57
Poor information dissemination and teaching to the community	38

5.2.2 PES Mechanism for use in the Area

According to a UNEP and Katoomba Group Primer (2008) on PES the saleable ecosystem services can be identified by focusing on:

• Specific ecosystem services that can be enhanced through particular changes in natural resource management actions (such as sequestering carbon through no-till agriculture, reducing sedimentation in rivers naturally through re-foresting hillsides, etc.). For example, a landowner may ascertain that buyers exist for improved water quality, which could be the focus of PES deals that include a combination of conservation easements, payments for riparian buffers, and/or payments improved livestock management.
• New natural resource management activities that are of interest to a landowner or community, and would produce ecosystem service benefits, but are too costly to adopt without external assistance**.** For example: a landowner looking to adopt agro forestry strategies for rural development may offer hydrological and/or carbon benefits.

PES deals focus on any or all of the ecosystem services there in present, and bundling several types of ecosystem services together in one project can maximize income and diversify risk. From literature review there were various mechanisms for PES identified; watershed protection services and biodiversity ecosystem services schemes. In Kenya there already exists a PES scheme between Kinangop WRUA and Lake Naivasha WRUA facilitated by Care International and WWF. Its successful implementation is what provided the base and desire of the researcher to initialize a process for formulation of a similar scheme to save Lake Ol Bolossat.
According to literature review findings (Scherr et al, 2006), the best mechanism to use in this case would either be:

1. **Watershed Protection Services**, this is because:
    - Beneficiaries or users are easy to identify and are often willing to pay for forestry interventions – even though there may be weak scientific evidence
    - Investments in watershed management are cheaper than treatment or new water supplies.
    - There is high win-win potential in developing countries since upper watershed farmers are usually poor, e.g., the Rewards for Upland Providers of Environmental Services (RUPES) Programme in Asia has built up collective action institutions and consolidated tenure.
    - Watershed PES works best when there is a scarcity of clean water, and water users have capacity to pay, e.g., urban citizens, companies.

- For private or market-based mechanisms, there is good potential for leverage of federal or municipal finance.

2. **Ecotourism, including sport hunting and fishing**, this is because
    - Huge market – up to 20% of all tourism;
    - Potential for participatory approaches;
    - New ecotourism certification standard proposed by Rainforest Alliance;
    - The high tourism potential of the area since it falls within a tourism corridor

5.2.3 Potential Buyers in the PES scheme

The buyers can also be referred to as donors (Porras et al. 2008; Smith, de Groot, Bergkamp 2006) since they provide the funds for the provision of ecosystem services, the most common ones are:

Government – providing County and national government funding; since most of the ecosystem services have far greater reaching effects and the scope of those who end up benefiting is large the government will chip in to offer services such as improvement of roads to ease accessibility to the area and to markets for the goods produced among others.

Private sector – making voluntary and required payments for water-related ecosystem services; these include the Nyahururu Water and Sewerage Company and others that are downstream in Samburu County and others within the course of the North Ewaso Nyiro River.

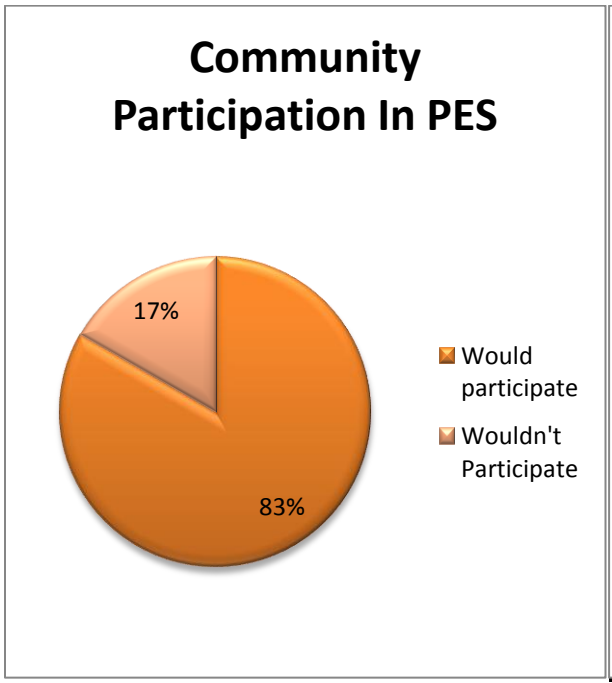
Private individuals – paying household and agricultural fees for use of water;

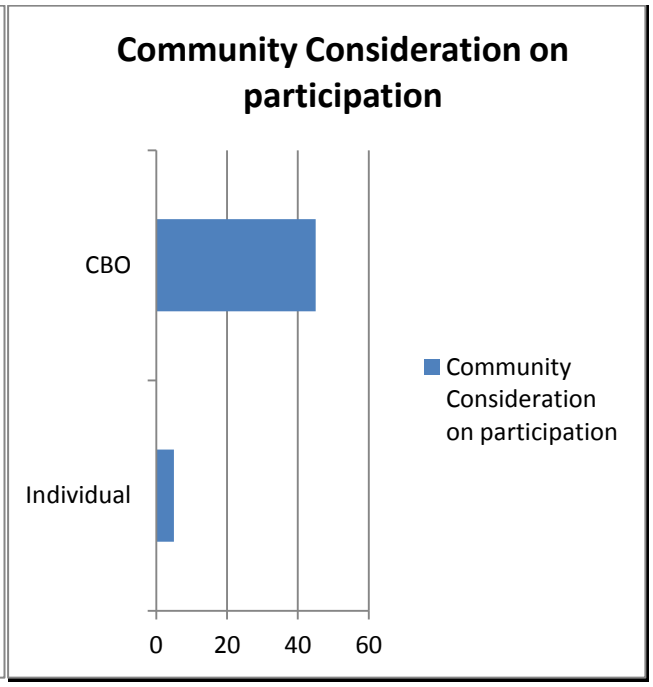
Charitable foundations – making donations from their assets such as Care International and WWF who can offer capacity building services and even promote IGAs that safe guard the ecosystem and benefit the community.

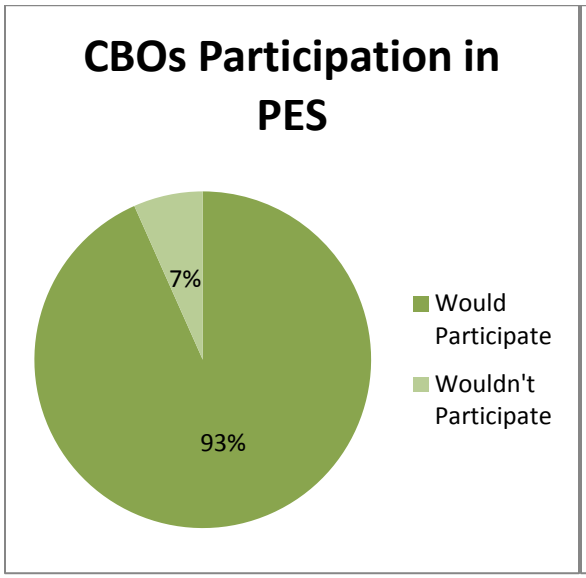
5.2.4 Community consideration on Participation in the PES scheme

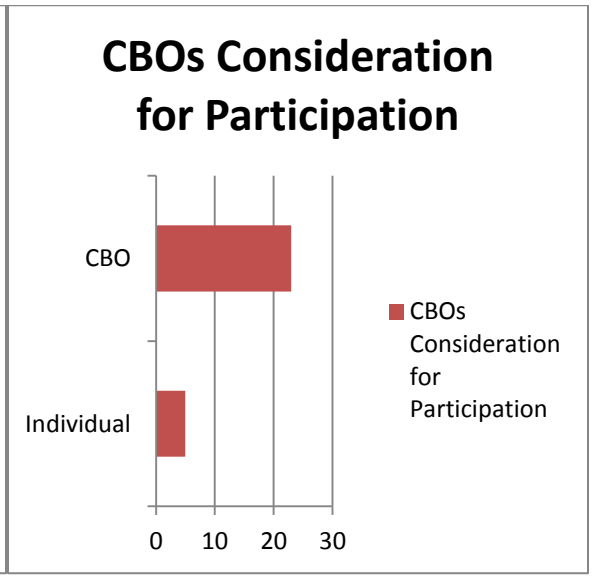
The objective was to assess the community's consideration on whether to sell as individuals or as a group. 30 questionnaires we administered to officials of 30 CBOs and 60 to the community

members to determine whether they would consider participating in the scheme, from those who said they would consider participation the researcher went ahead to determine what their consideration would be for participation-take part as an individual or as a group using the CBOs. The charts below shows views on participation (those that are willing to participate will either do so as an individual or a group-CBO).









From the findings it was evident that a majority of the people (83% of the community members and 93% of the CBOs) would be willing to participate in the scheme and from that number 45 community members and 23 CBOs would prefer the use of CBOs that were the groups considered for the study.

Table5.3: Recommendations made to ensure the schemes success

RECOMENDATIONS	NO. of RESPONDENTS	
	CBO Officials	Community members
Training and capacity building for the community	93%	92%
Involvement of the community at all levels of the project	83%	83%
Some developmental or monetary gain for the community	60%	97%
Consideration of all aspects of the environment together	77%	33%
No harassment from the government or government institutions	93%	87%

Source: Field Survey, 2014.

Due to the failures of past conservation exercises the researcher was determined to add the input of the community so as to address the failures of those past projects, the community was therefore involved in giving recommendations on what they would like to see incorporated in the scheme.

CHAPTER SIX: CONCLUSION AND RECOMMENDATION

6.1 Summary

This chapter presents the conclusion and recommendations that arose from the study. The research reviewed a wide range of secondary sources and collected primary data on which the conclusion and recommendations are based. The study was conducted within the Coasean theorem framework which emphasizes an incentivized approach towards the achievement of environmental conservation whilst maintaining development and improving livelihoods. It is therefore important for these to be considered in the development of any conservation projects or schemes as even evident from the recommendations made by the respondents. The research endeavored to answer the following questions:

I. What ecosystem services exist in the lake?

II. Which PES mechanism will yield the desired socio-economic and ecological outcomes?

III. Who are or can be the potential buyers in the PES scheme?

IV. What is the Community's consideration; is it to use Community Based Organization (CBOs) or individuals to sell the services?

6.1 CONCLUSION

In conclusion, the study showed that there were changes in the ecosystem of Lake Ol Bolossat with fluctuating levels of the lake, reduced sizes of forest lands and increased cultivation. There have also been several initiatives to offer interventions to at least arrest the situation but according to the data gathered they have been unsuccessful largely due to fragmented and sectoral approach in initiation and implementation-where every institution interested in safe guarding the areas ecosystem working as a lone range in trying to solve the problems there in, limited scope and objective, inadequate stakeholder involvement, lack of a financial structure that funds conservation, failure to integrate conservation and the developmental needs of the people, poor information dissemination and teaching to the community. All these issues need to be addressed in the PES scheme that the project aimed at evaluating its potential for implementation. The scheme would be highly welcomed with 83% of the community

respondents willing to take part and over 93% of the CBOs willing to also be part of the scheme. This showed high acceptance level of the scheme with certain recommendations there in to ensure its success.

6.2 RECOMMENDATIONS

- The County government should conduct an audit of its ecosystem services (Food production (in the form of crops, livestock, capture fisheries, aquaculture, and wild foods), Fibre (in the form of timber, cotton, hemp, and silk), Genetic resources (bio-chemicals, natural medicines, and pharmaceuticals), Fresh water, Air quality regulation, Climate regulation and Climate change mitigation, Water regulation and Watershed services, Erosion regulation, Water purification and waste treatment, Disease regulation, pest regulation, pollination, Natural hazard regulation , Cultural services (including spiritual, religious, and aesthetic values, recreation and ecotourism), Biodiversity conservation) and their status for the purposes of guiding conservation work in the County.

- There should be a GIS database developed by the County Minister of Environment of the above mentioned ecosystem services as an easier way of keeping records. If such a database existed it would help to determine things such as the highest water mark that is important in determining the riparian zones for demarcation and protection to avoid land grabbing or resettlement of people there.

  The County Government should lias with research institutions such as Kenyatta University to continue studies in line with in line with implementation of a PES scheme.

- With the successful implementation of such schemes with one previous one in the county, the legislators should look to developing a policy to guide PES in the county and further it to even the National assembly.

- Adjustments to the use of highest ranked water quality improvement BMPs should be used as a basis for determining PES and economic criteria should only be considered if there are problems with willingness and ability to pay by the downstream communities.

- A voluntary strategy where farmers are asked and agree to get involved in the protection and improvement of water resources is likely to succeed: This however would require some education through workshops to make farmers understand the benefits of BMPs adoption and how PES works.

- Educating the farmers, government, downstream business community and all other stakeholders would be the ideal starting point of a PES scheme.

- There is need for more research on institutional strengths and weaknesses in the management of funds and community mobilization. There is also a need for plat forms where each specific stakeholder can be able articulate their views, needs and the way forward.

- As there is currently no PES experience in the area, implementation of PES scheme would require institutions that would easily gain trust from the community.

6.2.1 AREAS FOR FURTHER STUDY

- ❖ Ecosystem services and emerging markets and payments
- ❖ Challenges to successful implementation of conservation activities
- ❖ Opportunities for market like conservation mechanisms in protection of ecosystem services.

APPENDICES

KENYATTA UNIVERISTY

Department of Environmental Planning and Management

HOUSE HOLD INTERVIEW QUESTIONNAIRE

INTRODUCTION

I am a Kenyatta University undergraduate student pursuing a Bachelor in Environmental Planning and Management. I am carrying out a research on potential payment for ecosystem services (PES) scheme in Lake Ol Bolossat, Nyandarwa County. I am kindly requesting for your time to answer some questions. The information you will provide shall solely be used for academic purpose.

Household Questionnaire

Bio Data Information

Date of Interview _____

Respondent(s) Name _____

1. Are you a member of any CBO?

☐ Yes ☐ No

2. Have you been part of any conservation work before?

☐ Yes ☐ No

3. If yes, how did you participate as?

☐ Individual ☐ CBO

4. Have any of the previous conservation activities been successful?

☐ Yes ☐ No

5. What is the reason for your answer?

_____

_____

_____

6. Would you participate in a PES scheme(conservation activities) around the Lake?

☐ Yes ☐ No

7. Would you prefer to participate as an individual or as a group (CBOs)?

☐ Individual ☐ CBO

8. What would you recommend to be done for the successful implementation of a PES scheme in the area?

_____

_____

_____

KENYATTA UNIVERISTY

Department of Environmental Planning and Management

CBOs INTERVIEW QUESTIONNAIRE

INTRODUCTION

I am a Kenyatta University undergraduate student pursuing a Bachelor in Environmental Planning and Management. I am carrying out a research on potential payment for ecosystem services (PES) scheme in Lake Ol Bolossat, Nyandarwa County. I am kindly requesting for your time to answer some questions. The information you will provide shall solely be used for academic purpose.

CBOs Questionnaire

Date of Interview _____

Name of CBOs _____

1. Number of members _____

2. Have you participated in any previous conservation work as a group? And if yes was it successful?

   ☐ YES ☐ NO

   _____

   _____

   _____

3. Would you advice your members to participate in a PES Scheme (conservation activity) in the area?

☐ YES ☐ NO

4. If yes, would you prefer they participate as individuals or as a group (CBO) and what would you recommend for the successful Implementation of the scheme?

☐ Individually ☐ CBO

_____

_____

_____

CHECKLIST

1)	Food production (in the form of crops, livestock, capture fisheries, aquaculture, and wild foods)	
2)	Fibre (in the form of timber, cotton, hemp, and silk),	
3)	Genetic resources (bio-chemicals, natural medicines, and pharmaceuticals)	
4)	Fresh water,	
5)	Air quality regulation,	
6)	Climate regulation and Climate change mitigation	
7)	Water regulation and Watershed services	
8)	Erosion regulation	
9)	Water purification and waste treatment	
10)	Disease regulation, pest regulation, pollination	
11)	Natural hazard regulation	
12)	Cultural services (including spiritual, religious, and aesthetic values, recreation and ecotourism)	
13)	Biodiversity conservation	

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