Modelling payment systems for environmental services in the Mt Elgon ecosystem of Kenya

By

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DEDICATION

This thesis is dedicated

To my mother, the greatest influence on my life, ***Veronica Kisaka.*** *For the sacrifice she made that I may get a good education. Although you are not here to share this success, your life lessons continue to be a source of inspiration and I am eternally grateful to you for your patience, encouragement, support and prayers. May your soul rest in perfect peace.*

To my loving son ***Philip Amwata*** *for your unfailing love, belief in me, understanding and motivation. May our good God abundantly bless you that you may fulfill all your dreams.*

I Love you Phil.

Lily

DECLARATION

I hereby certify that this thesis is the result of my own original work and has not previously been submitted to another university for the purpose of a degree. Where use has been made of the work of others, such work has been duly acknowledged in this text.

Signed ……………………………………………… Date: ……………………………..

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ABSTRACT

Unsustainable patterns of consumption by humankind have increased the rate of change in the natural ecosystems and consequently the levels of stress experienced within the environment. Access to sufficient good quality water is essential and a requirement to meet a number of the Millennium Development Goals (MDGs). However, poor land management and untenable agricultural practices have become the main drivers of the declining watershed services. Upstream farmers often have little or no incentives to take these impacts into account in their decision-making process. Therefore, without investment in ensuring proper land management, the trend in watersheds degradation will continue. Payment for Environmental Services (PES) has emerged as an incentive–based tool that is expected to motivate farmers to improve their agricultural practices. PES is set up to facilitate the process whereby the beneficiaries of environmental services pay compensation to providers of environmental services for conserving the ecosystem. This tool has received increasing attention as a means of creating incentive measures for managing the ecosystem, addressing livelihood issues for the rural poor, and providing sustainable financing for protected areas. The Government of Kenya, as part of its efforts to improve water resource management, is considering use of economic incentive. However, there is insufficient information to guide policy making in that direction. Little is known about the farmers' preferences for management schemes that will affect land use patterns, their willingness to accept compensation and the willingness of potential buyers to pay for the services. This study evaluates the willingness to accept and the willingness to pay for environmental services with a view to assessing the viability of a PES scheme for the Kuywa Watershed in particular, as well as the Mt. Elgon Ecosystem and other areas with similar conditions.

The objectives of the study are threefold (i) to examine respondents preferences for management options for the provision of environmental services in the watershed of River Kuywa of Mt. Elgon Ecosystem; (ii) to evaluate households' willingness to pay (WTP) and willingness to accept (WTA) payment for improved environmental services from the River Kuywa watershed; and (iii) to propose viable PES approaches for the management of the natural resource of the Kuywa watershed and the Mt. Elgon ecosystem in general. Using six land management attributes relevant to the local situation, the study applied the conjoint method to evaluate farmers' preferences for management options for the provision of environmental service and assess farmers' willingness to pay and willingness to accept payment for environmental services. To enable assessment of viability, an analysis was done of the institutional and legal framework within which the PES scheme would operate. Data were collected using literature review and document analysis, questionnaires, focus group discussions and key informant interviews.

Results indicate that poor water quality was the most acute problem, followed by deforestation. Results from the conjoint models show that the length of commitment period and land size that is 40% or more of the total land holding influence the farmers' rating of the management scenarios. The study found that a management contract that requires use of 20% of land holding for a period of 5 years, combined with a cash incentive, harvesting partially permitted, administered by a local NGO and requiring contribution of free labour for two days had the highest likelihood of being selected. The conjoint valuation exercise also came up with a WTA by farmers upstream of KSh. 7,080/= per year. The corresponding value downstream was KSh. 43/= per month over and above their regular water bill. In terms of the institutional and regulatory framework, Kenya has a wide range of policies, laws and regulation on water and other natural resources which provide an enabling environment for PES. With the decentralized institutional setup implemented in both the water sector and the agricultural sector, the institutional setting also provides an enabling environment for PES. With a positive WTA and WTP coupled with an enabling legal and institutional environment, the study concludes that PES is a viable environmental management tool for the Kuywa water shed and similar watersheds.

Key Words: *Payment for Environmental Services, Farmers' preferences, Willingness to Accept, Willingness to Pay, Ordered logit, Contingent valuation, Conjoint analysis*

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ACRONYMS AND ABBREVIATIONS

AG	Assurance Game
CA	Conjoint analysis
CAACS	Catchment Areas Advisory Committees
CBD	Convention for Biological Diversity
CBNRM	Community-based Natural Resource Management
CDM	Clean Development Mechanisms
CEE	Centre for Environmental Education
CES	Compensation of Ecosystem Services
CFAs	Community Forests Associations
CG	Chicken Game
CIFOR	Center for International Forestry Research
CIS	Co-investment in ecosystem services
COS	Compensation for Opportunities Skipped
CRES	Compensation and Rewards for Ecosystem Services
DANIDA	Danish International Development Agency
DRSRS	Department of Resource Survey and Remote Sensing
EAP	Environmental Action Plan
EMCA	Environmental Management and Coordination Act
EG & S	Environmental Good & Services
ERA	Ecosystems Restoration Associates
ES	Environmental Service
EOLSS	Encyclopedia of Life Support Systems
FAO	The Food and Agricultural Organisation
FD	Forest Department
FG	Fairness Game
FGD	Focus Group Discussion
GDP	Gross Domestic Product
GoK	Government of Kenya
GHG	Green House Gases
ICDP'S	Integrated Conservation and Development Projects

ICRAF	International Center for Research in Agro-Forestry
IIED	International Institute of Environment and Development
IPES	International Payments for Environmental Services
IoS	Institutions of Sustainability
IWRM	Integrated Water Resources Management
IUCN	International Union for Conservation of Nature
IWRM	Integrated Water Resources Management
JPOI	Johannesburg Plan of Implementation
KARI	Kenya Agricultural Research Institution
KFS	Kenya Forest Services
KNBS	Kenya National Bureau of Statistics
KUWRUA	Kuywa Water Resource Users Association
KWS	Kenya Wildlife Services
LBDA	Lake Basin Development Authority
LVEMP	Lake Victoria Environment Management Programme
LVNCA	Lake Victoria North Catchment Area
LVNWSB	Lake Victoria North Water Services Board
MA	Millennium Assessment
MBI	Market-based Incentives
MCMAP	Micro-Catchment Management Action Planning
MEA	Millennium Ecosystem Assessment
MES	Market for Ecosystem Services
MDG	Millennium Development Goal
MEA'S	Multilateral Environmental Agreements
MSA	Mean Species Abundance
NEAPC	National Environmental Action Plan Committee
NEC	National Environment Council
NEMA	National Environmental Management Authority
NET	National Environment Tribunal
NETFUND	National Environment Trust Fund
NGOs	Non Governmental Organizations
NTFP	Non-Timber Forest Products

NRM	Natural Resource Management
NWMP	National Water Resources management Plan
OECD	The Organisation for Economic Co-operation and Development
PCC	Public Complaints Committee
PD	Prisoner's Dilemma
PES	Payment of Environmental Services
PPP	Purchasing Power Parity
PRESA	Pro-Poor Rewards for Environmental Services in Africa
PWES	Payment for Watershed Environmental Services
REED	Reducing Emissions from Deforestation and Forest Degradation
RMCOM	Raw Material for Commercial Purposes
RSP	Random Sampling Points
SD	Sustainable Development
SERC	Standards and Enforcement Review Committee
SES	Social-ecological Systems
SIDA	Swedish International Development Agency
SLM	Sustainable Land Management
TEEB	The Economics of Ecosystems and Biodiversity
TEV	Total Economic Value
UNECE	United Nations Economic Commission for Europe
UNCED	United Nations Conference on Environment and Development
UNCTAD	United Nations Conference on Trade and Development
UNCSD	United Nations Conference on Sustainable Development
UNEP	United Nations Environmental Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
WASREB	Water Services Regulatory Board
WBCSD	World Business Council of Sustainable Development
WCED	World Commission on Environment and Development
WCS	World Conservation Strategy
WRMA	Water Resources Management Authority
WRUAS	Water Resources Users Authority
WSB	Water Services Board

WSP	Water Services Providers
WSRB	Water Services Regulatory Board
WSSD	World Summit on Sustainable Development
WTA	Willingness to Accept
WTP	Willingness to Pay

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CHAPTER 1
INTRODUCTION

1.1 Background

Desertification, biodiversity loss, reduced forest cover, water scarcity, increased soil erosion, and climate change contribute to the complex environmental challenges the world faces today. These are complicated by their linkages to other global challenges, such as fast growing population, increasing inequality and the global financial crises. Together, these challenges leave an estimated one billion people in the world without enough food, water and other basic needs (FAO, 2011). The United Nations, through its agencies and funds such as the United Nations Environment program (UNEP) (UNEP, 2008), the Food and Agricultural Organization of the United Nations (FAO) (FAO, 2011), and the International Fund for Agricultural Development (IFAD) (IFAD, 2013), recognizing the gravity of these global challenges, have endeavored to focus the World's attention on the questions about how we manage natural resource production systems, what value we assign to them, how we distribute these resources, and how we conserve them for future generations. This has culminated in declaring the year 2014 as the **International Year of Family Farming (IYFF)** which aims to raise the profile of family farming and smallholder farming by focusing world attention on its significant role in eradicating hunger and poverty, providing food security and nutrition, improving livelihoods, managing natural resources, protecting the environment, and achieving sustainable development particularly in rural areas.

Through unsustainable patterns of consumption, humankind has increased the rate of change in the natural ecosystems and consequently the levels of stress experienced within the environment (Baland, 1996). Biology and ecology have revealed that all living things depend upon each other and are interconnected through natural cycles and ecological systems (Chee, 2004). Such cycles and systems are naturally and continually subjected to change that can harm or enhance the ability of different species to survive and flourish (Chee, 2004). Interdependence exists across both time and space. Past, present and future are inextricably connected and man is directly linked back in time by the oldest members of the community and forward nearly a century by those born today. It is important to appreciate that both continuity and change have fundamental influences during the courses of peoples' lives (Dasgupta *etal.,*2000). Understanding the concept of interdependence will assist humankind in recognizing its responsibilities for the future. In the international community there is growing concern about environmental problems such as natural resource depletion and pollution and alarming loss of biological resources. The underlying causes of these problems are a mix of market and policy failures (Cobera *et al.,* 2009). There is a strong need to search for solutions which do not only address the symptoms but focus on the underlying causes for these problems.

Sustainable development highlights the interdependence of society, economy and the natural environment. It encompasses the two opposing notions of development and conservation: the first, *development*, implies positive and desirable change, usually and unfortunately with some adverse environmental consequences; while the second, *conservation*, is predicated on the idea of minimum disruptive change outside that due to natural processes, so as to maintain the capacity of environmental systems to continue producing goods and services (Frost *et al.,* 2006). Sustainability not only includes environmental integrity but also encompasses economic resilience and social development (Holling, 1996). Sustainability means ensuring human well-being without reducing the capacity of the world's natural resource production systems to support other life (Constanza *et al.,* 1997). The conservation and sustainable use of natural resources was enhanced by the Millenium Assessment (MA) which, by placing human well-being as the central focus for assessment, established sound scientific, conceptual, and political bases for the action (Asquith and Wunder, 2008).

Human societies have understood their dependence upon nature for a diverse array of benefits that support human well-being for a long time. As early as 428 BC, the ancient Greek philosopher Plato (circa 428–348 BC) recognized that problems of soil erosion and reduced water flows were linked to deforestation in the historic Greek region of Attica[1] (Mooney & Ehrlich, 1997). The Millenium Assessment (2003) estimated that with a world population of 3 billion at that time, and growing, and a world economy that will quadruple by 2050, an exponential increase in demand for and consumption of biological and physical resources, is expected with impacts on the environment. Increased interest in environmental services has grown out of concern that massive changes in ecosystem health taking place as a result of economic development could have significant negative impacts on production and consumption. This brought to the fore the issues of poverty-environment inter-linkages; the poor depend on a healthy natural resource system to sustain their livelihood and with limited opportunity for alternative sources of livelihood, this dependency increases. Given this scenario, over-exploitation of natural resources destroys the environment and by extension livelihood opportunities of the poor. This leads to the conclusion that environmental degradation, in conjunction with the emerging challenges of global climate change, are contributing to increasing levels of poverty. Therefore, as developing countries make poverty alleviation their major focus, the sustainable management of natural resources becomes imperative in securing the livelihood for the poor.

Concern with protecting the environment for the benefit of present and future generations is now at the center of the international agenda. Awareness of the extent of the damage done to our environment through unsustainable economic activities is steadily growing. In particular, there is growing awareness of the need for international actions to implement realistic and workable solutions for the reduction of these man-made environmental impacts. A combination of institutional (absence of secure property rights), market (environmental externalities) and policy failures (distortionary subsidies) result in the under-pricing of scarce natural resources and environmental assets. As a result, producers and consumers of these products and services do not receive correct signals about the true scarcity of the resources they consume or the environmental damages they cause. This gap between the private cost of a product (production cost) and the total cost to the environment (including depletion and damage cost) causes incorrect signals. Since the

[1] Attica is the name given to the southern portion of the Greek peninsula which is home to Athens, the capital of Greece. It is historic since much of ancient Greek history took place here and it is also home to the Plain of Marathon, Cape Sounion, Eleusis, and many other renowned ancient sites.

social cost for depletion and damages are not internalized, this results in over-production and over-consumption of products which are resource depleting and environment polluting.

Since the release of the Millennium Ecosystem Assessment (MA, 2005), ecosystems have become widely recognized as natural capital assets supporting and supplying services which are highly valuable to humans. Watersheds provide a wealth of ecosystem services that are important to quality of life. Rafuse (2013) found that healthy watersheds provide clean air, clean water, and Habitat for species as well as recreation and aesthetic value. Riparian areas, in particular, provide essential ecosystem services important to maintaining water quality. He further stipulated that riparian forest canopy helps regulate river temperatures while trees with deeper roots provide for erosion control and riverbank stabilization. Most importantly, native vegetation in riparian areas filters out pollutants from non---point sources (Rafuse, 2013). However, the provision of these services is endangered by the increasing challenges of water pollution and watershed degradation. Water pollution has emerged as one of the serious environmental problems confronting the world today (Rafuse, 2013). Water pollution from upstream sources jeopardizes downstream residents' access to safe drinking water. This has been attributed to nonpoint sources pollution from agricultural systems which is the largest source of surface water pollution and represents a significant challenge to water pollution control (Zhang *et al.,* 2009).

Farming activities are generally considered to be among the leading direct causes of tropical deforestation and biodiversity loss (Chomitz *et al.,* 2007), under certain policy scenarios it also shows potential for contributing to their reversal (Angelsen, 2010). Therefore, substantial attention has been redirected at farmers as potential protectors and providers rather than as destroyers of natural resources. This makes Individual land use decisions a common source of negative environmental externalities, affecting quantity and quality of downstream water supplies, reducing biodiversity and emitting carbon into the atmosphere (Jack *et al.,* 2008). However, studies show that the ‘polluters-pay principle’, has not been helpful for solving this. In addition, tremendous implementation and enforcement costs may arise when applying command-and-control measures or pollution levies to the nonpoint sources. A Coasean solution to land use externalities has gained popularity and proposes to align private and social costs through conditional payments from those affected by the externality to the landholder (Engel *et al.*, 2008). Watershed contexts are believed to tie in better with the Coasean upstream–downstream externalities framework, as they can capitalize on the production of straightforward externalities (water services) and the generation of relatively low transaction costs by adding ES payments to financing structures already established by local water utilities (Kosoy *et al.,* 2007). This prompted research exploring the potential of local payments for watershed services and the prospects it offers for securing long-term ecosystem protection (Ortega-Pacheco *et al.,* 2009; Porras *et al.,* 2008; Southgate and Wunder, 2009).

There is a growing appreciation of the important role that ecosystems play in providing goods and services that contribute to human welfare, and recognition of the impact of human actions on ecosystems. Over the years, the services provided by healthy forest and riparian ecosystems have not been fully recognized in the marketplace. Failure to adequately account for the benefits provided by ecosystems carries with it significant risks of deterioration and potential loss of beneficial services (Goldmark, 2012). In The absence of an ecosystem services marketplace, the costs of protecting or restoring ecosystems are externalized. The estimation of the economic value of environmental services is expected to play an important role in conservation planning and ecosystem based management (Plummer, 2009; Stenger *et al.,* 2009; Turner *et al.,* 2007), and to become increasingly important for local, national, and global policy and decision making(Turner *et al.,* 2010). It also has a role to play in ensuring that human actions do not damage the ecological processes necessary to support the continued flow of ecosystem services on which the welfare of present and future generations depends (Stavins, 2000) and therefore in ensuring sustainable development (Turner *et al.,* 2010). This becomes more relevant under the threat of climate change, where a 38^{0}C warming is estimated to be sufficient to transform about one fifth of the world's ecosystems (Fischlin *et al.,* 2007).

1.2 Environmental Valuation

Peterson *et al.* (2009) stated that the emphasis presented in the ecosystem services concept was formed with the idea of teaching people that ecosystem services serve us, thus demonstrating the utilitarian value of ecosystems for humanity and justifying the protection of biodiversity. According to Iftikhar *et al.*(2007) ecosystems are allowed to degrade because they have been routinely undervalued and in monetary terms underpriced. On this basis, therefore, environmental services are deemed important when the benefits they provide are viewed in economic terms by their users. Given the large scale of human activities and the resultant cumulative losses in environmental services, it is now time for society to re-examine the value it attributes to these services and incorporate these values in decision-making. Economic valuation of environmental services constitutes an alternative approach to natural resource management.

Functional performance of ecosystems provides valuable goods and services to society. These reflect human preferences for sets of goods and services for which there is demand. It is postulated by scholars (name some) that for sustainable natural resource management, it is important to understand the value of the resource in both qualitative and quantitative terms so as to guide their sustainable utilization and management. Ecosystems provide valuable services to local, regional and international community's (Costanza *et al.,* 1997; Millennium Ecosystem Assessment, 2005). However, traditional economic markets are underdeveloped or lacking for many environmental services such as watershed benefits, biodiversity conservation and carbon sequestration. As a result, decisions to convert or alter natural habitat towards market-based agricultural or timber activities generally fail to take into account the total costs of service loss (Westman, 1977; Hanley, 1992; Loomis *et al.,* 2000).

Public perceptions of ecosystem performance form the foundation upon which economic valuation of the environment is based. Valuation investigates in monetary terms public/individual preferences for changes in the state of the environment, and provides a means of quantifying the direct and indirect benefits, use and non-use values, as well as current and option values that people derive from an ecosystem. Additionally, valuation informs decision making by resource planners and practitioners on resource options, conservation and optimal allocation by demonstrating the economic importance of the resource. Valuation fits into the paradigm of Integrated Water Resources Management (IWRM), one of which principles is that water – and by extension other natural resources –

is an economic good; whose economic value must be recognized given the benefits they generate to communities and national economies.

Despite its positive attributes, the uptake of valuation for practical application to resource management has been slow (Naidoo *et al.,* 2008). This can be attributed to the complex dynamics between the ecology-economy interface and the failures of markets and systems of economic analysis and accounting (notably GDP) to capture values of ecosystem services. It is also due to limited understanding of: a) how different services are interlinked with each other and to the various components of ecosystem functioning and the role of biodiversity; b) how different human actions that affect ecosystems change the provision of ecosystem services; c) the potential trade-offs among services; d) the influence of differences in temporal and spatial scales on demand and supply of services; and e) what kind of governance and institutions are best able to ensure biodiversity conservation and the sustainable flow of ecosystem services in the long-term.

Valuing ecosystem services are easiest for goods and services that are traded in markets since the market price is taken as the value of the service. Swinton *et al.*(2007) highlighted that food, fibre and fuel have market prices that provide both incentive to produce those ecosystem services as well as measures of their value to society. But many other environmental services lack markets, and over the years tools and techniques have been developed to enable value to be assigned to these services. Payment for Environmental Services (PES) schemes build on these experiences and attempts to translate non-market environmental services into financial assets traded on markets. In developing PES schemes, effort is made to present environmental services as tradable goods that are then marketable. The market then establishes a price customers would then pay for the service, which then represents its value. Economic valuation highlights the importance of environmental services and in so doing discourages ecosystem degradation.

1.3 Payment for Environmental Services

Growing from valuation studies are market based approaches to conservation upon which the Payment for Environmental Services (PES) is based. PES is premised on the concept that "to maintain the flow of environmental goods and services for society, incentives are needed to induce local people to forego more disruptive land and resource use practices"(Bond and Frost, 2005). Bond and Frost suggest that policy instruments can be designed to modify the incentives faced by resource managers in a way that encourages sustainable management and conservation. Incentive based mechanisms include charges (such as taxes, user fees, and deposit-refund systems), subsidies, tradable permits (including markets for pollution reduction and tradable development rights), and market friction reduction (e.g. liability rules and information programs). PES is one such Incentive based instruments to which attention is being paid within the broader context of changing approaches to conservation and environment policy. Payment for Environmental services (PES) offers an emerging and promising conservation approach that provides natural resource users payments upon delivery of environmental services. Payments for Environmental Services (PES) is an economic instrument designed to provide positive incentives to natural resource users that are expected to result in continued or improved provision of environmental services.

PES is defined as a voluntary transaction in which a well defined environmental service (or land use likely to secure that service) is being bought by a minimum of one environmental services buyer from a minimum of one environmental services provider if and only if the provider continues to supply that service (Wunder, 2005). PESs are voluntary transactions involving well-defined tradable environmental service that can be bought by a buyer. Proponents of PES argue that compensating land user for ecosystem services would make markets to consider such services in decision making processes, thereby increasing chances of arresting land degradation and other environmental problem such as erosion and floods (Pagiola *et al.,* 2005).

The concept of PES is premised on a theoretical background that stems from neoclassical environmental economics (Pearce and Turner, 1990; Perman *et al.,* 1999), where environmental dilapidation is attributed to the constant inability of markets to internalize environmental externalities, and to free-riding brought on by the public-good nature of ecosystem services. Hence, the PES philosophy argues for the internalization of environmental externalities through the creation of ES markets or quasi-markets Heckens and Bastiaensen (2010) say the explicit focus on positive externalities results in a shiftfrom the 'Polluter Pays Principle' (PPP) to a 'Beneficiary Pays Principle' (BPP) (Pagiola *et al.,*2002; Pearce, 2004) or 'Provider Gets Principle' (PGP) (Hubermann and Leipprand, 2006). The land user is now seen not as a polluter, but as a service provider who is presented with an opportunity to add an ES to their production portfolio, either as a joint product of other goods or as a service that is independently generated.

With the decline in total foreign aid from bilateral and multilateral donors, several studies have shown that the market mechanism and direct payments will lead to the most efficient allocation of scarce conservation funds (Ferraro and Simpson, 2002; Pagiola *et al.,* 2002; Pearce, 2004). These studies say that by taking advantage of the land users' knowledge of the cost of ES provision and seeking out the low-cost providers (Engel *et al.,* 2008) or concentrating on the higher-benefit cases (Pagiola *et al.,* 2005), PES secures the basic economic premise of efficiency optimization of scarce conservation funds (Ferraro, 2001; Ferraro and Simpson, 2002; Pagiola *et al.,* 2002).This innovative approach has the potential for bringing positive changes to environmental management and conservation, contributing to sustainable development and poverty eradication. PES policies represent a growing trend in conservation policy. By altering private incentives to induce desired outcomes, PES schemes offer a direct and possibly more equitable method for achieving environmental outcomes than other approaches.

1.4 Problem Statement and Justification

Untenable ecosystem degradation is taking place in an interconnected world, with a growing population having unsustainable production and consumption patterns. The degradation of natural resource systems is fast reducing development opportunities, heightening risks and therefore threatening future human well-being, especially for poor and vulnerable populations(Sommerville *et al.,* 2010). By 2050, the Earth's population is expected to increase from 7 billion to over 9 billion and the world economy is projected to nearly quadruple, with growing demand for energy and natural resources as a result (OECD 2012). These demographic and socio-economic shifts and associated lifestyles imply consumption patterns that have significant consequences for the environment. The degradation of the Natural resource system is expected to continue to 2050, with the risk of irreversible changes that could endanger two centuries of future generations(OECD 2012).

According to WWF (2010), biodiversity in the tropics has declined by 30% since 1992,a further indication of the the ecosystem's severe degradation The Living Planet Index also reflects these changes in the health of the earth's ecosystems, based on monitoring almost 8 000 populations of over 2 500 vertebrate species. In contrast to the temperate biome, which is somewhat stable, all other indices show various degrees of decline (WWF, 2010). Without policy changes to curb and reverse this situation Biodiversity loss is expected to continue. Globally, terrestrial biodiversity (measured as mean species abundance – or MSA – an indicator of the intactness of a natural ecosystem) is projected to decrease by a further 10% by 2050 (OECD, 2012). The expansion of commercial forestry, the conversion of natural habitats to agriculture and other land-uses, human encroachment, development of infrastructure, as well as pollution and climate change are the main drivers of Biodiversity loss(Porras*et al.,* 2008).

In recent years, human pressure on land resources has increased, despite international goals to improve land management. Africa has not attainment of these goals, with over three million hectares of forest cover lost each year due to the expansion of agricultural lands to meet food needs and demand for fuel(Kelsey,2009).The Global Environment Outlook 4 (UNEP, 2007) alerted the world about unprecedented land use changes created by the rapidly growing population'sand unsustainable economic development. These drivers continue to cause ecosystem degradation, natural resource depletion and mounting pressures on land from competing uses(UNEP, 2007).

"Millions of hectares of tropical forest are cleared every year to make way for non-forest uses, or are degraded by unsustainable or illegal logging and other poor land-use practices" (FAO, 2011). Around 13 million hectares of forest were converted to other uses or lost through natural causes each year between 2000 and 2010 (FAO, 2010). These losses contribute 12-15% to global warming by releasing CO_2 into the atmosphere and hampering further CO_2 storage (Van der Werf *et al*., 2009). Currently forests cover around 30% of the Earth's land mass(FAO, 2010).) and although the rate of deforestation is slowing down, large areas of primary forest and other naturally regenerated forests are declining, especially in South America and Africa. Mature forests, which tend to be rich in biodiversity, are projected to shrink in area by 13% with an associated aggregate loss of biodiversity and ecosystem benefits estimated to be between USD 2 and 5 trillion per year, according to The Economics of Ecosystems and Biodiversity (TEEB) study (TEEB, 2010).

On the other hand, global water demand is projected to increase by some 55%, due to growing demand from manufacturing (+400%), thermal electricity generation (+140%) and domestic use (+130%) (OECD, 2012). Nutrient pollution from urban/industry wastewater and agriculture is projected to worsen in most regions, intensifying eutrophication and damaging aquatic biodiversity (OECD, 2012).About 80 per cent of the world's over7 billion people, almost all in developing countries, live in areas with high levels of threat to water security (UNEP, 2007). About one-third of global freshwater ecosystems has already been lost, and further loss is projected by 2050 (UNEP, 2007). Freshwater availability will be further strained in many regions, with 2.3 billion more people than today projected to be living in river basins experiencing severe water stress, especially in Africa and Asia. The number of people with access to an *improved* water source (although not necessarily *safe* water for human consumption) is expected to increase (OECD, 2012). However, globally more than 240 million people are expected to be without such access by 2050 (OECD, 2012). Sub-Saharan Africa is unlikely to meet the Millennium Development Goal (MDG) of halving by 2015 the 1990 level of the population without access to an improvedwater source. Africa is facing major challenges in providing enough water to its population, a process driven again by the growing population placing extra demand on resources that are growing scarcer. More people are likely to experience more severe water stresses in the coming decades, with projected climate change impacts and continuing population growth (Vorosmarty *et al*., 2010). This led to the call in the Johannesburg Plan of Implementation (JPOI) (WSSD, 2002) for the efficient use of water resources and sensible allocation among competing sectors.

The current situation with the degrading ecosystem and the estimated projections by various world bodies highlights the need for urgent action to change the course of future development and protect the resource for future generations. Natural resource systems have thresholds beyond which damaging change becomes irreversible. However, these thresholds are not yet well understood and neither are the consequences. Africa needs to place itself on the sustainable development path in order to achieve food security, energy sufficiency and manage environmental risks, inspite of a fast-growing population, globalization, climate change, and an urgent need for improved governance(Kelsey, 2009.). The continent is lagging behind with respect to meeting internationally agreed environmental, economic and social targets, while increasing pressure on its natural resources builds up tensions and weak governance structures leave a complex web of issues unresolved(UNEP, 2011). A key challenge is to strike a balance between giving clear policy signals to resource users and consumers, while leaving room for maneuver and for adaptation, given the uncertainties. Africa's has a track record of collaborative projects between governments, communities and stakeholders provides a ray of hope as it contains the seeds for a more sustainable future.

Human societies are faced with a tension between providing for near-term human needs, while also supporting ecosystem services that provide for long-term sustainability (MA 2005). Ecosystems deliver goods and services of enormous value to human society. However intensive land and water use, extraction of natural resources, and chemical emissions into the environment are leading to a worldwide loss in biodiversity and degradation of ecosystem functioning (Hooper *et al*., 2005). Indicators of this degradation are cumulative with long term effects of environmental related disasters such as floods, landslides, droughts and desertification. The MA report states that it is possible to address these problems and reverse the trend in ecosystem degradation over the next 50 years. This will require, significant changes in policy and practice, most of which are not currently underway or are just in their infancy (MA 2005).

The challenge of stemming environmental degradation continues to dominate discussions of the sustainable development agenda globally. The Millenium Ecosystem Assessment (MA), in assessing the current state of ecosystems and their ability to support human well-being, consistently found the world's natural capital and ecosystem services are being depleted at a global scale by human actions (MA, 2005).The magnitude and rate of depletion is placing increasing pressure on the ability of Earth's ecosystems to support the needs of present and future generations. Based upon an analysis of trends between 1950 and 2000, the MA (2005) reported that approximately 62 percent of the world's ecosystems are being degraded or used unsustainably. Other scholars have estimated that 85 percent of cultivated lands contain areas that are degraded by soil erosion, salinisation, soil compaction, nutrient depletion or unbalance, pollution and the loss of biodiversity (Zheng *et al.,* 2013). Moreover, each year 12 million hectares are lost due to desertification; an area of this size would be able to produce 20 million tonnes of grain and annually feed over six million people (WBCSB and IUCN, 2008).

The ecosystems such as forests and wetlands that provide watershed services form part of the infrastructure needed for water security. Water security encompases the availability of water for a domestic use, agriculture, industry, transport or for downstream ecosystems and while also implying reducing pollution, droughts, risks related to floods and water based hazards. However, watershed ecosystems continue to be degraded globally and particularly in developing countries. Humankind continues to encroach into water catchments converting the land for other uses like agriculture and settlement. It is generally accepted that land-use decisions affect the provision of watershed environmental services. In Kenya, the root cause of environmental degradation and biodiversity loss is the conversion of her wetlands for agricultural development. Wetlands are especially at risk the world over, both because they have more fertile soil and are fragile ecosystems.

Globally more than one (1) million people lack access to safe water (World Bank, 2004) with Africa accounting for 27% of this number. In Kenya only 53% of the population has good quality and reliable water supply (World Bank, 2004). With growing population and the resultant increasing demand for water, water shortages and rationing is a common in many urban areas of developing countries. In rural areas due to water scarcity, women and children are forced to walk several kilometers in search of clean water. This affects other productive sectors of the rural economy due to loss of precious time. Further poor quality and inadequate quantity of water has significant negative effects on health and food production (Kariara, 2009)

Managing land and water ecosystems is difficult because of the public good characteristics of watershed services they provide. Public goods cannot be supplied in sufficient quantities by individuals acting in their own self-interest. When the benefits of an ecosystem service accrue mainly to the individual owner as is the case for farm produce then private markets are likely to work relatively well in stimulating service provision(Go´mez-Baggethun, 2011). However, when the benefits flow to all and access cannot be denied to anyone, such as in water purification or climate stabilization, then a mismatch arises between public interests and the interests of the resource manager (Jack *et al.,* 2007). In watersheds the land-management practices decisions of landholders upstream affect the quantity and quality of water received downstream. But since the effect of their actions does not affect them directly, they have little incentive to consider these impacts in decision making. Alternately, water users downstream have little incentive to pay for improved watershed service provision if they cannot exclude non-payers from enjoying these benefits (Pagiola*et al*., 2002). This difference in private and social benefits, or the problem of externalities results in a classic market failure and Individuals will tend to provide too little of the ecosystem service.

The conventional approach to addressing the public good problem is for the government to take responsibility for the provision of these goods and services. Governments then take direct control for natural resource protection and endeavor to deter environmental degradation by establishing a legal norm coupled with a sanction for non-compliance. This has evolved with time to incorporate more inclusive management approaches such as integrated conservation and development projects (ICDPs), also known as community conservation and community based natural resource management approaches (CBNRM)(Barrett and Arcese,1995). These regimes attempt to link environmental conservation to the socio- economic development of communities living adjacent to or within an ecosystem, through a combination of limited permitted use of natural resources from the area, developing alternative sources of livelihood, and improving social services. The assumption is that such developments will reduce the pressures on the protected areas. Despite these efforts environmental degradation continues unabated.

To date, regulatory natural resource management strategies have not yielded significant reduction to environmental pressures (Berkes, 2004). The traditional command and control policies on their own have not generated the desired result, are difficult to enforce in practice and have raised concerns of equity since they limit livelihood options for the poor and for natural resources users . The command and control policy may be effective in controlling point-source pollution from identified sources like industries or sewage treatment plants. They are however, less effective and difficult to enforce for non-point sources of pollution, where for instance, several geographically spread and heterogeneous upstream landholders, utilize their land in a manner that collectively results in water pollution or scarcity downstream(Doody *et al.,* 2009)

According to Barrett and Arcese (1995),the initial perception that approaches involving community participation and alternative livelihood sources presented a win-win solution to environmental degradation cannot be upheld based on its patchy success record. These projects have been complicated to implement and are not cost-effective. Scholars have queried whether they have contributed to sustained development or lasting conservation benefits, let alone both (Gartlan, 1998; Logan and Mosely, 2001; Ferraro and Kiss, 2002). Further, environment and natural resource management (NRM) remains little integrated into other policy areas and re-investment into the sector is limited (Ferraro, 2009). In many developing countries economic, institutional and policy failures prevail increasing the pressure on ecosystem service (ES) and result in imperfect service delivery (Ferraro, 2009).

The Millennium Ecosystem Assessment noted that the quantity and quality of two thirds of the environmental services provided by ecosystems in Sub-Saharan Africa are in decline (MA, 2005). The present patterns of production and consumption have already reached the ecological limit of the planet and unsustainable human and industrial activities continue to contribute to the decline in the quality of the environment. The growing demand for natural resources has extensively changed ecosystems leading to a substantial and largely irreversible loss in the biodiversity. If this trend continues, the severity of the effects of environmental degradation will be felt with increased incidences of floods; decline in agricultural productivity due to poor soils; low levels of access to adequate, safe water for domestic and industrial use due to siltation of dams and other water reservoirs; and other adverse effects of climate variability. All these undermine economic growth and national development propagating the renowned poverty cycle that will continue for generations to come putting future generations whose livelihood depends on the survival of these ecosystems at great risk (Holden and Limerud, 2007)

Kenya is a water-scarce country: renewable fresh water per capita currently stands at 647 m^3 and is expected to fall to 235 m^3 by 2025 if supply does not keep up with the population increase (World Bank, 2004). Economic growth and increases in human population are leading to escalating demand for water resources, while increasing further the pressure on the ecosystems that provide watershed services. Unless we change, households will not have access to adequate quantities and quality of water making them more vulnerable to illness and disease. These negative environmental health conditions contribute to increased incidences of water borne diseases particularly of infants and children, resulting in a higher infant mortality rate. For Kenya that currently stands at 62 deaths per 1,000 births (World Bank, 2004).

As pressure continues to mount on government to curtail spending and cut budget deficits, their ability to invest adequately in provision of public goods and services is called into question (Landell-Mills *et al*.,2002). With dwindling government support for conservation within and outside protected areas, there is increasing pressure to find innovative and sustainable solutions for promoting and financing natural resource conservation. Faced with fullfing their commitments to signed Multilateral environmental agreements, Governments are now increasingly attracted to economic instruments as a new set of tools to address environmental degradation. Payment for Environmental Services (PES) has become an attractive economic instrument since payment from users to providers is conditional on the continued provision of the ecosystem service (Schanzenbacher, 2009). Therefore, incentives through PES could enhance participation in sustainable management for ecosystem rehabilitation and biodiversity conservation. The increased interest in PES is accompanied by an increased call for empirical research on the demand, supply and financial sustainability of such programs. This study seeks to provide an evidence-based economic case for use of PES as a watershed management strategy.

In developing countries opportunity exists for emerging markets in PES to help address the challenges of poverty and natural resource degradation. This study is motivated by that opportunity and building on knowledge of PES, endeavors to understand how the goals of economic development and ecosystem conservation have been put into practice. Taking the case of the River Kuywa watershed, this research strives to comprehend to what extent the PES can collaborate with existing resource management and other related institutions to foster both objectives. The thesis will explore whether or not such watersheds offer conditions suitable for establishment of locally – based payments for watershed services programmes, designed to control soil erosion, sediment transport and water quality. The study will investigate the potential for intermediary actors/institutions to facilitate linkages between ecosystem services buyers and sellers. The results of this study will directly inform the region's PES feasibility analysis, while also contributing to a broader understanding of investment in PES programs which continue to expand globally.

1.5 Research Objectives and Questions of the Study

In this section, the research objectives and research questions that guided the study are presented.

1.5.1 Research Objectives

The overall objective of the study was to examine the scope for the application of the Payment for Environmental Services (PES) approach as an incentive-based instrument for the protection and management of watersheds within the Mt. Elgon ecosystem.

Specifically the study:

i. examined respondents preferences for management options for the provision of environmental services in the watershed of River Kuywa of Mt. Elgon Ecosystem;

ii. evaluated households willingness to pay (WTP) and willingness to accept (WTA) payment for improved environmental services from the River Kuywa watershed;

iii. proposed viable PES approaches for the management of the natural resource of the Kuywa watershed and the Mt. Elgon Ecosystem in general.

1.5.2 Research Questions

The research questions are presented separately for each specific objective.

In relation to specific objective 1:

a) Which environmental services are being provided by the Watershed resources and what are their linkages to the services received by downstream beneficiaries?
b) Who are the stakeholders involved in the provision, transfer and utilization of the environmental services?
c) Which are the preferred land use practises that landowners would be willing to adopt to improve provision of environment services.

In relation to Specific objective 2:

d) How much is the individual willing to Pay (WTP) for environmental services in the downstream part of the Watershed?
e) How much is the individual willing to accept (WTA) as incentive for the continued provision of environmental services in upstream parts of the watershed?
f) What variables influence the households WTP/WTA for improved environmental services?

In relation to specific objective 3:

g) What is the legal and political environment in which the PES system will operate?
h) Which institutional frameworks are in place and is any one adequate to support the establishment of the PES scheme?

i) Which is the most viable PES approach in the Kuywa River catchment and by extension the larger Mt. Elgon Ecosystem?

Improving knowledge related to these objectives and research questions will guide decision-making by policy makers and ecosystem managers and in so doing support development of strategies for sustainable watershed management of the Mt. Elgon Ecosystem and other similar ecosystems in the Lake Victoria Basin.

1.6 Significance of the Study

Since the United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro in 1992, sustainable management of natural resources became the required standard management practice. Twenty-two years later, environmental degradation continues unabated. The United Nations Conference on Sustainable Development (UNCSD, 2012), Rio+20 summit recognizing this, reaffirm the need to strengthen international environmental governance within the context of the institutional framework for sustainable development, in order to promote a balanced integration of the economic, social and environmental dimensions of sustainable development (UNCSD,2012). They took cognizance of the fact that poverty eradication, changing unsustainable patterns of consumption and production and protecting and managing the natural resource base for economic and social development are the overarching objectives of and essential requirements for sustainable development. The Governments who are party to this convention, Kenya included, committed themselves to promoting integrated and sustainable management of natural resources and ecosystems that support, inter alia, economic, social and human development while facilitating ecosystem conservation, regeneration and restoration and resilience in the face of new and emerging challenges. PES provides an avenue for Government to achieve this since they appear to offer a way of improving livelihoods, or at least lessening the adverse livelihood implications of land-use restrictions.

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Scholars and resource managers across the world realize that in order to stop further loss of the world's ecosystems as well as their services and to achieve the Millennium

Development Goal 7 (MDG 7), countries need to overhaul and modernize their environmental governance regimes. Recently efforts to mainstream the environment and natural resource management into the policy frameworks are spreading (UNEP, 2008). Awareness and interest in the possibility of integrating market-based mechanisms as additional sources for funding and incentives for natural resource management (NRM) are growing (Wunder *et al.,* 2008), as is the belief that incentive-based approaches can support an integrated ecosystem approach to achieve improved natural resource management (Baijukya, 2008; Buerli, 2006).

From an economic perspective, PES provides a market-based approach for achieving environmental outcomes by providing a way to internalize economic externalities, a problem that has long been recognized and studied in the environmental economics literature (Turner & Daily, 2008). PES schemes are expected to complement traditional command and control measures and they fit well into the current trend towards decentralized and self-organized systems for natural resources management. Furthermore, depending on the circumstances they might be more flexible, cost-efficient and effective than a command and control approach. Yet, market-based mechanisms are still slow in gaining ground in Africa and their potential and effects are little explored.

Kenya aims to be a nation that has a clean, secure and sustainable environment by 2030 by: (i) increasing forest cover from less than 3% at present to 4%; and (ii) lessening by half all environment-related diseases. Specific strategies to achieve this involve promoting environmental conservation in order to provide better support to the economic pillar flagship projects of the Vision 2030 and for the purposes of achieving the Millennium Development Goals (MDGs); improving pollution and waste management through the design and application of economic incentives; and in addition, the country will harmonise environment-related laws for better environmental planning and governance. This commitment of the Government of Kenya provides an avenue for the application of PES as an economic incentive not just for pollution control but control of other sources of environmental degradation as well. Further, there is a conscious move by many communities in Kenya to ensure that environmental service providers are compensated for conservation. Many community leaders in different parts of Kenya have increasingly demanded to be rewarded, even in kind, for protecting environmental goods from those who derive economic or consumptive benefits from such services (Kelsey, 2009). Though the concept of PES is still not well understood and the demand for environmental services compensation is still rudimentary, PES has the potential to contribute to natural resource conservation, to inject sustainable funding for the protected areas and improve rural livelihoods (The World Bank, 2004). This warrants that PES as a management tool is ever better understood, mainstreamed into decision-making, and that the required policies and actions are implemented soundly.

Knowledge generated from this study will guide decision-makers in developing watershed level, community-based PES programs with sound policy and institutional frameworks. As an alternative policy tool, watershed-based PES programmes present promising means for addressing resource degradation in Kenyan watersheds and in other areas with similar ecosystems characteristics, and for securing access to safe drinking water. This study will also provide insights into stakeholders’ willingness to support participatory, self-financing and institutionally sound watershed management.

1.7 Outline of the Thesis

The thesis is arranged into nine chapters. **Chapter 1** provides the background information to the study, covering the environmental challenge and the human dependence on the environment that brought rise to the concept of environmental goods and services. The study outlines the concept of economic valuation of natural resources that changed the thinking about the worth of the environmental resources. The first section of the chapter ends with a brief discussions on the genesis of payment for environmental services as an economic instrument for the management of natural resources. The chapter proceeds to set out the problem statement and justification for the study as well as its objectives. The research questions are posed and the significance of the study is presented.

The literature review has been spread across chapter 2, 3 and 4, organized in such a way as to provide a logical flow of the material that informs the study. The literature review covers the theoretical basis for the study, reviews and experiences in environmental governance and an enabling environment for the implementation of payment for environmental services.

Chapter 2 is a review of the theories underlying the study area. It covers the tragedy of the commons which could be the starting point for increased attention to managing common pool natural resources which have public good characteristics. It elaborates this by going through the various game theories starting with the prisoner's dilemma which was accompanied the writings on the tragedy of the commons and move through other games presented by scholars to dispute Hardin's thesis. The chapter outlines as a contrast to Hardin's theory, the cooperative governance approach as presented by Ostrom, which opened discussion on the possibility for negotiations and agreements on the management of common pool resources. This leads into the theories that highlight the interdependence between man and nature that start with the theory of the firm leading into the sustainable development agenda brought to fore by The Brundtland Report, '*Our Common Future'* and the follow up Rio Summit in 1992. The chapter looks at the ecological side of the equation by reviewing work on resilience as it relates to natural resources and informs management decision. It highlights the need for development to be mindful of nature's thresholds in decision making. This background leads into discussions on the concept of environmental services which stem from the interdependence of man and nature and present the benefits that nature provide to man and the chapter concludes with a review of the economic valuation of environmental goods and services.

With the grounding provided by the theoretical framework, **Chapter 3** reviews literature on environmental governance. With the development of theories and concepts came different approaches to environmental management. The chapter starts with definition of the term environmental governance and follows this with a discussion of several approaches that have been used over the year. These include protectionist approaches, privatization approaches, community based approaches, participatory approaches, ecosystems approach, integrated management approach and the market-based approaches. This leads into the review of literature on payment for environmental services, the chapter defines the concept and outlines its application as an environmental management tool.

The chapter ends by looking at the advantages and critics of the PES as an economic tool for environmental management.

Chapter 4 follows on the preceding discussion on PES and looks at an enabling environment for the application of the tool. PES requires policy and institutional support to facilitate its establishment and implementation. Based on documentation of experiences across the World, the chapter looks at what would constitute an enabling institutional environment. It reviews the various actors and the roles they should play in the scheme. This is followed by a look at the legal environment that would facilitate operationalization of PES. The chapter reviews appropriate legal instruments that are required and examines the scope and content of specific PES legislation. **Chapter 5** comprises the study methodology, introducing the study area of River Kuywa watershed in the Mt. Elgon ecosystem, Kenya. The analytical framework outlining the empirical data analysis models is presented and informs the type of data collected this is outlined next together with the sampling and data collection procedure.

The research findings and analysis results are presented in Chapter 6, 7 and 8arranged to respond to specific objectives 1, 2 and 3 respectively. This will facilitate easy handling of the material as it provides a logical flow. **Chapter six** begins with a discussion on the environmental challenges experienced by the respondents and outlines the natural resources available in the watershed and the associated environmental services they are likely to provide. The chapter then presents the results of the conjoint analysis and discusses the preferences landowners have for management scenarios for a potential PES scheme that will provide environmental services to downstream communities. **Chapter 7** presents the results from the contingent valuation exercise and the iwtp analysis. It discusses the willingness to accept payment (WTA) of upstream participants and the willingness to pay (WTP) of downstream populations, including the socio-economic and demographic factors that influence this decision. **Chapter 8** presents and discusses the prevailing institutional and regulatory environment in which the proposed PES scheme will work. The chapter covers existing government departments, private sector players, non-governmental organization structures and community level institutions. It focuses on the water sector players and also other sector like environment and agriculture that have a stake in the management of watersheds. The chapter then presents an examination of the applicable legislation for PES starting with provisions of the Constitution of Kenya, then looking at environment and water sector legislation, forest and protected area legislation and also the agriculture sector legislation which all have an effect on the establishment and implementation of PES.

The final chapter, **Chapter 9**; presents the conclusion of the study starting with a summary of the key findings and the researches conclusions on the viability of implementing a PES scheme as a management tool for the sustainable conservation of the Kuywa watershed, the expanded Mt. Elgon ecosystem and other ecosystems with similar characteristics. The chapter concludes with recommendations for policy and further research.

CHAPTER 2
THEORETICAL FRAMEWORK

2.1 Introduction

The theoretical framework of a research is the philosophical basis on which the research takes place and forms the link between the theoretical aspects and practical components of the investigation undertaken (Mertens, 1998). This chapter presents a synthesis of the theories that are relevant to the study area and the broader field of knowledge. The chapter starts with the genesis of the problem of environmental management, which stems from the resource being common pool resources, and examines theories relevant to the management of these resources. It follows with an examination of the concepts of the linkages between the economy and the environment leading into the concept of sustainable development. The chapter also looks at the resilience perspective which brings on board the ecological aspects of environmental management. Grounded with this background the study follows through to the offshoots of these theories and looks at the concept of environmental goods and services and their economic valuation. These form the basis upon which the study on PES will find its grounding.

2.2 Managing Common Pool Resources

Natural ecosystems are generally common pool resources, defined by Ostrom (1990) as natural or man-made resource systems that are sufficiently large as to make it costly to exclude potential beneficiaries from obtaining benefits from its use. As common pool resources they have public good characteristics that present a major challenge for their management. Public goods are a special class of externalities that are non-excludable and non-rivalry. This means that consumers cannot be effectively excluded from use, even if they do not pay for the privilege. The public good problem is related to “The Tragedy of the Commons”, described in ecologist Garrett Hardin publication in1968. Garrett’s idea appeared when environmental concerns were broadening from local issues to global ones – a time when other major environmental works, such as ‘The Population Bomb’ (Ehrlich,

1968) and 'The Limits to Growth' (Meadows *et al.,*1972) were getting very serious attention and discussion in policy and academic circles. These works all pointed to similar conclusions: that the global environment was threatened by what seemed to be very fundamental attributes of homo sapiens: for Ehrlich (1968) our desire to procreate; for Meadows *et al.* (1972) our tendency to expand endlessly the production and consumption of goods and services; and for Hardin (1968), our shortsightedness and our tendency to look out for ourselves first. To save the planet, these works stated, humanity would have to find ways to change or curb human nature.

2.2.1 The Tragedy of the Commons[2]

Hardin argument opposes Adam Smith's classic thesis that individuals in pursuit of their own gain are led by the invisible hand of the market to simultaneously advance the general public interest (Hardin, 1968). Based upon the need for rational scientific management, Hardin proposed examination of the veracity of Smith's assumption, and to decide if the liberal freedoms it anchors are consistent with or antagonistic to the requirements of achieving an optimum population (Hardin, 1968). It is in this context that Hardin's presents the tragedy of herdsmen sharing a common pasture. In this common pasture the herdsmen approach their shared resource as 'Smithian' individuals, operating according to a basic rationality of personal gain, calculated in terms of marginal utility. Each herdsman sees that the benefit from each animal he adds to his herd accrues to him, while the losses from increased pressure on the pasture are distributed amongst all users. Hence he rationally concludes that adding as many animals as possible is his best strategy for economic gain. However, the pasture can support only a limited number of animals, and it is ultimately destroyed. This tragedy is an economic problem whereby every consumer attempts to reap the greatest benefit from a common resource. As the population increases the demand for the resource outstrips supply and every additional unit consumed by each individual consumer, denies others the benefits. Further, this means that consumption of a common resource by individuals acting in their personal and immediate self-interest, neglecting the well-being of the group (or society), reduces or even completely destroys the resource.

[2] This discussion is an adaptation from a paper presented by Alex Lutta for the encyclopaedia of life support systems

Hardin's article is primarily focused on the problem of world population growth, and a largely forgotten contribution of his argument is its criticism of technologically based solutions to this challenge. Hardin's argues that runaway population growth belongs to a set of problems for which technological solutions do not exist and require re-examination of fundamental principles of morality, and to confront political questions about what is just versus what is necessary. In this respect, Hardin's polemic is a powerful attack against both the pervasive faith in technological solutions and the associated cornucopian view that the resources of the earth are essentially limitless. In place of this worldview, Hardin posits one which recognizes not only the fact of the earth's ultimate finitude, but also the reality of scarcity which confronts so many of the planet's inhabitants.

The argument that Hardin originally intended as an ecologist's interpretation of the problem of unfettered human population growth has subsequently become widely accepted as a general theoretical framework to explain diverse cases of resource over-exploitation and has had a considerable influence on resource policy around the world (Latta, 2009). Hardin's parable of the inexorable logic that leads the users of a common pasture to overstock their herds and destroy the commons, has apparent parallels in the degradation of a wide range of common goods such as fisheries, forests, water resources and the atmosphere. The tragedy of the commons is invoked as a catchall explanation for the origins of the ecological crisis that currently confronts the human species. From this stand point examining common property through the lens of the rational, logical, economizing individual espoused by economists and formalists, Hardin's parallels asserted that communal lands were doomed to overuse and were environmentally unsustainable as each participant granted open access would take full advantage of all the resources he could consume without considering the environmental or social impact as this was the most economically beneficial and most rational action for self-preservation.

The political issues which Hardin raises revolve around the question, 'What shall we maximize?' He claims that confronting the population forces us to abandon Bentham's goal of the "greater good for the greater number". This is because it is neither desirable nor possible to maximize these two variables (greatest good and greatest number) at the same time. Maximizing population necessarily means decreasing to a bare minimum the “good” available to each individual. Hence, the optimum population, which will maximize the good available to each individual, must be less than the maximum possible population. Hardin is quick to admit that determining what is good and what might be an optimum population for realization of that good, are difficult tasks. Nevertheless he is convinced that positive action based upon rational analysis of these two questions is necessary if humanity is to avert a population disaster.

These works became touchstones for the modern environmental movement. There is a great deal of scholarly discussion and literature on the significance and effects of the public goods problems to an economy and the identification of the most suitable remedies. Given their nature, it is difficult to regulate the levels of use of public goods even when they are threatened with exhaustion because even though many people benefit from the resource, individual beneficiaries or groups of beneficiaries will usually not have enough incentive to conserve the resource. This means the resource will be under-supplied; over-utilized and degraded (Stewart, 2010). It is postulated that the tragedy of the commons viewed as a food basket may partially be averted by private property rights, or something formally like it. However, several natural resources like water systems cannot easily be fenced to restrict access. However, Hardin’s and likeminded Scholars who accept the veracity of Hardin’s pessimistic diagnosis, saw this as the only solution to the crisis, the elimination of the commons – either through the institution of private property or by way of a strong, even authoritarian state that uses administrative law and mutually agreed upon coercion including coercive laws or taxing regimes. Though markets have been proposed as a possible remedy, poorly organized markets have had little success in providing these goods.

These studies inspired a generation of environmental regulations, by which central governments sought to “command and control” human appetites; a generation of policies based on the use of financial incentives to curb the same appetites in ways that sought to be more efficient; and a generation of moral appeals to the “better” parts of human nature. They also inspired a generation of natural scientists to measure, monitor, and model environmental change and a generation of researchers, mostly from the social sciences, to develop a new science of human-environment interactions (e.g. Turner *et al.,* 1990; National Research Council, 1992; Stern, 1993).Hardin's thesis remains relevant today, particularly as pressure on resources begins to be felt at a global level. The political and moral questions raised by his parable of herdsmen sharing a common pasture must today be confronted in the context of the possible demise of the global commons such as water bodies, forests and the atmosphere.

For many of the scientists who refused to accept Hardin's (1968) formulation of a tragedy with no satisfying endings (i.e. a choice between environmental collapse and coercive government), the commons was a compelling riddle – a social trap (Platt, 1973) a dilemma (Stern, 1976), or a drama (National Research Council, 2002) – not necessarily ending as tragedy. A better theoretical formulation was needed to find more satisfying endings. Research conducted since the Tragedy of the Commons have proven that Hardin's assertions were incorrect because he failed to recognize the place of traditional governance mechanisms in the control and monitoring of natural resources including common property regimes (Dietz *et al.,* 2003; Ostrom, 2000). Dietz, Ostrom and Stern demonstrate how community-based governance produces greater environmental sustainability utilizing common property and communal land in comparison to privatized lands (Selolwane, 2001; Bigalke, 2000; Owen and Owen, 1984; Albertson, 1998).

It is in the context of such critique that most contemporary research on the problem of managing "common property or "common pool" resources has taken place. Critics have argued that both resource systems and property regimes are more diverse and complex than Hardin's thesis allows. They have also demonstrated that common property regimes have a history of success, especially in local and/or traditional resource management contexts. Ostrom (1990) provides the best breakthrough in this line of thought when she found that Local commons - fisheries, forests, water supplies, grazing lands - provided a rich set of cases with considerable variation on key outcome variables, particularly the success or failure of the appropriators in maintaining the productivity of resource bases for their extractive purposes over time. Using the Game theory starting with the Prisoner's dilemma associated with Hardins, Ostrom looked at various variations that could be applied to the game.

2.2.2 The Game Theory[3]

The growing body of game theory has been used extensively to address the question of whether or not individuals are capable of cooperation and will choose to cooperate and organize voluntarily. In this literature, the choice the individual confronts is generally viewed as a comparison of expected benefits and costs of alternative choices of actions, with the economic concepts of costs and benefits defined rather abstractly (Oakerson, 1992). Numerous games have been developed, starting from the classical prisoner's dilemma game. This game has, to a great extend, been the underlying argument for the pessimism on cooperation within the natural resource management literature (Bardhan, 1993; Feeny, Berkes, McCay, and Acheson, 1990; Ostrom, 1990). The application of other games to NRM situations leads to more optimistic views. While a full discussion of this literature is beyond the scope of this study, we focus on the assumptions which are made in the different games, in order to inform the theoretical background for this study.

2.2.2.1 The Prisoner's Dilemma Game

Hardin's widely recognized "The Tragedy of the Commons" (Hardin 1968) can be formalized into a classical Prisoner's Dilemma (PD) game.1 In a 1-shot version of this game the players face a payoff structure which implies a dominant strategy of defection or noncooperation, and makes unlikely the possibility of voluntary organization. From an individual standpoint this choice of strategy in a 1-shot PD game is rational, but it becomes irrational from an overall view. Everybody would be better off if they cooperated instead of defected. Consequently the PD game has been used as an argument for nationalization as well as privatization of natural resources. The former is based on the argument that the original payoff structure in the PD game can be changed by the state in such a way that cooperation becomes a dominant strategy. For example, regulations and penalties can create a new pay-off structure that encourages people to cooperate (Ostrom, 1990). This, however, assumes that the state (and its representatives) has proper motivation, sufficient

[3] The discussion on Game theory was adapted from Rasmussen andMeinzen-Dick (1995). Local Organizations For Natural Resource Management: Lessons From Theoretical And Empirical Literature

knowledge, and enforcement ability to provide optimal resource management. It ignores the need for extensive local information for monitoring and enforcing regulations, in which the state has no comparative advantage, and problems caused by rent-seeking by agency staff who have low incentives to successfully manage the resource.

On the other side, the "property rights school" argues that the existence of a set of well defined property rights is the most appropriate way to make individuals internalize the externalities and thus avoid resource degradation. It even argues that the institution of private property will emerge spontaneously whenever a cost-benefit comparison makes it appear as more desirable than any other system (Baland & Platteau, 1994). This approach is premised upon the existence of complete and perfect markets, including futures markets. In practice, such conditions are often absent for many natural resources in developing countries, where information and bargaining asymmetries, high transactions costs, and non-divisibility of the resource violate the assumptions of the property rights school.

2.2.2.2 Games in Favor of Cooperation

The structure of the PD game is highly artificial, and does not represent the conditions actually faced by individuals in most NRM situations. A number of alternative games have been applied by those who believe that the constellation of costs and benefits of collective action on natural resources is often of a kind which is much more favorable to the possibility of cooperation than the PD game predicts (Bardhan, 1993; Nugent, 1993). These games take into account the interactions between individuals. Theorists such as Axelrod (1984), Elster (1989), Runge (1986), and Taylor (1988) have argued that if certain conditions are present, the players will face a payoff structure which makes voluntary cooperation possible, even desirable. The major game structures which support this conclusion are: Chicken Game (CG); Assurance Game (AG); Repeated Prisoners' Dilemma (PD) with tit-for-tat strategy; Fairness Game (FG).

Despite the similarity of the conclusions drawn by these authors, it is important to note that the games they are referring to are not the same. The assumptions that are made and the factors which have been identified to condition organization differ in the games. Rather than discussing these differences in any detail, this paper focuses on identifying factors which determine organization, particularly the variation along two fundamental variables: **size of the group** and the **time horizon** of the game situation and analysis. The Chicken Game (CG) is the simplest of the four games. It describes a one-shot situation in which at least one of the players will cooperate simply because both players want to avoid a dominant strategy of defection--which is the least favorable strategy in terms of comparison of costs and benefits (see Taylor, 1988). Each player would rather cooperate than have universal defection, but given the cooperation of the other, each player has an incentive to defect. Therefore, the worst possible outcome is averted, but universal cooperation is also not achieved.

The Assurance Game (AG) is a coordination game. In this game the payoff structure the players face is not as favorable as in the CG, and each player prefers symmetric solutions (see Runge 1981; 1984). Thus, universal cooperation or universal defection are possible equilibriums. Accordingly there is no dominant strategy. Under these circumstances the degree of **communication** between players will be a crucial to the possibility of cooperation or organization. Extension of the AG to multi-player games assumes that each player will only choose to cooperate if at least a critical mass of the other players is doing the same. Thus **catalysts** can play an important role in getting cooperation started. Furthermore the choice of action will depend on the **mutual expectations** and at last the **degree of trust** of the members of the group (Baland & Platteau, 1994; Runge, 1984).

The more complex dynamic analysis of the repeated games appear to be most useful for identifying factors of organization. The Tit-for-tat strategy (TS) of cooperation is a result of a repeated PD game situation. If cooperation gets started, it will be **reciprocated** (Axelrod, 1984; Nugent, 1993), as each player plays whatever the previous player played. The argument is that "each player accumulates experience of the behavior of his opponent since he meets him personally at each round of the game and is able to recall his past moves" (Baland and Platteau, 1994). In other words, according to the Tit-for-tat strategy, an organization can emerge and be maintained if there the group is **small,** there is in the beginning a **willingness to give the cooperation a trial,** and certain **stability** of the group which allows the **continuous interacting for a longer period of time** between the same members. Unlike the AG, the choice of the players in dynamic games will not only build on expectations but also on observed past behavior (Bardhan, 1993).

In other dynamic game strategies such as the Fairness Game (FG), the importance of **social norms** has been identified as a crucial factor determining organization. In particular, Elster (1993) highlights the role of the "'Norm of fairness': cooperate if and only if most other people cooperate." In FG there will be a dominant strategy of cooperation, and the argument is that the players will not hesitate to cooperate because they know that, if they do so, the other players will follow suit. On the basis of the discussion of CG, AG, TS, and FG in the literature, the following factors can be identified as affecting the degree or possibility of cooperation in local organizations: relative benefits of cooperation (over alternatives); size of the user group; users' perceptions of time horizon; degree of communication between players; expectations; degree of trust; a willingness to try cooperation; catalysts to start cooperation; stability of the group; existence of other cooperative structures; non-anonymous relationship between members; and content of social norms.

Accordingly, there is a basis for local self-governed organizations to arise spontaneously and voluntarily in some situations, and they will be an effective solution for NRM. Thus state regulation or privatization do not provide the only effective forms of management for natural resources--there can also be a collective action sector in which resources are managed in common. The importance of the distinction between a situation where the management takes place in the collective action sector and an open access situation is stressed by the "common property theorists" who argue that theorists of nationalization and privatization often are overlooking this important distinction. Thus Bromley and Cernea (1989) suggest that what Hardin calls "The Tragedy of the Commons" should rather be called "The Tragedy of Open Access".

2.2.3 The Cooperative Governance Approach

Ostrom's premise that each type of "commons" called for its own set of governance regimens, which would vary according to the social and ecological context forms the basis of her approach to managing the commons. The stakeholders in each "commons" had every reason to evolve such governance regimens on their own, and Ostrom argued that Under their stewardship, the "commons" would fare as well or better than under private or government ownership (Scherr *et al.*, 2002). Her approach attracted a growing circle of adherents, especially after the publication of her discipline-altering book, "Governing the Commons" (1990). In this book, Ostrom challenged the idea that shared resources (e.g. "the commons") would inevitably suffer from overuse, resulting in the infamous "tragedy of the commons" coined in 1968 by Garrett Hardin. Her research demonstrated that individuals sharing a resource could organize themselves to sustain the commons on which each depended (Ostrom, 1990).

In showing that self-organization is possible, Elinor Ostrom's work challenged not only the "tragedy of the commons" belief but also the conventional wisdom associated with the "(il)logic of collective action." The logic was straightforward: people often fail to produce a resource or good to which each would have access for their individual benefit. Instead they take advantage of those who do their part for the common good, "free ride" at the expense of those who have contributed, hoping to "free ride" until they are forced to contribute. As Mancur Olson (1965) asserted, a rational individual will contribute to a shared benefit only if there is a "selective" incentive—a benefit available only to contributors—associated with producing the resource to be shared in common. In experiments Ostrom showed that the archetypal model of commons tragedy, the canonical game theory example of mutually destructive behavior known as the "prisoner's dilemma" is not inevitable; in field research she found: Under the right circumstances, people are willing to accept additional efforts and costs. It all depends on trust in the fact that others will also act. Humans have the capacity to engage and see that their own long-term future is harmed if they don't change their lifestyles. Under the right circumstances they understand: It's not me against you. It's all of us against ourselves, if we don't act. So trust really is the most important resource.

In challenging the tragedy of the commons narrative, Ostrom argued that individuals using an existing commons could organize as commons users (a user-group) to manage collectively held properties or govern the use of common-pool resources. In challenging the logic of a collective action dilemma, she argued that individuals could form a "producer-group" to provide the shared good or by, for example, contracting with the producer of the good, create a "provider-group," making the good available to itself or to other users. Perhaps most profoundly, she showed that the conventional wisdom about regulating the use, provision, or production of a commonly held resource had limited the "solutions" to either a commons or a collective action dilemma to two, simplified abstractions: The Market or The State. In the prevailing theories either an invisible hand solved these dilemmas by dividing the commons into private properties, or authorities took control, tutoring the inexpert commons user in sustainable resource management and lawfully coercing wayward non-contributors with the threat of punishment.

In the abstract modelling of "economic man", "rational actors", and self-interested, if not selfish behavior, orthodox economic theory had failed to consider what people might be doing to organize and, perhaps, govern themselves for a sustainable future. Elinor Ostrom asked what fishers, herders, farmers, and urbanites actually did when they faced a commons or a collective action dilemma. She found that individuals can cooperate in taking the collective action necessary to create the governance structure to use a commons for their mutual benefit. She found that cooperative behaviour can become a norm under conditions supplied by several specifiable constitutional choice and collective choice arrangements. Upon this basis she identified eight design principles for successful governance of commons including: (i) Define clear group boundaries; (ii) Match rules governing use of common goods to local needs and conditions; (iii) Ensure that those affected by the rules can participate in modifying the rules; (iv) Make sure the rule-making rights of community members are respected by outside authorities; (v) Develop a system, carried out by community members, for monitoring members' behavior; (vi) Use graduated sanctions for rule violators; (vii) Provide accessible, low-cost means for dispute resolution; (viii) Build responsibility for governing the common resource in nested tiers from the lowest level up to the entire interconnected system.

To date protecting common-pool resources still poses great challenges at both the local and the global scale. This is further exacerbated by the fact that in many developing countries economic, institutional and policy failures prevail increasing the pressure on ecosystems and result in imperfect service delivery (Ferraro, 2009). However, Stern (2010) in applying these principles to global commons found that applying Ostrom's approach to global resources and emerging technologies can improve understanding and expand the solution set for these problems from international treaties, top-down national regulation, and interventions in market pricing systems to include principles of self-governance. Stern (2010) concludes that governance of both global resources and emerging technologies can be studied and understood from a commons perspective and that a set of design principles can be defined for these commons that extend and elaborate Ostrom's original design principles.

2.3 The Economy – Environment Link

The term circular flow of economic activity in neoclassical economics refers to an economic model that describes the economy as having two sectors: Production and Consumption, with the interdependent entities of producers and consumers being the firm and the household respectively. The exchange of goods and services in product markets and factors of production in resource/input markets takes place between the firm and the household. Firms provide goods and services to consumers in exchange for consumer expenditure and buy factors of production from households in exchange for payment for factors. This model does not include the environment; however, the economy produces goods by transforming matter and energy resources and creates waste. Matter and energy are taken from the environment and waste is put back into the environment. Therefore the natural environment interacts with the economy as a source of raw material for production and as a receptacle for the waste produced in consumption and production. To the economy the natural environment also provides less tangible benefits like recreational facilities and global life support (Perman *et al.,* 2003). These interactions implied that the standard circular flow of economics should incorporate the environmental system.

2.4 Sustainable Development

2.4.1 The Concept of Sustainability

The concept of sustainability derives from a shift in perspective - from a focus on economic development that is often defined as the expansion of consumption and GDP, to a new view of development called sustainable development (Harris and Goodwin, 2001). Sustainability is a cross cutting subject that refers to the capacity of a phenomenon to be maintained into the long-term future (Martin, 2003). Sustainability entails integrating economic, social and environmental objectives and making choices among them where integration is not possible (Goodland, 1995, Goodland and Daly, 1996). Social sustainability is concerned with poverty reduction. Economic sustainability focuses on the provision of physical inputs, both renewable and non-renewable, into the production system (Goodland, 1995). Environmental sustainability is concerned with the preservation and maintenance of life forms (Sutton, 2004).

Sustainability is not a new phenomenon. Writers, such as Mill and Malthus (18th century) included notions about economic sustainability in their works (Goodland, 1995; Goodland and Daly, 1996) and this culminated in the modern day neo-Malthusian understanding of the effect of exponential population growth on resources. However, the major breakthrough for sustainability came with the initiation of the World Commission on Environment and Development, whose report, The Brundtland Report, *Our Common Future* (WCED, 1987) is commonly taken as a starting point of the concept. However, its roots were in the 1972 Stockholm Conference on the Human Environment—where the conflicts between environment and development were first acknowledged—and in the 1980 World Conservation Strategy of the International Union for the Conservation of Nature, which argued for conservation as a means to assist development and specifically for the sustainable development and utilization of species, ecosystems, and resources.8 As with previous efforts, the report was followed by major international meetings. The United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro in 1992 (the so-called "Earth Summit") issued a declaration of principles, a detailed Agenda 21 of desired actions, international agreements on climate change and biodiversity, and a statement of principles on forests. Ten years later, in 2002, at the World Summit on Sustainable Development in Johannesburg, South Africa, the commitment to sustainable development was reaffirmed. In the interim, sustainable development as a concept, as a goal, and as a movement spread rapidly and is now central to the mission of countless international organizations, national institutions, corporate enterprises, "sustainable cities," and locales. Twenty years on, the UNCSD, 2012 , RIO+20 committed to launch a process to develop a set of Sustainable Development Goals (SDGs), which will build upon the Millennium Development Goals and converge with the post 2015 development agenda

Sustainable development has been defined as the “ability to make development sustainable—to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs (WECD, 1987). It has also been defined as an evolving process that improves the economy, the environment, and society for the benefit of current and future generations. Some studies have argued that, sustainable development is neither a fixed condition nor is there a final sustainable state, but it is inherently a dynamic process (Mog, 2004). Kemmler and Spreng (2007) illustrated this point by arguing that future generation, with greater knowledge and sophisticated technology and different needs, will define sustainable development in their own way and set different development goals. In addition, Meadows (1998) recognizes that sustainable development is dependent on a society’s worldviews and values. Mebratu (1998) categorizes the existing variety of definition of sustainable development into three major groups: (i) institutional version; (ii) ideological version; and (iii) academic version. The institution version entails those given by the World Commission on Environment and Development (WCED), the International Institute of Environment and Development (IIED) and the World Business Council for Sustainable Development (WBCSD). All these definitions share the same definition of sustainable development, but with different focus areas. Finally the economist, ecologist and sociologists reflect the response of the scientific community to the challenge of the environmental crisis of the twentieth century. Parris and Kates (2003) maintain that sustainable development is better defined in the form of normative judgments such as goals and targets coded in formal judgments, treaties, and declarations, not in form of semantic and philosophical clarifications.

Despite the debates and argument around the concept of sustainability, the issue itself has prompted policy-makers to formulate new strategies for achieving a balanced economic and technological pathway that would safeguard the environment, not only here and now, but also elsewhere in the future (Nijkamp and Vreeker, 2000). Further there is some consensus on the component of sustainability. Sachs (1999) distinguishes between four dimensions: (i) *ecological sustainability:* conservation of the natural capital of nature supplemented by environmental and territorial sustainability - the former is related to the resilience of natural ecosystems used as sinks, the latter is about evaluating the spatial distribution of human activities and rural-urban configurations; (ii) *economic sustainability:* taken broadly, the efficiency of economic systems to ensure continuous socially equitable, quantitative, and qualitative progress; (iii) *social sustainability*: including its corollary, cultural sustainability; and (iv) *political sustainability:* providing a satisfying overall framework for national and international governance. Other literature however, indicates that the Political sustainability is a subset of social sustainability and therefore maintain only three dimension. Harris and Goodwin (2001) clarify the three dimensions of sustainability from the perspective of important features of a sustainable system:

(i) *ecological/environmental sustainability*: work on this dimension leads to an environmentally sustainable system that maintains a stable resources base, avoids over-exploitation of renewable resources only to the extent that investment is made in adequate substitutes. This includes maintenance of biodiversity, atmospheric stability, and other ecosystem functions not ordinarily classed as economic resources;
(ii) *economic sustainability:* this dimension ensures that an economically sustainable system is able to produce goods and services on a continuing basis. It also maintains manageable levels of government and external debt; and avoids sectoral imbalances that damage agricultural or industrial production; and
(iii) *social sustainability:* efforts to deal with this dimension lead to a socially sustainable system that result in fairness in distribution and opportunity, and adequate provision of social services including health and education, gender equity, and political accountability and participation.

2.4.2 Models of the Dimensions of Sustainable Development

The sustainable development model is a representation of the three components of sustainability. The prevailing sustainable development model, the three pillar model, is based on the supposedly separate existence of the natural, economic and social systems which have equal weighting and are interlinked as shown in the figure 2.1. According to

Holmberg (1994) this type of model suggests that: (i) the three systems are independent systems and may be treated independently (reductionist); (ii) where the three systems interact is the solution area of integration where sustainability is achieved, whereas outside the interactive area is assumed to be an area of contradiction (bivalent); and (iii) the objective of sustainability requires full integration of the economic, social and environmental systems and can be achieved through the summation of the objectives in the different systems (linear thinking). The diagram indicates that full sustainability is attained when all three components integrate (Peattie, 1995; Mitchell, 2000).

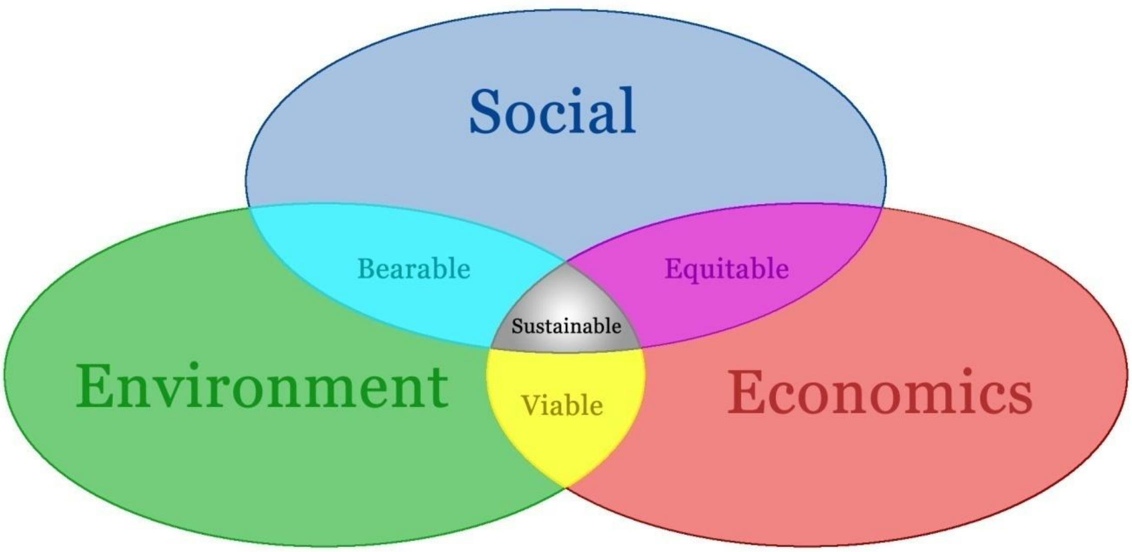


Figure 2.1: Pillar model of the dimensions of sustainable development

Source: (Lazano, 2008)

A contrary model, the embedded model differs from the pillar model in that it is based on the premise that these dimensions are dependent on each other as opposed to being separate. Further it does not assume that they have equal weighting. The model sets the ecosystem as the dimension with highest weighting and implies that ultimately the other dimensions within the ecosystem are entirely dependent upon it. Guijt and Moiseev (2001) in developing this model argued that Social and economical development can only take place if the environment offers the necessary resources, meaning the social and economic dimensions can only prosper if they adapt themselves to the limits of environmental carrying capacity. Mebratu (1996) in discussing this model, came to, among others, the conclusions that : (i) the social and economic cosmos have never been, and will never be, a separate system independent from the natural system; (ii) numerous conflict and harmony arise in the intersection area, serving as a seedbed for the process of co-evolution of the natural and human systems; (iii) the means of interaction within the interaction zone results from numerous systems that cannot be exclusive to one cosmos; and (iv) the environmental crises result from cumulative effect, or human neglect of one or important systemic parameters resulting in numerous feedback deficient systems.

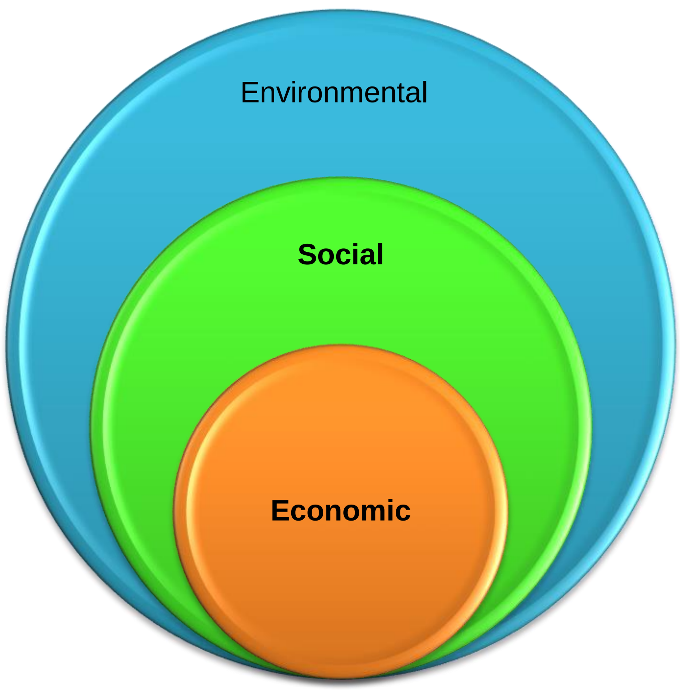


Figure 2.2: Embedded model of the dimensions of sustainable development

Source: (Lazano, 2008)

Other models discussed in literature include:

- **The Atkisson's Pyramid** that has mainly been used as a training tools to support the learners to move quickly up the sustainability learning curve, from basic principles and frameworks, to systems analysis, to innovative strategies for action.

- **The Prism of Sustainability** was developed by the German Wuppertal Institute and defines SD with the help of four components – economy, environment, society and institution. In this model the inter-linkages such as care, access, democracy and eco-efficiency need to be looked at closely as they show the relation between the dimensions which could translate and influence policy. In each dimension of the prism, there are imperatives (as norms for action).

- **The Amoeba Model** is used to visually assess a system's condition relative to an optimal condition. The model is circular with the various indicators positioned around the outside. Lines radiate from the centre to the indicators, on a continuum from unsustainable (in the centre) to sustainable (the outside of the circle). A circle would indicate the optimum conditions. This type of model allows simultaneous assessment of different indicators, and easy comparison between components of the system. "The Amoeba Model" is a powerful technique for accelerating the innovation process and training to be far more effective in achieving SD.

2.4.3 Principals of Sustainable Development[4]

The principles of Sustainable Development (SD) refer to abstract rules or guidelines that one can apply in order to achieve sustainable development. Various sets of principles of sustainable development have been proposed in the past decades including the Bellagio Principles (1996) and the Earth Charter (2000).

[4]Adapted from Center for Environmental Education, India (2007)

2.4.3.1 Bellagio Principles

The Bellagio Principles were created by the International Institute of Sustainable development, Canada in collaboration with experts from around the world in 1996. These principles are meant to be guidelines to start and improve assessment activities of nongovernment organizations, corporations, community groups, governments and International institutions. Overarching principles were sought that would provide a link between theory and practice. These principles deal with **four** aspects of assessing progress toward sustainable development.

Aspect 1 deals with the starting point of any assessment - establishing a vision of sustainable development and clear goals that provide a practical definition of that vision in terms that are meaningful for the decision-maker;
Aspect 2 covers principles 2 to 5 and deals with the content of any assessment and the need to make sense of the overall system with a practical focus on current priority issues;
Aspect 3 deals with principles 6 through 8 on key issues of the process of assessment; and
Aspect 4 involves principles 9 and 10 focusing on the necessity of establishing a continuing capacity for assessment.

2.4.3.2 The Earth Charter Principles

The Earth Charter Principles stemmed from the World Conference on Sustainable Development (WCSD), 1992 and were launched in The Hague, Netherlands, on 29 June 2000. These Principles have since been formally endorsed by organizations, including the UNESCO conference of member states, the world conservation union of IUCN, national government ministries, national and international associations of universities, and hundreds of cities and towns across the world.

The Earth Charter principles cover various aspects such as environmental responsibility, peaceful coexistence and respect for life, democracy, and justice. They include:

- Respect Earth and life in all its diversity.
- Care for the community of life with understanding, compassion, and love.

- Build democratic societies that are just, participatory, sustainable, and peaceful.
- Secure Earth's bounty and beauty for present and future generations.
- Ecological Integrity - four principles addressing Earth's ecological systems and biological diversity, a preventive and precautionary approach as the best method of ecological protection, and compassionate treatment of all living beings
- Social and Economic Justice - five principles addressing patterns of consumption and production, human rights, community well-being, human development, poverty, spiritual well-being, and the dissemination of ecological knowledge.
- Democracy, Nonviolence and Peace - principles addressing access to information, participatory decision making, accountability in governance, gender equality, cooperation, and formal education and lifelong learning.

2.5 The Resilience Perspective

Building on the sustainable development tenets, two fundamental errors underpinning natural resource policies are increasingly being acknowledged. The first error has been an implicit assumption that ecosystem responses to human use are linear, predictable and controllable. The second has been an assumption that human and natural systems can be treated independently. However, evidence that has been accumulating in diverse regions all over the world suggests that natural and social systems behave in nonlinear ways, exhibit marked thresholds in their dynamics, and that social-ecological systems act as strongly coupled, complex and evolving integrated systems (Folkes *et al.,* 2002). This calls for a change in thinking and practice of environmental management. The resilience perspective is increasingly used as an approach for understanding the dynamics of social–ecological systems as one system. The resilience approach emphasizes non-linear dynamics, thresholds, uncertainty and surprise, how periods of gradual change interplay with periods of rapid change and how such dynamics interact across temporal and spatial scales.

The resilience perspective emerged from ecology in the 1960s and early 1970s through studies of interacting populations like predators and prey and their functional responses in relation to ecological stability theory (Holling, 1961; Morris, 1963; Lewontin, 1969;

Rosenzweig, 1971; May, 1972). Ecologist C.S. Holling in his paper on resilience and stability in ecological systems illustrated the existence of multiple stability domains or multiple basins of attraction in natural systems and how they relate to ecological processes, random events (e.g. disturbance) and heterogeneity of temporal and spatial scales (Holling, 1973). He introduced resilience as the capacity to persist within such a domain in the face of change and proposed that ‘‘*resilience determines the persistence of relationships within a system and is a measure of the ability of these systems to absorb change and disturbance and still maintain the same relationships of state variables, driving variables, and parameters”* (Holling, 1973).

Holling (1973) suggested that this behaviour could be best defined through two distinct properties: resilience and stability. “**Resilience** determines the persistence of relationships within a system and is a measure of the ability of these systems to absorb changes of state variables, driving variables, and parameters, and still persist. In this definition resilience is the property of the system and persistence or probability of extinction is the result. **Stability**, on the other hand, is the ability of a system to return to an equilibrium state after a temporary disturbance. The more rapidly it returns, and with the least fluctuation, the more stable it is. In this definition stability is the property of the system and the degree of fluctuation around specific states the result”. This led to the definition of resilience by Walker and Salt, (2006) as “**the ability of a system to absorb disturbances and still retain its basic function and structure**”. Folke *et al.,* (2010) say resilience is best defined as “the capacity to change in order to maintain the same identity” in all these definitions the concept of resilience in relation to social–ecological systems incorporates the idea of adaptation, learning and self-organization in addition to the general ability to persist disturbance” (Folke, 2006).

Although there have been several definitions and descriptions of resilience, two distinct meanings of resilience must be highlighted. The first one refers to dynamics close to equilibrium and is defined as the time required for a system to return to an equilibrium point following a disturbance event (Pimm, 1984). It has been coined “engineering resilience” and is largely identical to the stability property “elasticity” (Grimm & Wissel, 1997). The second meaning of resilience refers to dynamics far from any equilibrium steady state and is defined as "the capacity of a system to experience shocks while retaining essentially the same function, structure, feedbacks, and therefore identity" (Walker *et al.,*2006). This has been termed "ecological resilience" and is comprised of three characteristics: (1) the amount of change a system can undergo and still remain within the same basin of attraction, i. e. to retain the same controls on structure and processes; (2) the degree to which the system is capable of self-organization; and (3) the degree to which the system expresses capacity for learning and adaptation (Carpenter *et al.,* 2001; Walker *et al.,*2002; Folke, 2006).

Folke *et al.*(2010) said that 'resilience thinking addresses the dynamics and development of complex social–ecological systems (SES)', making three aspects that interrelate across multiple scales central to it namely (i) **resilience**, which in this context is the capacity of a SES to continually change and adapt yet remain within critical thresholds; (ii) **adaptability,** which represents the capacity to adjust responses to changing external drivers and internal processes, and thereby allow for development along the current trajectory (stability domain); and (iii) **transformability** which is the capacity to cross thresholds into new development trajectories. It is notable that resilience "is not only about being persistent or robust to disturbance. It is also about the opportunities that disturbance opens up in terms of recombination of evolved structures and processes, renewal of the system and emergence of new trajectories" (Folke, 2006). The theory therefore starts with determining the thresholds.

2.5.1 Thresholds

Walker and Meyers, (2004) defined a threshold as "a breakpoint between two regimes of a system". Once a threshold has been crossed it is usually difficult (in some cases impossible) to cross back. A system's resilience can be measured by its distance from these thresholds. The closer it is to a threshold, the less it takes to be pushed over. Though social-ecological systems are affected by many variables, they are usually driven by only a handful of key controlling variables. Along each of these key variables are thresholds; if the system moves beyond a threshold it behaves in a different way, often with undesirable and unforeseen surprises. It is said to have undergone a regime shift". A

regime shift involving alternate stable states occurs when a threshold level of a controlling variable in a system is passed, such that the nature and extent of feedbacks change, resulting in a change of direction (the trajectory) of the system itself. A shift occurs when internal processes of the system (i.e. rates of birth, mortality, growth, consumption, decomposition, leaching, etc.) have changed and the state of the system (defined by the amounts of the state variables) begins to change in a different direction, toward a different attractor. In some cases, crossing the threshold brings about a sudden, large, and dramatic change in the responding state variables. In other cases, the response in the state variables is more gradual but, nevertheless, once the threshold has been passed, the feedbacks have changed and the dynamics of the system shift from one basin of attraction to another (Walker and Meyers, 2004).

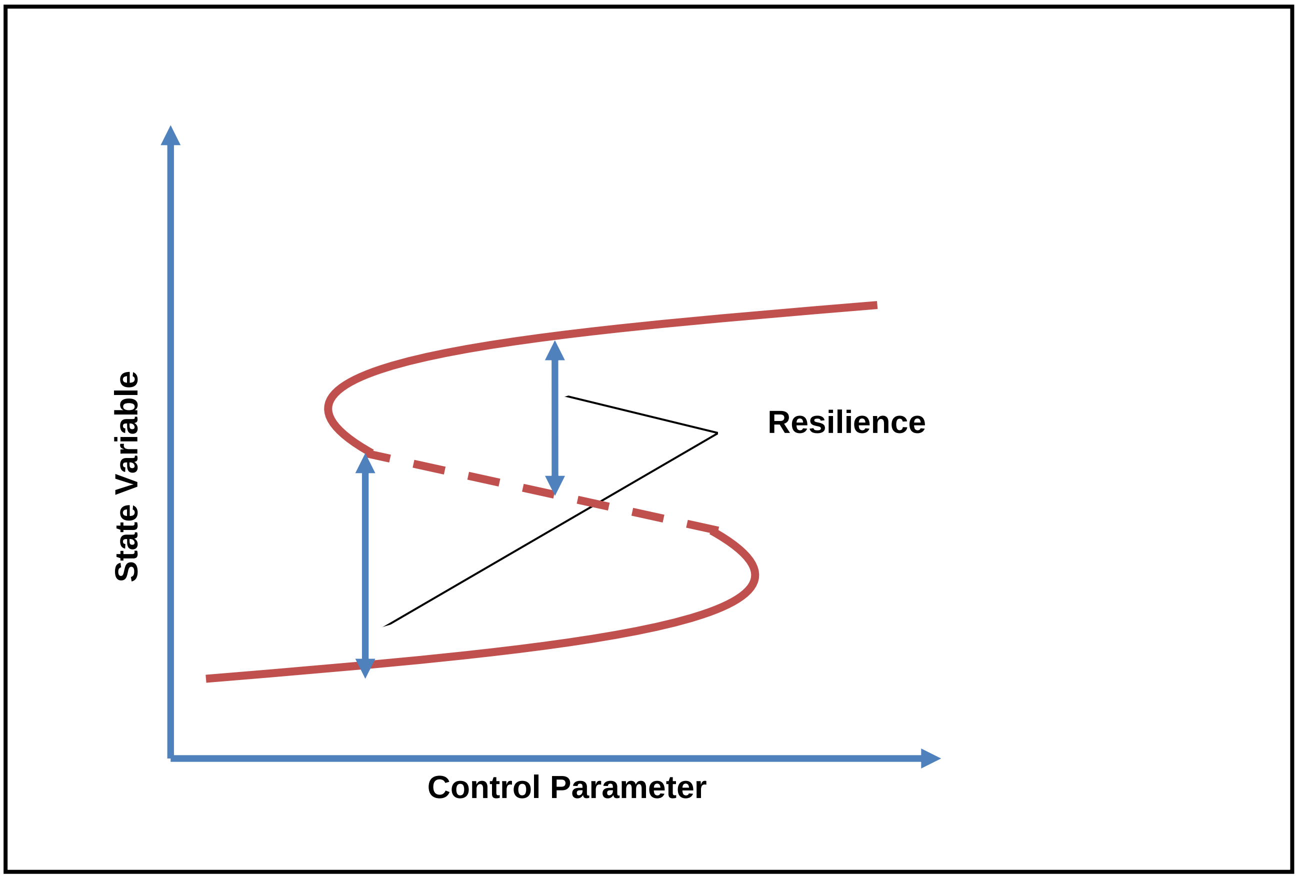


Figure 2.3: Representation of a change in state by a variable to a new state
Source: Folke (2006)

2.5.2 The Adaptive Cycle

Social-ecological systems are always changing. By studying ecosystems all around the world, researchers have learned that most systems of nature usually proceed through recurring cycles consisting of **four phases**: (i) *rapid growth* (or *exploitation*, **r** phase), (ii) *conservation* (**K** phase), (iii) *release* (or *creative destruction*, **omega** phase), and (iv) *reorganization* (or *renewal*, **alpha** phase) – usually, but not always, in that sequence (Holling, 1986). This is known as the **adaptive cycle,** it *describes how an ecosystem organizes itself and how it responds to a changing world*. Figure 2.4 shows this cycle. The manner in which the system behaves is different from one phase to the next, with changes in the strength of the system's internal connections, its flexibility, and its resilience. These cycles operate over many different scales of time and space. The manner in which they are linked across scales is crucially important for the dynamics of the whole set. Understanding the significance of a system's internal connections, its capacity to respond to disturbance and how these aspects change from phase to phase contributes to resilience thinking. This understanding is also important for policy and for managing natural resources because it suggests there are times in the cycle when there is greater leverage to change things, and other times when affecting change is really difficult (like when things are in gridlock). The kinds of policy and management interventions appropriate in one phase don't work in others. Figure 2.4 is a representation of the adaptive cycle (adapted from Folke *et al.,* 2010).

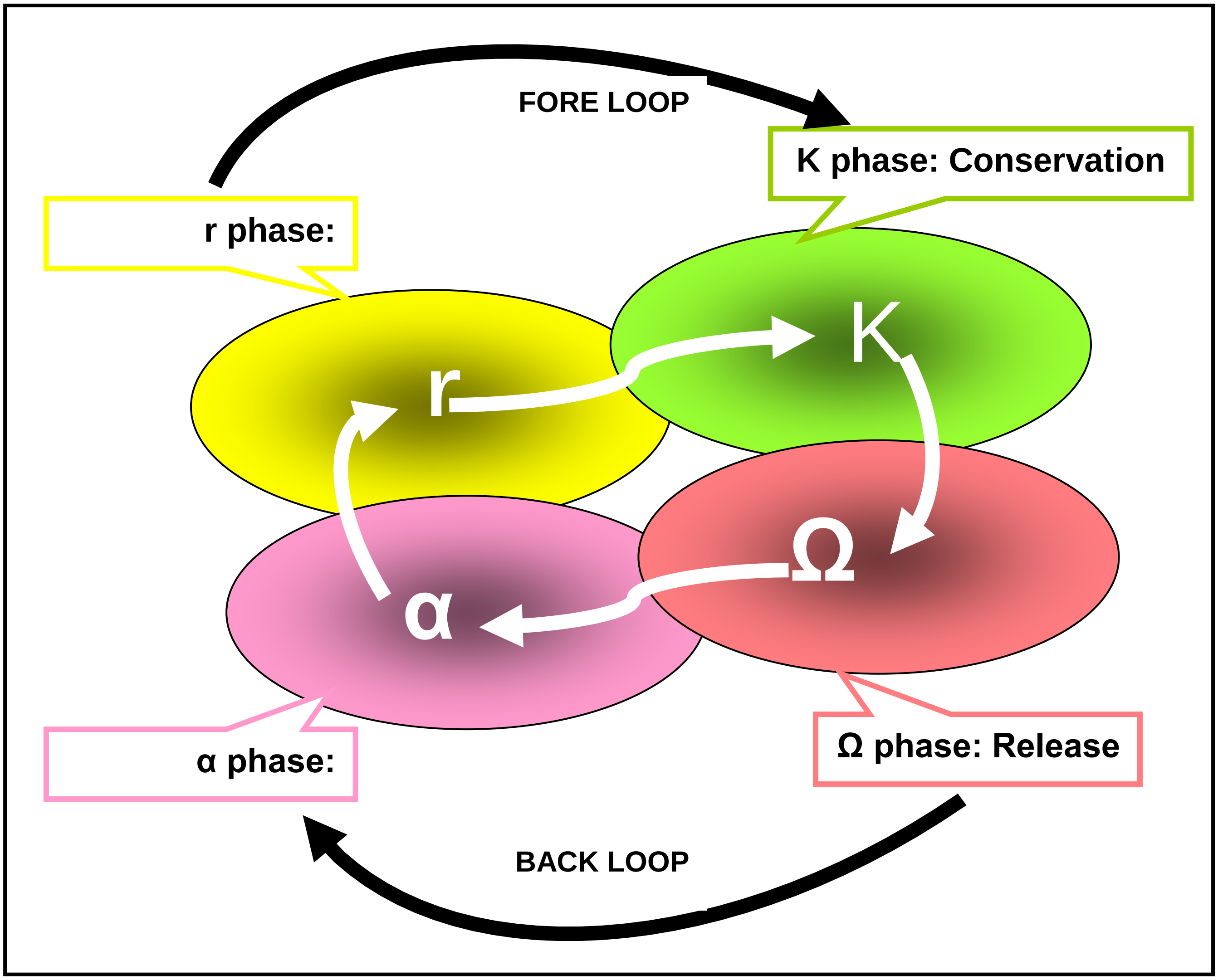


Figure 2.4: Illustration of the four phases in the adaptive cycle
Source: adapted from Walker and salt (2006)

1. The rapid growth or exploitation phase (or r phase): Early in the cycle, the system is engaged in a period of rapid growth as species or people (i.e. a new business venture) exploit new opportunities and available resources. These species or actors make use of available resources to exploit every possible ecological or social niche. The system's components are weakly interconnected and its internal state is weakly regulated. The most successful of such actors are able to prosper under high environmental variation, and tend to operate over short timeframes.

2. The conservation (K phase): The transition to the conservation phase proceeds incrementally. During this phase, energy gets stored and materials slowly accumulate.

Connections between the actors increase, and some of the actors change, though by the end of the growth phase few, if any, new actors are able to establish. The competitive edge shifts from opportunists to specialists who reduce the impact of variability through their own mutually reinforcing relationships. These ones live longer and are more conservative and efficient in their use of resources. They operate across larger spatial scales and over longer time periods. They are strong competitors. As the system's components become more strongly interconnected, its internal state becomes more strongly regulated. Prospective new entrants or new ways of doing things are excluded while capital grows (though it becomes increasingly harder to mobilize). Efficiency increases and the future seems ever more certain and determined. The growth rate slows as connectedness increases, the system becomes more and more rigid, and resilience declines. The cost of efficiency is a loss in flexibility. Different ways of performing the same function (redundancy) are eliminated in favor of simply performing the function in the most efficient way. Increasing dependence on existing structures and processes renders the system increasingly vulnerable to disturbance. Such a system is increasingly stable—but over a decreasing range of conditions.

3. The Release or creative destruction (or Omega, Ω, phase): The transition from the conservation phase to the release phase can happen in a heartbeat. The longer the conservation phase persists the smaller the shock required to end it. A disturbance that exceeds the system's resilience breaks apart its web of reinforcing interactions. The system comes undone. Resources that were tightly bound are now released as connections break and regulatory controls weaken. The loss of structure continues as linkages are broken, and natural, social, and economic capital leaks out the system. In each case, through the brief release phase, the dynamics are chaotic. But the destruction that ensues has a creative element. Tightly bound capital is released and becomes a source for reorganization and renewal.

4. The Re-organization or Renewal (or Alpha, α, phase): In the chaotic release phase, uncertainty rules; all options are open. It leads quickly into a phase of reorganization and renewal. Novelty can thrive. Small, chance events have the opportunity to powerfully shape the future. Invention, experimentation, and re-assortment are the order of the day.

In systems terms, the release phase is chaotic – there is no stable equilibrium, no attractor, no basin of attraction. The reorganization phase begins to sort out the players and to constrain the dynamics. The end of the reorganization phase and the beginning of the new rapid growth phase is marked by the appearance of a new attractor, a new “identity.” Early in renewal, the future is up for grabs. This phase of the cycle may lead to a simple repetition of the previous cycle, or the initiation of a novel pattern of accumulation, or it may precipitate a collapse into a degraded state (in social systems, a poverty trap).

Taken as a whole, the adaptive cycle has two opposing modes: (i) **fore/ front loop** which is characterized by the accumulation of capital, by stability and conservation, a mode that is essential for system well-being to increase. The rapid growth and conservation phases form the for loop of the cycle; (ii) a **back loop** comprises the release and reorganization phases are referred to as the back loop, characterized by uncertainty, novelty, and experimentation, and during which there is a loss (leakage) of all forms of capital. The back loop is the time of greatest potential for the initiation of either destructive or creative change in the system. It is the time when human actions—intentional and thoughtful, or spontaneous and reckless—can have the biggest impact. Usually, a system passes through an adaptive cycle by moving through the four phases in the order described here (i.e., rapid growth to conservation to release to renewal) But this is not necessarily so. Systems cannot go directly from a release phase back to a conservation phase. It is important to reemphasize that the adaptive cycle is not an absolute; it is not a fixed cycle, and many variations exist in human and natural systems. A rapid growth phase usually proceeds into a conservation phase but it can also go directly into a release phase. A conservation phase usually moves at some point into a release phase but it can (through small perturbations) move back toward a growth phase. In the next box, a summary and some reflections on adaptive cycle are offered.

2.5.3 Panarchy

Any system is composed of a hierarchy of linked adaptive cycles operating at different scales (both in time and space). The structure and dynamics of the system at each scale is driven by a small set of key processes and, in turn, it is this linked set of hierarchies that govern the behavior of the whole system. This linked set of hierarchies is referred to as a “panarchy.” Very importantly, the processes that produce panarchy patterns are in turn reinforced by those patterns – that is, **the patterns and processes are self-organizing**. This is a key aspect of complex adaptive systems.

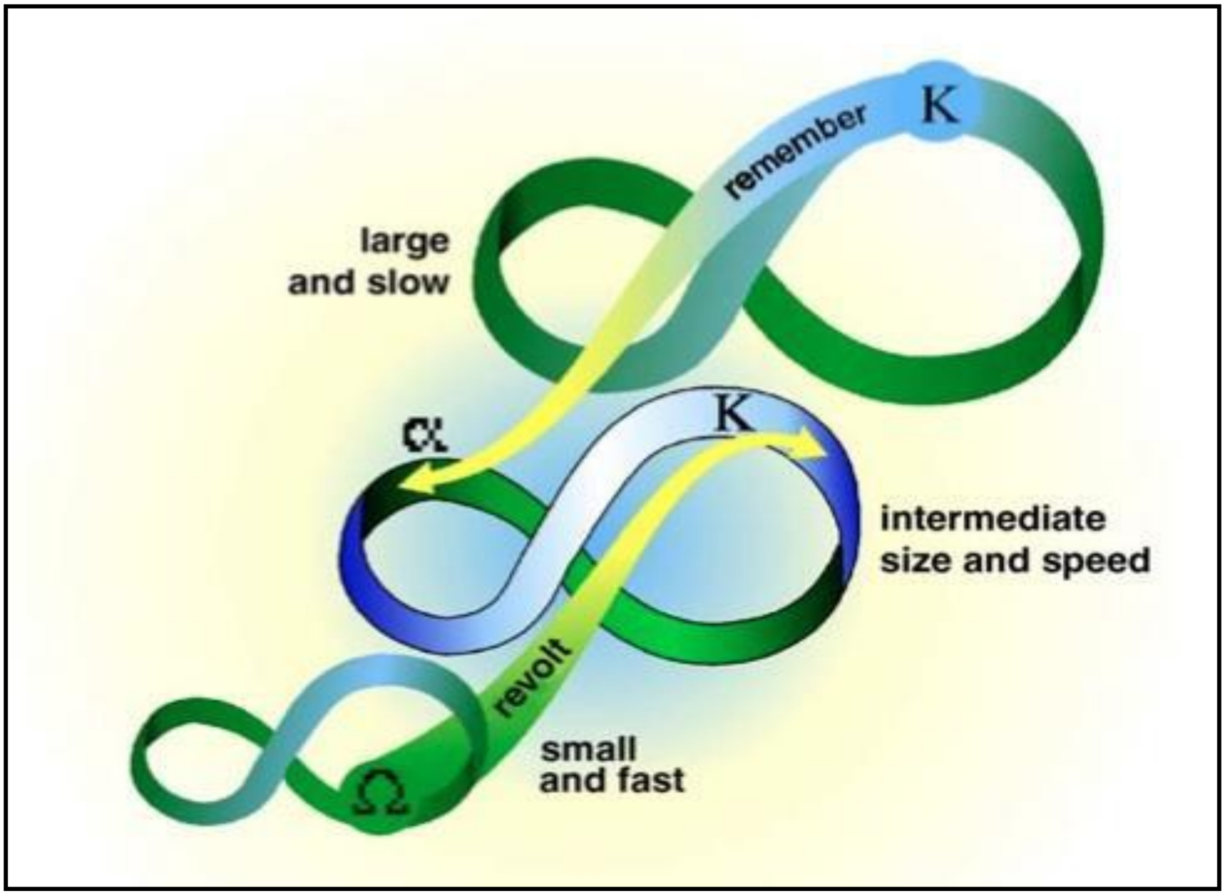


Figure 2.5: Panarchy or linked multi-scale adaptive cycles

Source: Folke (2006)

Of particular interest in figure 2.5, are **linkages across scales**. They are a key aspect of the **multi-scale adaptive cycles** that make up a panarchy. What happens at one scale can influence or even drive what’s happening at other scales. Ignoring the effects of one scale on another (**cross-scale effects**) is one of the most common reasons for failures in natural resource management systems. *The lesson is that you cannot understand or successfully manage a system by focusing on only one scale.* It is important to remember that a cross-scale connection is important in times of change, renewal, and re-organization. Thus, the ability for renewal and re-organization into a desired ecosystem state following disturbance will therefore strongly depend on the influences from states and dynamics at scales above and below and across time as well. Each level operates at its own pace, embedded in slower, larger levels, but invigorated by faster, smaller cycles.

The connections in the figure above labeled ‘‘**revolt’’** and ‘‘**remember’’** are examples of the interplay across scales that are of significance in the context of building resilience. The revolt arm indicates that cascade of events moves the disturbance to a larger and slower level. **Memory** is the accumulated experience and history of the system, and it provides context and sources for renewal, recombination, innovation, novelty, and self-organization following disturbance. The panarchy (as seen in the figure) is therefore both creative and conservative through the dynamic balance between rapid change and memory, and between disturbance and diversity and their cross-scale interplay. It sustains at the same time as it develops (Holling, 2001, cited in Folke, 2006).

2.6 Environmental Services

While explicit recognition of environmental services is a relatively new phenomenon, the notion that natural ecosystems help support society can be traced to ancient times. Thinking about people-environment interactions and their effects on human welfare stretches back centuries and includes writings from Roman times on the increase in population and decline in what we now call environmental services (Johnson, 2000). Early modern writers on the subject include Marsh (1874), Leopold (1949), Carson (1962), and Krutilla and Fisher (1975). Over the past few decades many attempts have been made to systematically link the functioning of ecosystems with human wellbeing. Westman (1997) examined the link between ecological and economic systems by attempting to answer the question “How much are Nature’s Services Worth?”. The term “environmental services” was first used in the late 1960s, but the concept has only recently gained hold in the broader research, policy and natural resource management community (Whitten et al., 2003,). Ehrlich and Ehrlich (1981) coined the term “environmental services” and in the following decade ecologists further elaborated the notion of ecosystems as life-support systems, providers of ecosystem services and economic benefits (Ehrlich and Mooney 1983; Odum 1989; Folke *et al.,* 1991; De Groot, 1992). However, it was not until the late

1990's that the concept got widespread attention with the publications by Costanza *et al.* (1997) and Daily (1997).

At the same time, the interdisciplinary field of ecological economics developed the concept of natural capital (Costanza and Daly, 1992; Jansson *et al.,* 1994; Dasgupta *et al.,* 1994), which includes non-renewable resources, renewable resources and environmental services to demonstrate the significance of ecosystems as providing the biophysical foundation for societal development and all human economies (Common and Perrings, 1992; Arrow *et al.,* 1995). The central elements in this "environment – economic link‟ are the intertwined notions of natural capital stocks and the ecosystem services that flow like interest or dividends from those stocks. According to the Millennium Ecosystem Assessment (MA, 2005a), natural capital is "an economic metaphor for the limited stocks of physical and biological resources found on earth". Spangenberg (2010) stated that environmental services were produced by the natural capital stock and that they contribute to the total economic value of the ecosystem. An ecosystem is an array of organisms, plants, animals and microbes found in a defined area and the physical/chemical environment with which the living community interacts (Heal, Gretchen *et al.,* 2001). Environmental services arise from and depend on the broader sets of ecological components, processes and functions. In an attempt to facilitate discussion and systematic analysis of environmental services, De Groot *et al.* (2002) created a classification system specifying the relationship between, and transitions from ecosystem processes and components and their transition to goods and services.

Ecosystem functions are defined as a subset of the interactions between ecosystem structure and processes that underpin the capacity of an ecosystem to provide goods and services. The building blocks of ecosystem functions are the interactions between structure and processes, which may be physical (e.g. infiltration of water, sediment movement), chemical (e.g. reduction, oxidation) or biological (e.g. photosynthesis and denitrification), whereby „biodiversity‟ is more or less involved in all of them, although the precise detail of the relationship is often unclear or limited (TEEB, 2010). Ecosystem functions are also widely defined as those that convene the range of natural processes and components that grant ecosystems the capacity to generate goods and services, which in turn satisfy human needs directly or indirectly (de Groot, Wilson *et. al.,* 2002). While Spangenberg (2010) states that "environmental functions refer variously to the habitat, biological or system properties or processes of ecosystems

The notion of environmental services was introduced and promoted as an alternative way of thinking about conserving biodiversity threatened by habitat destruction; one in which human well-being is considered more explicitly. The introduction of the concept of ecosystem services on the global agenda by the Millennium Assessment (2003) provided an important bridge between the imperatives of maintaining biodiversity and the challenges in meeting the Millennium Development Goals. Natural or human-managed ecosystems provide positive environmental externalities, normally not taken into account in individual economic decisions (Pagiola *et al.,* 2002a) The term environmental service refers to the provision of these positive externalities (Kosoy *et. al.,* 2007). Spangenberg (2010) defined environmental goods (such as food) and services (such as waste assimilation) as representing the benefits human population derive, directly or indirectly, from ecosystem functions. Daily (1997) noted that environmental services are the conditions and processes through which natural ecosystems, and the species that make them up, sustain and fulfil human life, while Boyd and Banzhaf (2006) define environmental services as "components of nature, directly enjoyed, consumed, or used to yield human well-being". Rosegrant, (2002) and Johnson and Baltodano (2004) also defined environmental services as "the conditions and processes through which ecosystems sustain and fulfil human life, including the provision of food and other goods".

Common to emerging terminology, different words are being used by authors with diverse background to describe similar concepts. In literature, we come across studies that apply both the terms ecosystem services, usually found in ecological science and ecological economics literature, and environmental services, more frequently applied in environmental economics and policy publications (Jeanneaux & Aznar, 2010). Further, these definitions raised questionsof whether only human benefits can be counted in Environmental Goods and Services. In spite of the work done so far, there is still much debate about definitions and classifications (e.g., Daily 1997; Boyd and Banzhaf, 2007; Wallace, 2008; Costanza, 2008; Fisher and Turner, 2008; Fisher *et al.,* 2009; Granek *et* *al.,* 2009) and perhaps we should accept that no final classification can capture the myriad of ways in which ecosystems support human life and contribute to human well-being. Environmental services are vital because they provide society with important goods and services for livelihood, economic development and health. While accepting that no fundamental categories or completely unambiguous definitions exist for such complex systems, and that any systematization is open to debate, it is still important to be clear about the meaning of the core terms used. Boyd and Banzhaf (2006) argue for the necessity of developing a standard definition for the term *ecosystem/environmental services*.

The Economics of Ecosystems and Biodiversity (TEEB) (2010) refers to environmental services as*conceptualizations ("labels") of the "useful things" ecosystems "do" for people, directly and indirectly*; whereby it should be realized that properties of ecological systems that people regard as "useful" may change over time even if the ecological system itself remains in a relatively constant state. Ecosystem/Environmental services are defined in TEEB as ***"the direct and indirect contributions of ecosystems to human well-being"***. The importance of environmental services for human well being was highlighted by the Millennium Ecosystem Assessment project, an international initiative of more than 1,300 scientists from different academic and geographical backgrounds under the call of UN Secretary-General and with institutional support from various international organisations. This project helped to popularize environmental/ecosystem services on both academic and policy-making environments. The reports produced explored the relationship between environmental services and human well-being and defined an ecosystem as a "dynamic complex of plants, animal, and microorganism communities and the non-living environment interacting as a functional unit". They then defined ecosystem or environmental services (ES) as benefits received from healthy ecosystems, satisfying human needs without neglecting other species requirements that are usually not internalized in economic decisions (MEA, 2005). This study adopts this definition.

The concept of environmental services is attracting increased attention as a way to communicate societal dependence on ecological life support systems. Natural ecosystems provide a range of environmental goods and services that benefit humankind. The quantity and quality of these benefits depend on the health of ecosystems providing the services. A critical factor is the maintenance of adequate stocks of ecosystem resources to ensure an adequate flow of environmental services (Batabyal *et al.,* 2003). Human decisions lead to actions that have impacts on ecosystems, causing changes in ecosystem structure and function. These changes in turn lead to changes in the provision of environmental services, which have impacts on human welfare. A clear understanding of these links provides information that can lead to the reform of institutions and better decisions that ultimately improve the state of ecosystems and the services they provide to society.

In recent decades, the interdisciplinary field of ecosystem management focused on human-nature dependence has emerged and represents a major area of inquiry into understanding the current state of Earth's ecosystems and their ability to support human wellbeing (MA, 2005). The notion of environmental services has grown out of these linkages identified between the biophysical aspects of ecosystems and human benefits. The collection of benefits provided to humans by the environment has taken the name of environmental/ecosystem services, which have been defined as a ***"set of amenities provided by natural or managed ecosystems that may directly or indirectly benefit society"*** (MA, 2005). The Millennium Ecosystem Assessment report (2005) classified environmental services into four categories; (i) provisioning services, which are the products obtained directly from the environment like food or water; (ii) regulating services, which are the benefits obtained from the regulation of environmental processes such as control of floods, erosion regulation, water purification and waste treatment; (iii) supporting services which are needed to maintain the functioning of other ecosystem processes, including nutrient cycling; soil creation; and photosynthesis; and (iv) Cultural services which are the non-material benefits that people obtain the environment such as aesthetic pleasure, recreational opportunities, and spiritual and cultural sustenance. Table 2.1 depicts this classification.

Table 2.1: Classification of environmental services

BENEFIT CATEGORY	**SERVICES**	**SUB-CATEGORIES**
DIRECT	Provisioning services	• Food • Fiber • genetic resources • bio-chemical • natural medicines and pharmaceuticals • ornamental resources • fresh water
	Regulating services	• Air quality regulation • climate regulation • water regulation • erosion regulation • water purification • waste treatment • disease regulation • pest regulation • pollution • natural hazards regulation
	Cultural services	• Cultural diversity • Spiritual/religious value • knowledge systems • educational values • inspirations • aesthetic value • social relations • sense of place • heritage values • recreation & tourism
INDIRECT	Supporting services	• Soil formation • photosynthesis • primary production • nutrient recycling • water recycling

Environmental service approaches have become an important fulcrum of conservation efforts across the planet, based on the Millennium Assessment (MA) and a growing range of related studies. According to Goldman *et al.* (2008), "Where traditional approaches focus on setting land aside by purchasing property rights, ecosystem service approaches aim to engage a much wider range of places, people, policies and financial resources in conservation." With this new environmental services approach has come new strategies and tools to support conservation efforts worldwide. Responses and actions that boost the ability of environment to better deliver services crucial to the human population can be found at all levels, local to international and environmental services play a significant role on multiple levels: on the local, national, regional (e.g. Water management, and biodiversity conservation) and global level (e.g. carbon sequestration and biodiversity protection). Conservation interventions under these approaches may also be differentiated on a spatial scale, from landscape to species or community to household, and may be led by different actors in society including international agencies, nationalgovernments, local governments, civil society organisations, private sector, local communities or combinations of these. The width and depth of the reach of these approaches makes policy and institutional factors a central component of their success.

Though the release of the MA popularized the concept of environmental services especially for use by policy makers, progress in its practical application in land use planning and decision making has been slow (Daily *et al.,* 2009)

2.6.1 Watershed services

Environmental services generated from watersheds are a fraction of diverse environmental benefits that people obtain from the environment. A watershed is an area of land that drains down-slope to a common outlet, it comprises several ecosystems which together work to provide ‘watershed services’ which are defined as: “the benefits obtained from the ecosystems within a watershed that support downstream water users, and ecosystems (Porras *et al.,* 2008). Watershed services therefore can be considered as the subset of environmental services concerned with the impact of land use change on hydrological functions which include water quality functions such as sedimentation and contamination as well as water quality functions relating to annual water yield, seasonal flow, or ground water levels (Porras *et al.,* 2008).

Water resource conservation and management occupy an increasingly important place in the international development agenda because of the growing pressure on important ecosystems and those relying on the associated environmental services (MA, 2005).

Water is essential to life on earth; therefore ensuring sufficient supply contributes significantly to development and functioning of human society. However, water like other environmental resources is regarded as a free good; therefore, water users pay little or pay the amount, which does not reflect the real economic value of this resource. There are no incentives to the stewards of the catchment areas, which are critical for the continuous flow of fresh water. In 1992 the International conference on Water and Environment that was held in Dublin put forward a principle that ***water has an economic value and that it should be recognized as an economic good.*** However, much has yet to be done on the ground to realize this principle. However, increasing scarcity of water has made environmental services that affect water supply valuable.

2.6.2 Drivers of change in Environmental Services

Environmental Services (ES) are directly linked to development as they form the basis for the livelihoods of many people ranging from food and energy production, to freshwater provision, disease regulation and climate change adaptation (Ranganathan *et al.,* 2008). The capacity of ecosystems to provide environmental services is hampered by their ever-growing degradation, which diminishes the prospects of sustainable development (UN, 2007). This is caused by the increasing demand for the environmental services. It is noteworthy that between 1960 and 2000, while the world's population doubled and the global economy increased six fold, the Millennium Ecosystem Assessment documented a decline in over 60 percent of the world's environmental services (MEA, 2005). Figure 2.1 depicts the connection between ES and human well-being as well as the drivers of change influencing the interaction of the two realms. Environmental services and resources are open access resources and several direct as well as indirect drivers of change impact their provision. The Millennium Ecosystem Assessment (2003) identified key threats to ecosystem services and categorized them into two drivers of change; indirect socioeconomic drivers (such as policy and legal framework), and direct drivers. Thereby direct drivers of change such as land-use changes are influencing the provision of ES and indirect drivers as demographic changes influence the human well-being. Any change will consequentially have a direct impact on the other. When trying to take up an environmental service approach, this has to be taken into account.

2.6.2.1 Indirect Drivers

Indirect drivers of ecosystem change affect the way people directly use and manage ecosystems and their services. Indirect drivers include demographic shifts, technology innovations, economic development, legal and institutional frameworks, including policy instruments, the steady loss of traditional knowledge and cultural diversity and many other factors that influence our collective decisions (OECD, 2003; MA, 2005b; OECD, 2008). IISD& UNEP (2004); and Baijukya (2008) highlighted population pressure; low income; limited institutional capacity; limited infrastructure; insecure property rights; limited awareness of NRM and ecosystem service valuation as the key indirect drivers of ecosystem change in Africa. Ferraro (2009) emphasized the effect of weak environmental policy framework on ecosystem management, placing it highly as a significant driver of ecosystem change.

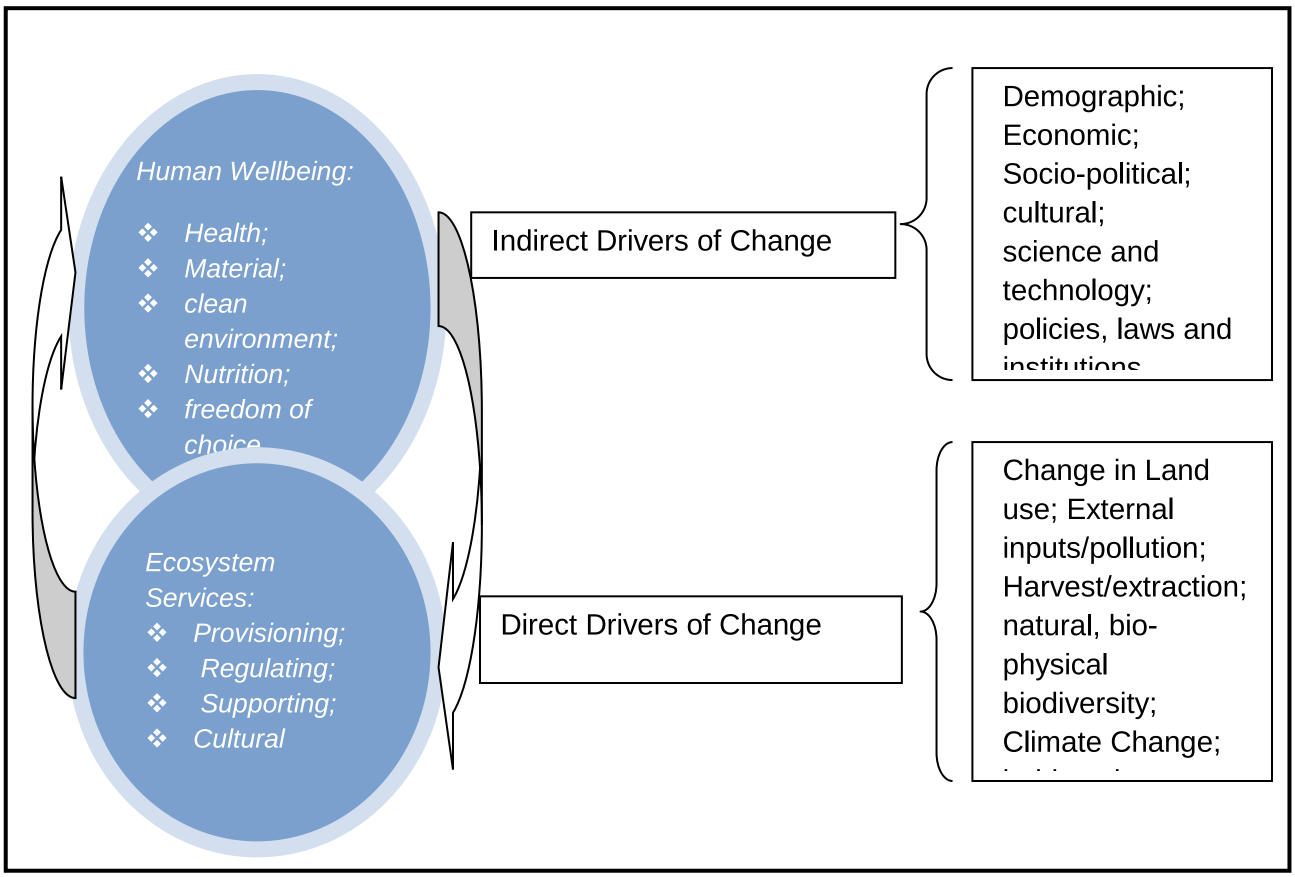


Figure 2.6: Driver of changes in ecosystem
Source: UNEP, 2008

2.6.2.2 Direct Drivers

Direct drivers can be organized in negative, neutral and positive categories. *Negative drivers* include, among others, habitat destruction, over-use of resources and pollution. Increasing land degradation, predominantly small-scale farming; and high land fragmentation also constitute negative drivers. Examples of *neutral drivers* would be land use change (which can have positive or negative consequences for ecosystems and biodiversity, depending on the context and management regime). Increasing intensification and industrialization of agriculture and animal husbandry should also be placed in a broader context: intensification (provided it is done in a sustainable manner), can provide extra space for natural habitat. Finally, *positive drivers* for enhancing natural capital would include ecosystem conservation and restoration, development of sustainable management regimes and use of environmental-friendly technologies, aimed at reducing human pressure on ecosystems and biodiversity e.g. organic farming, eco-tourism and renewable energy.

2.6.2.3 Land Use and ES

Land use/cover changes are key direct drivers to ecosystem change and therefore affect greatly the supply of environmental services. Tupie *et al.* (2004) observed that as poverty and demand for land for urban and agricultural use increases, habitats and therefore biodiversity are increasingly under threat. Land use changes could result in changes in the flow of a number of environmental services in terms of quantity and quality. Meyer and Turner (1992), categorized the main driving forces of land use changes into technological capacity, socioeconomic organization, level of development and culture. Negative contribution of increasing population growth to the pressure on natural resources has also been noted by most literature (Lambin and Ehrlich, 1997; Lambin, Geist *et al.,* 2003; Verburg, Overmars *et al.,* 2006). Wright, (2005) also noted that these changes have significant short and long term impacts on the functions of physical, chemical and biological components of the earth. A study by Munoz *et al.,* 2005 showed that the main correlates for deforestation in Mexico were proximity to cities and rural population centers, low slope and soil appropriate for agriculture. This suggests that the driving force behind deforestation is the relative profitability of agricultural and pastoral activities versus forest.

Farming practices such as excessive logging, slash and burn agriculture, mining and quarrying, fuel wood collection coupled with wildfires, illegal occupation and conversion to other land uses are drivers which have impacted on ecosystems ability to supply ES (OTTO, 2006)

Additionally, the conversion of natural watershed lands to agricultural, industrial or urban uses add to water pollution burden while simultaneously diminishing its ability to assimilate and process those pollutants. Deforestation, road construction, clear-cutting and poor farming practices can send large influxes of eroded sediments into rivers and streams, markedly degrading the quality of water and aquatic habitats (Calder, 2000). FAO, (2001) estimated that the World's forests were converted to other land uses/cover at a rate of 0.3% annually in the 1990s and even more rapidly and diverse in developing tropical countries. Tropical deforestation, agricultural exploitation and urbanization are identified as the major land use/cover changes around the globe (Lambin, Turner *et al.,* 2001).

2.6.3 Classification of Environmental Services

Ecosystem services have been classified in a number of ways, including by: (1) Functional groupings, such as regulation, carrier, habitat, production, and information services, (2) Organizational groupings such as services that are associated with certain species, that regulate some exogenous input, or that are related to the organization of biotic entities and (3) Descriptive groupings, such as renewable resource goods, non-renewable resource goods, physical structure services, biotic services, biogeochemical services, information services, and social and cultural services (Wallace, 2007). The Millennium Ecosystem Assessment classifies environmental services along functional lines, using four categories of: regulating, provisioning, cultural and supporting services (Wunder *et al.,* 2008; MEA, 2005). Table 2.2 outline these categories.

Table 2.2: Categories of environmental services

	Type of Service	**Examples**
1	Provisioning Services (*products obtained from ecosystems*)	Food Freshwater Fuelwood Fiber Biochemicals Genetic resources
2	Regulating Services (*Benefits obtained from regulation of ecosystem processes*)	Climate regulation Disease regulation Water regulation Water purification Pollination
3	Cultural Services *(nonmaterial Benefits obtained from ecosystems)*	Spritual and religious Recreation and Ecotourism Aesthetic Inspirational Educational Sense of place Cultural heritage
4	Supporting Services *(Services necessary for production of other ecosystem services)*	Soil formation Nutrient cycling Primary production

According to these MEA reports, provisioning services –are related to the capacity of ecosystems to provide tangible goods, usually with structured markets in which society is used to perform transactions. For the other three categories, the relationship between ecological interactions and well being is less explicit, and transactions are rarely performed in structured markets. Regulating services are the benefits related to the natural processes that regulate the conditions which make human life possible. Cultural services, on the other hand, are connected to human values, identity and behaviour. On the basis of all these services there are supporting services, necessary for the provision of other environmental services and to the functioning of ecological systems in the long term (MEA, 2005).

Following the MA classification, TEEB proposed a typology of 22 ecosystem services divided in 4 main categories; provisioning, regulating, habitat and cultural & amenity services. An important difference adopt by TEEB, is the omission of Supporting Services such as nutrient cycling and food-chain dynamics, which are seen in TEEB as a subset of ecological processes. Instead, the Habitat Service has been identified as a separate category to highlight the importance of ecosystems to provide habitat for migratory species and gene-pool "protectors". The availability of these services is directly dependent on the state of the habitat providing the service (TEEB, 2010).

Other scholars, acknowledging that environmental services are not always produced and available on the same location where they are used and required, it means benefits or changes in ES levels can be felt locally, regionally or globally, suggested a definition of ecosystems at the landscape scale. Fisher et al. (2009) differentiated between ES: (i) Consumed and provided at one location (in-situ); (ii) Produced at one location yet benefitting the surrounding areas (omni-directional, no directional bias); (iii) Benefiting one specific location positioned in the direction of service flows (directional). Pagiola *et al.,* 2005 and Wunder, 2005 adopted the classification for environmental services based on the following:- (i) Carbon which is the sequestration of carbon in biomass; (ii) Biodiversity mainly the conservation of habitat for wildlife; and (iii) Scenic beauty essentially involving cultural, recreational and aesthetic value of the landscape; (iv) Water encompassing the provision and regulation of fresh water quantity and quality; .

2.7 Economic Valuation of Environmental Goods and Services

To conserve or enhance environmental services delivery and create a new perception of ES, environmental economists suggest that they have to be integrated in decision making and given an economic value (Wunder *et al.,* 2008; Stiglitz & Walsh, 2002; Pagiolo, 2005; Spangenberg and Settele, 2010).Economists such as Pavan Suhdev, (2010) claim that the lack of valuation is the underlying cause for the observed degradation of ecosystems and the loss of biodiversity. Like other economists he is convinced valuation can make "a comprehensive and compelling economic case for conservation". Dixon (2008), stipulates that valuing ecosystems in economic terms provides a direct tool for environmentalists to persuade government officials to take serious account of the benefits of the ecosystems in their decision making regarding the choice of development alternatives. Valuation is also of great importance to the identification of under-utilised goods and services that might provide the basis for development of alternative livelihoods for communities. Valuation is no longer a metaphor, but has been turned into an economic figure, on par with other value, price and cost calculations.

However, while “valuing the environment”, one has to note that valuing means different things to people, depending on their individual worldview. In economics, a good or service is valuable if it increases human well-being. This implies that goods and services have no value in their own right. Rather, their value is defined only in the context of human welfare“ (Krieger, 2001). Economic value is always associated with trade-offs, i.e. something only has (economic) value if we are willing to give up something to enjoy it. The common metric in economics is monetary valuation and some critics say the reliance on this metric has plagued many ecosystem service assessments, failing to incorporate several types of value which are critical to understanding the relationship between society and nature (e.g. Norgaard, 1998; Wilson and Howarth, 2002; MA, 2005a; Christie *et al.,* 2006). The Oxford English Dictionary defines value as “the worth, usefulness, importance of something”. The Millennium Ecosystem Assessment defined value as “the contribution of an action or object to user-specified goals, objectives, or conditions” , the measurement of which could include any kind of metric from the various scientific disciplines, e.g. ecology, sociology, economics (MA, 2003). Heal argues that while natural systems have non-economic value and economic value, economic values are probably easier to communicate and agree on than the other aspects of value. He notes that it is notoriously difficult to reconcile differences in the sphere of non-economic value. In contrast, there is a good chance of reaching agreement on matters of economic importance or value. Agreeing with him, this study adopts the definition given in UNEP (2007) that states that environmental valuation, is the process of putting monetary values on environmental goods and services (G&S), many of which have no easily observed market prices.

2.7.1 Types of Benefits Derived from Environmental Services

The three main types of benefits (well-being aspects) and related values and valuation metrics are briefly introduced below (Adapted from TEEB, 2010).

2.7.1.1 Ecological Benefits and Values

The ecological importance (value) of ecosystems has been articulated by natural scientists in reference to the causal relationships between parts of a system such as, for example, the value of a particular tree species to control erosion, or the value of one species to the survival of another species or of an entire ecosystem (Farber *et al.,* 2002). At a global scale, different ecosystems and their constituent species play different roles in the maintenance of essential life-support processes (such as energy conversion, biogeochemical cycling, and evolution) (MA, 2003).

Ecological measures of value (importance) are, for example, integrity, health, or resilience, which are important indicators to determine critical thresholds and minimum requirements for ecosystem service provision. These measures of value should be distinguished from what can be included in economic values because although they contribute to welfare, they cannot readily be taken into account in the expression of individual preferences, as they are too indirect and complex, albeit they may be critical for human survival. The related value paradigm could be formulated as the importance people attach to a healthy, ecologically stable environment, both as a contribution to human survival (instrumental value) and for intrinsic reasons (values). Although the notion of ecological value is still much debated, the „value" of natural ecosystems and their components should be recognized in terms of their contribution to maintaining life on earth, including human survival in its own right (Farber *et al.,* 2002).

2.7.1.2 Socio-cultural Benefits and Values

For many people, biodiversity and natural ecosystems are a crucial source of non-material well-being through their influence on mental health and their historical, national, ethical, religious, and spiritual values. While conceptual and methodological developments in economic valuation have aimed at covering a broad range of values, including intangible ones. it can be argued that socio-cultural values cannot be fully captured by economic valuation techniques and have to be complemented by other approaches in order to inform decision-making. This is notably the case where some ecosystem services are considered essential to a people's very identity and existence. To obtain at least a minimum (baseline) measure of importance of socio-cultural benefits and values several metrics have been developed such as the Human Wellbeing Index.

2.7.1.3 Economic Benefits and Values

Biodiversity and environmental services are important to humans for many reasons. In economic terms, this can be considered as contributing to different elements of “Total Economic Value”, which comprises both use values (including direct use such as resource use, recreation, and indirect use from regulating services) and non-use values, e.g. the value people place on protecting nature for future use (option values) or for ethical reasons (bequest and existence values). The economic importance of most of these values can be measured in monetary terms, with varying degrees of accuracy, using various techniques (including market pricing, shadow pricing and questionnaire based).

2.7.2 Economic Valuation Approach

Based upon a literature review, this section establishes a framework for the valuation of ecosystem services. The framework includes three types of services and four types of value, and is based upon Pearce and Turner (1990), Costanza *et al.* (1997), De Groot *et al.* (2002) and Millennium Ecosystem Assessment (2003). The framework is presented in Fig. 2.3. Following this framework, valuation of ecosystem services consists of four steps: (i) specification of the boundaries of the ecosystem to be valued; (ii) assessment of the ecosystem services supplied by the system; (iii) valuation of the ecosystem services; and (iv) aggregation or comparison of the values of the services (Total Economic Value. TEV). Step iii and iv are discussed below

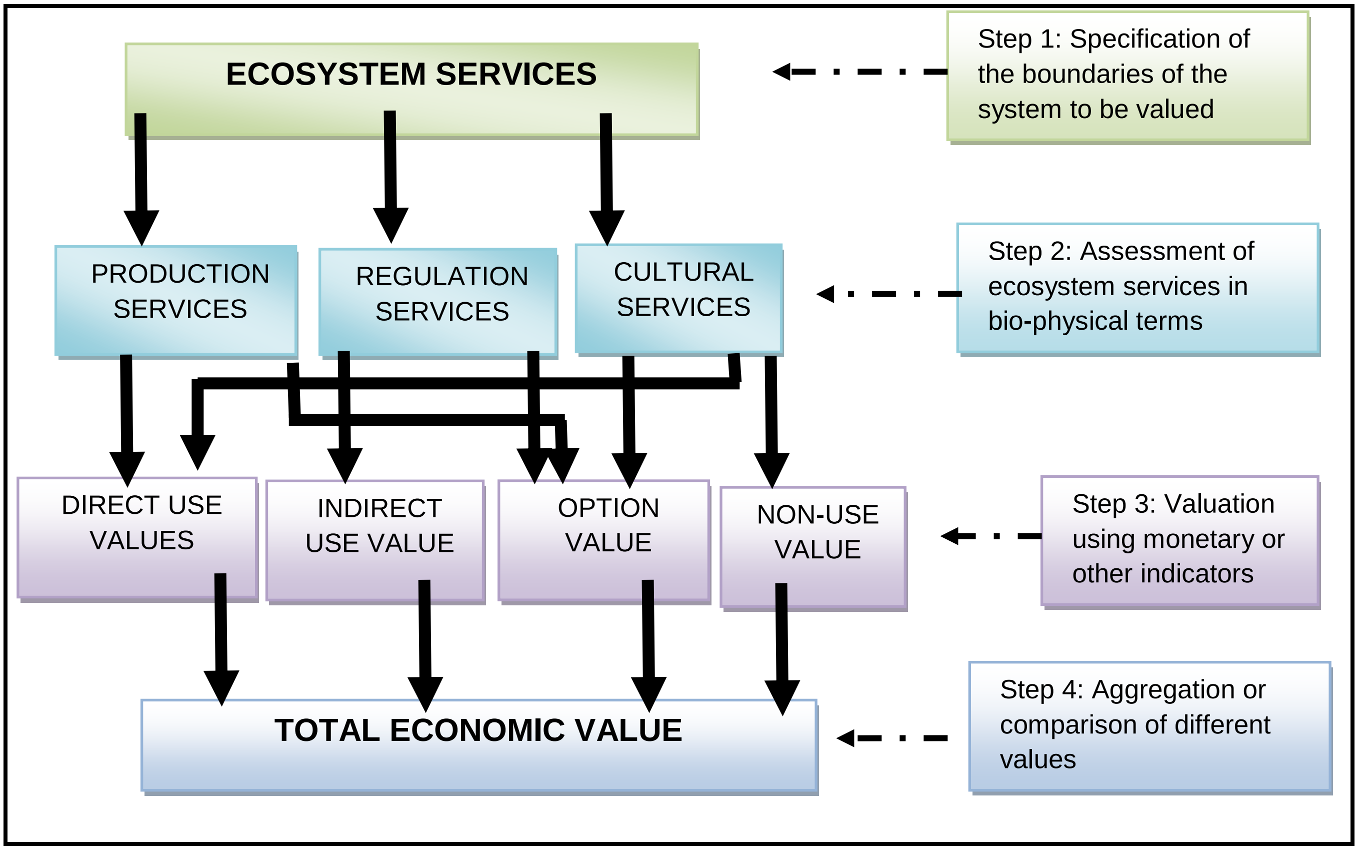


Figure 2.7: Ecosystem service valuation framework
Source: Hein. Koppen et. Al. (2006)

The Valuation of ecosystem services based on the concept of total economic value (TEV) and offered by Pearce, Markandya *et al.* (1989) has become a widely used framework for looking at the value of ecosystems. TEV explicitly recognizes that the economic value of a good or service is composed of different parts—some of which are tangible and directly used; some of which are intangible or very remote. UNEP (2007) defines the *total economic value* (TEV) as the sum of all the benefits that are attributable to the specific resource or ecosystem being valued. Total economic Value is typically disaggregated into two categories of use values and non-use values.

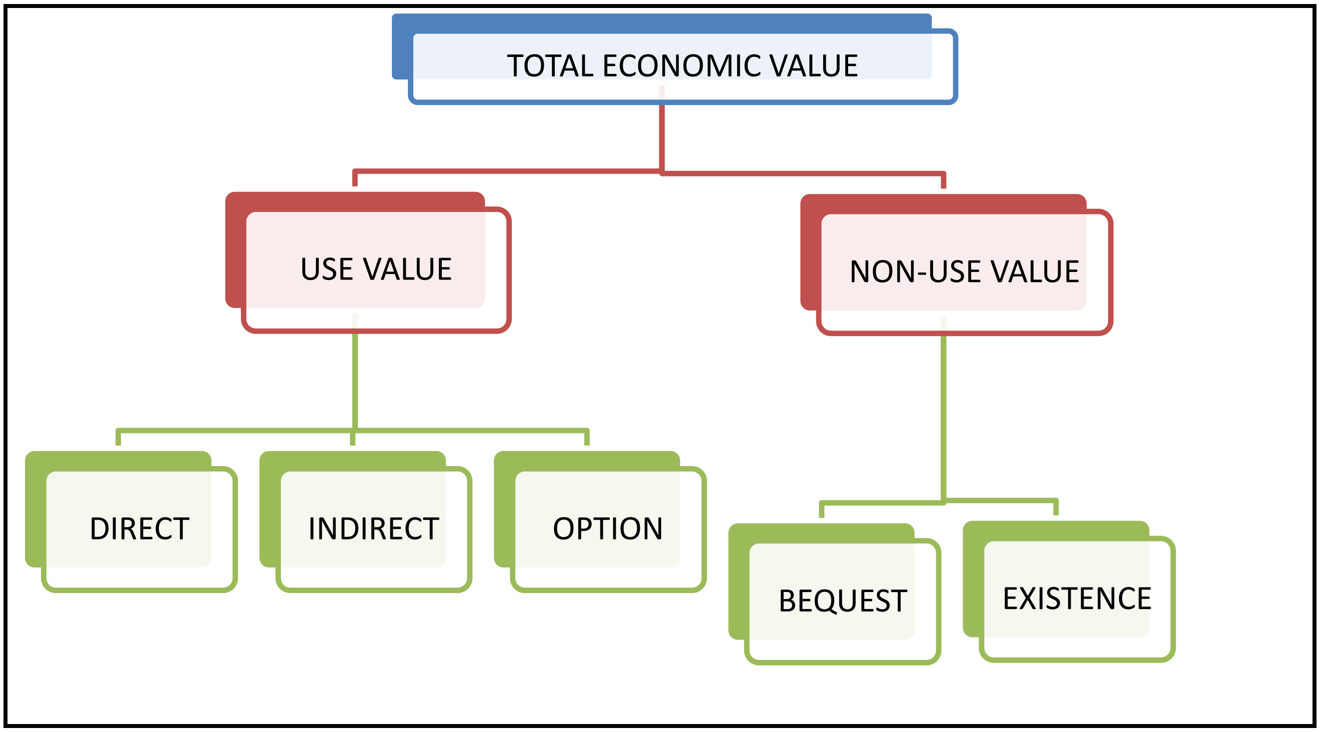


Figure 2.8: Economic valuation approach
Source: UNEP 2007

2.7.2.1 Use Values

The use value refers to the actual use of a good. It can also relate to the intended use or the possible use of a good. The possible use of a good refers to the fact, that people want to maintain a good in existence in order to preserve the option of using it in the future (Bateman *et al.,* 2002). Use values are composed of two elements direct and indirect use values:

Direct Use: The direct use values of a resource or a system are the tangible or physical aspects of such resources, which can either undergo physical processing or provide direct (personal) utility or satisfaction and which have direct market prices for quantification (UNEP, 2007). According to Bann (1997), these are the “values derived from the direct use or interaction with an ecosystem’s resources and services”. These direct use values are further categorized as extractive or consumptive, and non-extractive or non-consumptive (Ebarvia, 1999). Examples of extractive or consumptive use values are the use of fuel, timber, non-timber forest goods, medicines, fodder and food; while examples of non-extractive or non-consumptive values are the recreational aesthetic beauty, science and education

Indirect Use: Indirect use values consist of the various functions that the environment provides, including regulation of river flows, flood control, water purification, carbon sequestration, nutrient or contaminant retention, and supporting consumption and production processes. The indirect use value of an environmental function is related to the change in the value of production or consumption of the activity or property that it is protecting or supporting (Ebarvia, 1999). It relate to services that sustain economic activities such as drinkable water production and hydroelectricity generation.

Option Use: This concept may be termed or understood as the *potential* direct and indirect uses of a natural system and the *"additional amount that an individual would be willing to pay above the actual current price to maintain the natural resource and to avoid irreversible damage that would inhibit possible future use of the resource*" (Ebarvia, 1999). It is the value attached to maintaining the possibility of obtaining benfits from ecosystem goods and services at a later date, including from ecosystem services that appear to have a low value now, but could have a much higher value in future because of new information or knowledge (Koppen *et al.,* 2006). It arises because of an individual's uncertainty about his or her future demand for a specific resource, or the availability of this resource in the future. It is still considered as a "use" value since it still relates to future direct or indirect use of the resource (Barbier *et al*., 1997).

2.7.2.2 Non-Use Values

Non-use values, derive from the benefits the environment may provide that do not involve using it in any way, whether directly or indirectly. It refers to the willingness to pay for a good, to maintain it in existence even though there is no actual, planned or possible use (Bateman *et al.,* 2002). There exist several classifications of non-use values this study uses one espoused by UNEP (2007), that classifies non-use value into Existence and Bequest vlaue.

***Bequest Value**:* Is the value derived from the desire to pass on ecosystems to future generations. This is an important subset of non-use value that results from an individuals' willingness to pay for the preservation or conservation of a resource so that future generations will still be able to reap its benefits. This may be particularly high among those who are currently enjoying the rights to use the resource because they may want their heirs and future generations to be able to derive the same benefits from the system.

Existence Value: Existence value refers to the intrinsic value of ecosystems and the components thereof and their potential cultural and landscape beauty function (FOEN, 2005). This is related to aesthetic, cultural, and moral aspects that a resource may have. It is the value that an individual places on the resource because of the satisfaction that he or she derives from merely knowing that the resource, ecosystem or species exists, regardless of whether it will be used or not. It refers to a good, which has no actual or planned use value to the individual or for anyone else, but the individual is willing to pay to maintain this good in existence for various reasons. This is a form of non-use value which is difficult to measure since it involves subjective valuations by individuals unrelated to their own or others' use. What for example is the monetary value of a "species", whilst many individuals might place a high existence value on whales or turtles, few would place high existence values on worms or microorganisms, yet from a genetic perspective the values of worms or micro-organisms could potentially be of far greater than the intrinsic value of whales and turtles.

2.7.3 Valuation Techniques

However Environmental Valuation is a major challenge and subject to a debate on the commodification and valuing of nature as espoused by Diamond & Jerry, 1994; and Kosoy & Corbera, 2010. Also the actual process of valuing nature is extremely complicated. A number of different methodologies are under development yet they remain contested and so far have not been able to include the multi-dimensional nature of Natural Resources. It is often argued that different actors will rank and appreciate ES differently and finding a common understanding is a crucial yet difficult process (Kosoy & Corbera, 2010). Some researchers try to account for the subjective nature of ES valuation through conducting case specific surveys on the household level. (Maraseni *et al.,* 2002). Over the years, economists have developed a whole "tool box" of valuation techniques that aim to take into account the various challenges facing environmental valuation. Valuation techniques can be categorized broadly into three groups namely: market-based value; surrogate market-based value; and simulated survey-based value (UNEP, 2007). Figure 2.9 outlines the main categories and the specific techniques under each category. All of these techniques are well developed, commonly used, and quite robust with several examples of their use. These approaches can measure all or part of the value of different environmental resources.

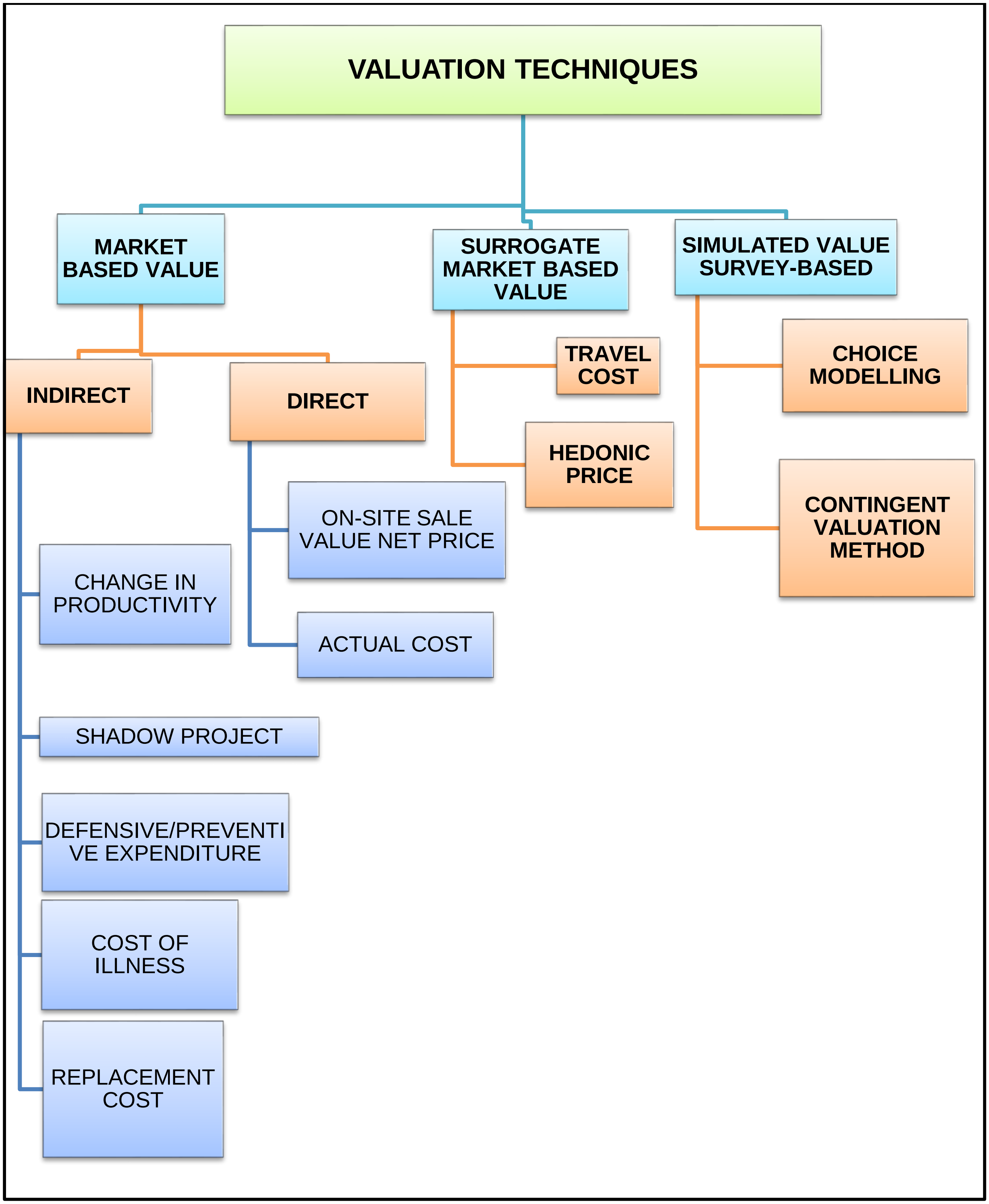


Figure 2.9: Valuation techniques

Source: UNEP 2007

2.7.4 Challenges to Economic Valuation

Schagner (2008) argues that regardless of the weaknesses attributed to the concept of total economic valuation (TEV), it must be acknowledged that the monetization of the environment provides opportunities to take marginal changes of the environment better and more objectively into in policy decisions. The claim to deliver objective data as the optimal basis for decision making is upheld despite the fact that ecosystem service valuation faces challenges.

It is still a conceptual challenge to allocate values to single services in case the good traded on markets is co-produced by several services, in particular if each of them is essential for the result. Water management for example, is not only about the physical environment, but is concerned with ensuring people achieve their needs through socially fair, wise economic, and ecosystem friendly processes. However, valuation techniques isolate single services from a system context in order to value them meaning the techniques have limited applicability in more complex approaches such as ecosystem management (Schagner, 2008). The integrated management of land, water and living resources promotes conservation and sustainable use in an equitable way (Guerrero, 2008), therefore valuation techniques alone can in no way replace a management system incorporating social concerns and challenges.

Further, economic valuation counts only what is currently demanded and takes the prices estimated for ES to be the value of the Ecosystem. Environmental valuation has focused on the value of the service being provided, ignoring the stock. This implies that all those elements of stock which are essential for producing the respective services can be given up without a change in utility provision and thus in value. In other words economic valuation addressed the economically relevant part of biodiversity.

This poses the danger that when what has been valued is compared to other utilities and it may be protected or shed, depending on what creates more cash income. As a result, the economic optimum (maximum utility generated by protecting as much biodiversity as people would be willing to pay for; realized for instance by including the price of environmental services in the market transactions: internalization of external costs) may well represent the economically optimal destruction of biodiversity. It may call for substituting non utility providing elements of ecosystems for more productive ones (Dixon, 2008).

Ecosystems are dynamic, both internally and in response to changing environments. This presents another of the limitations of economic valuation in that it reflects the current knowledge and the current preferences and use structure, which are bound to change with changes in the consumption and production patterns. Dixon (2008) stipulated that there is an interesting interaction between awareness, environmental valuation, and confidence in the results. He felt that the more that people know about a resource, the greater they tend to value those resources and the more "robust" are the valuation estimates. Conversely, the less that is known about the resource, the lower are the estimated values and the less confidence we have in the results. He attributed this to the fact that environmental valuation is designed to reflect people's values, and those values are not intrinsic or unchangeable. Increased exposure to, awareness of, and knowledge of environmental goods and services will change values.

Economic valuation, commands a variety of methods which are based on the same set of economic assumptions, but approach the ecosystem services from different angles, thereby resulting in different values for the same ecosystem (Kosoy & Corbera, 2010). Additionally, Economic valuation handles small, marginal changes well, but has problems when the changes are large and non-marginal. Economics is basically a science of marginal changes—changes in a few percent in supply or demand, or in price or income. Large changes like 50percent or more are outside what economics is designed to address, so issues like global warming, mass extinctions, or dramatic changes in pollution levels have to be handled carefully instead of merely extrapolating from results based on small changes. This will require new studies where large changes are explicitly described to respondents and then valued. Economic valuation of non-marginal changes may well become an important new area for applied methodological research by economists (Dixon, 2008).

Assigning economic values to natural systems remains controversial since these values are frequently partial and imperfect. The traditional lack of markets for many environmental goods and services is now slowly changing and increasing opportunities exist for people to express their desires via market forces. These acts include donations to conservation groups, buying property with specific environmental attributes, making payments for environmental services, purchasing ecotourism trips, and demanding more environmentally friendly products. Since not all environmental goods can be turned into private markets, the evolution of economic valuation and active markets is an important step, but not a panacea for all environmental management issues. However, the evolution of markets provides extremely useful information for improved policy making. Direct payment for ES have therefore been proposed as promising tools, alternative to command-and-control instruments for forest protection (Nathan and Kelkar, 2001), biodiversity conservation (Pagiola *et al.,* 2004) and watershed management.

Another of the debates within EG&S research is whether to assign economic value to environmental goods and services or merely provide incentives to ensure their protection. Heal has argued that rather than valuation, providing incentives is key to conservation. He notes that “valuation is neither necessary nor sufficient for conservation and suggests that the economic prerequisite for conservation lies in incentives which will make conservation more attractive than any other use. He proposes that this can be achieved by translating some of the social importance of ecosystem services into income and ensuring that this income accrues to the owners of the ecosystems as a reward for their conservation” (Heal, 2000). Many of the programs which provide payments to farmers for environmental services use incentives to protect those services rather than creating markets based on their true economic value.

2.8 Chapter Summary

Natural resources are common pool resources that have a public good characteristic and the concern for their management originated around the time of Hardin’s writing the Tragedy of the commons that brought to light the dire consequences of the human patterns of consumption highlighting that as the population increases the demand for the resource outstrips supply and every additional unit consumed by each individual consumer, denies others the benefits. He proposed that privatization was the only plausible solution. This theory has been applied to environmental management discourse on management of commons and stood in the wake of government's centralization of resource management and use of protectionist and command and control management techniques. However critics like Ostrom disputed Hardin's thesis and demonstrated that common property regimes have a history of success, especially in local and/or traditional resource management contexts. Ostrom's premise that each type of "commons" called for its own set of governance regimens, which would vary according to the social and ecological context forms the basis of her approach to managing the commons. She argued that individuals using an existing commons could organize as commons users (a user-group) to manage collectively held properties or govern the use of common-pool resources. To date protecting common-pool resources still poses great challenges at both the local and the global scale. This is further exacerbated by the fact that in many developing countries economic, institutional and policy failures prevail increasing the pressure on ecosystems and result in imperfect service delivery.

The debate on sustainable development has prompted policy-makers to formulate new strategies for achieving a balanced economic and technological pathway that would safeguard the environment, not only here and now, but also elsewhere in the future. This has guided environmental decision making towards a more inclusive management regime. The resilience thinking is increasingly used as an approach for understanding the dynamics of social–ecological systems as one system. The resilience approach emphasizes non-linear dynamics, thresholds, uncertainty and surprise, how periods of gradual change interplay with periods of rapid change and how such dynamics interact across temporal and spatial scales. The Combination of sustainable development discussions and resilience perspective brings to fore the ecological and economic perspectives of natural resource management. The increasing recognition of the interdependence of human and the natural environment led to the concept of environmental goods and services as benefits derived by human kind from the environment. This caused a shift in management technique to focus efforts of conservation on the benefits derived by society. This is closely related to the increasing body of knowledge on economic valuation which is expected to raise the profile of the environmental goods and services in the policy making process.

CHAPTER 3
ENVIRONMENTAL GOVERNANCE

3.1 Introduction

Discussions on environmental governance have occupied scholars for decades, resulting in the development of several approaches to suit emerging issues. This chapter after defining the term environmental governance looks at the various approaches that have been used over the years for natural resource management. This background leads to the discussion of the economic instruments that will be the focus of this study. The chapter looks at markets for environmental services the genesis of the incentive based tool Payment for Environmental services (PES). The Chapter concludes with a detailed review of literature on PES detailing its use and critic.

3.2 Defining Environmental Governance

Several definitions of environmental governance have been given which take into account the role of all actors that impact on the environment. The three most common definitions are: i) “the whole range of rules, practices and institutions related to the management of the environment in its different forms (conservation, protection, exploitation of natural resources, etc.)” (Ostrom, 2001); ii) “all the processes and institutions, both formal and informal, that encompass the standards, values, behaviour and organizing mechanisms used by citizens, organizations and social movements as well as the different interest groups as a basis for linking up their interests, defending their differences and exercising their rights and obligations in terms of accessing and using natural resources.” (Jagers and Stripple, 2003) and iii) "the formal and informal institutions, rules, mechanisms and processes of collective decision-making that enable stakeholders to influence and coordinate their interdependent needs and interests and their interactions with the environment at the relevant scales" (Agrawal, 2005). All in all, environmental governance deals with the supreme consideration for managing all human activities, political, social and economic and includes governments, business and civil societies, and emphasizes whole system management. To capture this diverse range of elements, environmental governance often employs alternative systems of governance, for example watershed-based management (Sonnenfield and Mol, 2002).At the international level, global environmental governance is “the sum of organizations, policy instruments, financing mechanisms, rules, procedures and norms that regulate the processes of global environmental protection” (Hirst and Thompson, 2002).

Environmental governance views natural resources and the environment as global public goods, belonging to the category of goods that are not diminished when they are shared (Evans, 1996), meaning that everyone gets to benefit from for example, a breathable atmosphere, stable climate and stable biodiversity. Nevertheless, public goods are recognized as beneficial and therefore have value. The five key principles of environmental governance include: (i) Embedding the environment in all levels of decision-making and action; (ii) Conceptualizing cities and communities, economic and political life as a subset of the environment; (iii) Emphasizing the connection of people to the ecosystems in which they live; and (iv) Promoting the transition from open-loop/craddle-to-grave systems (like garbage disposal with no recycling) to closed-loop/cradle-to-cradle systems (like permaculture and zero waste strategies). The notion of a global public good thus emerges, with a slight distinction: it covers necessities that must not be destroyed by one person or state. The non-rivalrous character of such goods calls for a management approach that restricts public and private actors from damaging them. One approach is to attribute an economic value to the resource. Water is possibly the best example of this type of good.

To respond to the challenges of externalities, several governments resorted to command-and-control policy instruments. These instruments mandated that individuals undertake stated actions and failure to comply led to application of laid down sanctions. These policy instruments were a legacy of the colonial governance systems that some environmental management authorities in developing countries still rely on as a method of conservation. Other earlier forms of environmental governance systems entailed the establishment of parks and reserves managed by government and denied local communities access to the natural resources therein. However, experience and the academic literature have concluded that the conventional approach to environmental protection in the colonial and postcolonial periods has not been successful in abating environmental degradation. This can be attributed to the negative impacts on livelihood of local communities by reducing land and resource use options and also the high opportunity cost in this protectionist approach to conservation is economically unviable to communities with high incidence of poverty (Iftikhar *et al.,* 2003). This failure made it increasingly clear that institutional mechanisms need to be designed to enable local people, dependant on the resource to be involved in conservation and derive direct benefit from conservation.

3.3 Genesis and Development of Global Environmental Governance

As is common with many concepts, most of what is conceptualized today as ‘global environmental governance’ is not without predecessors. The concept of global environmental governance builds on a substantial pedigree of studies that have analyzed international environmental cooperation long before, starting with the 1972 Stockholm conference on human development and the Rio Summit which brought out sustainable development as central to conservation leading to a new phase of environmental governance and led to the first wave of academic studies on intergovernmental environmental cooperation and organization (Kennan, 1970; Johnson, 1972; Caldwell, 1984). The Summit was bolstered by a series of international conventions and follow up summits that have resulted in slow but fundamental changes in environmental governance approaches. The realization of the inextricable link between poverty and environment and the increasing concerns of human dependence on natural resources resulted in approaches to conservation that address issues of poverty reduction, economic prosperity and environmental conservation together. An integrated conservation approach to ecosystem management was the result of this realization.

Today the most relevant precursor of the concept of global governance is the debate on international environmental regimes of the 1980s (Krasner, 1983; Young, 1989) and 1990s, including the discussions on the creation of environmental regimes, on their maintenance, and on their eventual effectiveness (Young, 1999). Important earlier research also addressed intergovernmental environmental organizations (Kay and Jacobson, 1983; Barrett *et al.,* 1995) and non-state environmental organizations

(Raustiala, 1997; Wapner, 1996), both of which have received new attention in the global governance discourse. Across sub-Saharan Africa, natural resources remain central to rural people's livelihoods, while local norms and customs shape people's everyday forms of resource use. In contrast, the commercial uses of natural resources often remain highly centralized, conditioned by government policies of the colonial and post-colonial eras. During the past several decades, there has been a shift from this predominantly centralized natural resource management towards more devolved models known very broadly as Community-Based Natural Resource Management (CBNRM), which work to strengthen locally accountable institutions for natural resource use and management, enabling local groups of people to make better decisions about the use of land and resources. Proponents of Integrated Conservation Development projects (ICDPs) postulate that poverty alleviation programs will catalyze trickle down improvements in sustainable land-use, based on the theory that raising incomes is a critical precursor to adoption of sustainable production techniques and movement away from poverty related deforestation (Wunder, 2006). With the implementation of this strategies came the need for increased community participation in Natural resource management.

Community-based natural resource management (CBNRM) is regarded as a major innovation in the conservation and management of natural resources (Fabricius 2004, Turner 2004). CBNRM Programmes in southern and East Africa attracted substantial donor investment in the late 1980s and early 1990s. Because it involves the transfer of authority over natural resources to local communities, including of potentially valuable resources such as wildlife and timber, CBNRM is often about major institutional reforms and fundamental changes in power. CBNRM has had positive impacts in several spheres including the development of new policy and legislation that provides communities with more secure rights and benefits over natural resources. It is also generally agreed that this approach served to improve organisational capacity at the local level leading to democratic local governance and therefore empowerment of previously disenfranchised groups. CBNRM is also creditted with reduced vulnerability at household level due to livelihood diversification and employment creation that brought financial benefits at community level. One other positive innovation of CBNRM programmes was the move in the direction of ecosystem management as opposed to management to maximise financial returns. This approach resulted in improvements in biodiversity and the resource base, effectively breaking the downward spiral of poverty, resource dependence and degradation.

In East Africa, governments and supporting donors and NGO's have encouraged the development of diverse modes of local involvement in natural resource management since the 1990s (Barrow *et al.,* 2000). In some locales, such as the Amboseli ecosystem in southern Kenya, experiments with CBNRM date back as far as the 1960s and 1970s (Western, 1994). There is however a general consensus among stakeholders that the current environmental governance arrangements are inadequate and have led to continued degradation of the environment. Considerations for a reformed regime must take into account the economic and social benefits of preserving the environment especially among the local population.

3.4 Challenges Facing Environmental Governance

Several years after the Rio Earth Summit, and the Stockholm Conference on the Human Environment, the world community lacks effective institutional and legal mechanisms to address global-scale environmental degradation. This deficiency weighs ever more heavily as nation-states come to recognize their inability to address critical problems on a national basis and to appreciate the depth and breadth of their interdependence. Devised during the infancy of environmental awareness, when problems were perceived as largely local, relatively distinct, and subject to technological fixes, the current international environmental regime is weak, fragmented, lacking in resources, and handicapped by a narrow mandate. There is motion, but there is little progress. More than 500 multilateral environmental treaties are now in existence (UNEP, 2001), more than a dozen international agencies share environmental responsibilities, and yet environmental conditions are not improving across a number of critical dimensions. The strategies that have been applied so far have only had moderate success in countering environmental degradation and have failed to provide adequate incentives and motivation to stimulate conservation and sufficiently increase the income of the local populations (MA, 2005).

Problems such as climate change, ocean pollution, fisheries depletion, deforestation, and desertification persist – with trends that are often broadly negative. Moreover, advances in a range of ecological sciences continue to unveil new threats to the global commons – from airborne mercury to disrupted hydrological systems – as well as new interrelationships among issues. The environmental challenges we now face clearly illustrate the extent of interconnectedness of the earth's ecological as well as economic systems. These problems demand collective action on a global scale, yet there is no established and effective forum where parties can engage in a sustained and focused dialogue, identify priorities, and devise action plans for tackling environmental concerns with worldwide implications. Absent a vibrant international environmental body, many decisions with serious environmental repercussions are taken within the economic, trade, and finance institutions, where short-term economic priorities often trump long-term sustainability. It is clear, that strong environmental governance is the overarching issue that affects all key priority areas and can give attention required to the linkages in ecological integrity, social well-being as well as economic efficiency.

In Africa, existing policies lack the framework to address the complex challenges while conflicting laws, values and interests degrade the ability to develop collaborative institutional systems essential for managing ecosystems and responding to common challenges (MA, 2005) However, the steady increase of countries signing Multilateral Environmental Agreements (MEAs) such as the Convention on Biological Diversity, the Ramsar Convention or the Kyoto Protocol signifies rising political recognition of environmental issues. The MEAs have put in place legal frameworks to address many important environmental concerns, but this does not immediately translate into solving all the related environmental problems. In practice, domestication of the MEAs has been slow, and poor policy interventions coupled with increased human activity continue to degrade natural resource and threaten the future of ecosystems, with negative impacts on the livelihoods of communities that depend on these resources as well as the economies at large.

3.5 Approaches to Environmental Governance

3.5.1 Exclusionary Conservation Approach

According to Siurua (2006), until recently, the paradigm which dominated natural resource conservation discourse, policy and practice was the establishment of national parks, forests reserves, heritage sites, and other formal protected areas. A dominant feature of this paradigm was that areas selected for conservation were often left untouched or restricted to land-uses that were viewed as compatible with conservation values (Rinzin, 2009). Conservation, in this paradigm, was constructed as the protection of wild species or stocks of biodiversity in special areas (protected areas), away from human society's interference. Siurua (2006) notes that this strategy was pioneered in the United States strictly for the preservation of scenic wilderness areas and exported to Asia and Africa by European colonialists and, later, by conservation experts. Inherent in this paradigm is the idea that human beings are a threat to the conservation of wild species, hence the need for sanctuaries (or fortresses) where such species can receive physical protection (Jones, 2006; Buckingham and Turner, 2008). As a result, this approach to resource management is also known as the "fortress conservation paradigm" (Siurua, 2006; Berkes, 2004). In addition, other writers refer to it as a 'fences and fines' conservation approach (Siurua, 2006; Jones, 2006). This is because where human activities were allowed restrictions were imposed through the issuance of licences and a breach of regulations guiding access to protected areas attracted a fine (or a jail term). In other cases, these untouched areas were fenced to create a distinction between the reserves and human-dominated systems (Rinzin, 2009). A second feature of this conservation paradigm was its highly centralised approach to resource governance. Areas designated as protected areas were brought under the management of state bureaucracies staffed by biologists, forestry ecologists and wildlife scientists (Campbell, 2000; Adisu and Croll, 1994). In this regard, local actors living in and around these areas were excluded from participating in the decision-making processes regarding these resources. Conservation, in this conception, was seen as a technical matter requiring application of expert knowledge acquired through scientific training (Adisu and Croll, 1994). Consequently, natural resources conservation relied on a unitary source of knowledge (to the detriment of other forms of knowledge such as local knowledge).

As a model that gained popularity among conservationists and governments, its power lies in powerful scientific narratives about human-environment relationships that gained ground in academic scholarship over most of the past century. These narratives explain why local actors' livelihood systems have often been viewed as a threat to conservation and why the state has often been positioned as the best actor to manage natural resources. In particular, equilibrium thinking in ecology and Hardin's ideas of the *Tragedy of the Commons* have played an important role in this. As an exclusionary conservation paradigm, its effects on human welfare are well-acknowledged in literature (Siurua, 2006; Jones, 2006). Many authors point out that in many developing countries, this command and control approach brought a lot of hardships to rural actors through land alienation and restrictions on their livelihood activities some even without any forms of compensation (Campbell, 2000; Slater, 2002).

3.5.2 Creation of Protected Areas (PAs)

Formal or 'projectized' CBNRM in other parts of the world tends to focus on Protected Areas (PAs), including fishing grounds, marine parks, hunting areas among others, which are managed principally by the state. In part this is due to the established centralised approach to resource management, but also due to the high priority among global actors. New climate change policies, such as the proposed REDD projects, may provide funding for CBNRM specifically meant to support protected areas. In the Republic of Congo for instance, preliminary studies were carried out to investigate the size of carbon stocks, and establish whether funding of Protected Area (PA) through carbon mechanisms would be successful in reducing emissions for deforestation (Brown, 2006). At one end of the community involvement spectrum, many government-donor initiatives focus on residents inside the buffer zones of state PAs and are focused on reducing any negative effect such as the bushmeat or ivory trade (Rieu *et al.,*2007). Often these projects allow for sustainable resource extraction, where the creation of PAs has had the effect of limiting use, and they also provide community development and alternative livelihood opportunities through micro-projects (a good example is the micro-development initiatives like the Cane rat (*Thryonomys swinderianus*) farming micro-project in Lope reserve, Gabon, in the mid 1990s).

In most cases, the conservation micro-projects offer support to the communities as a means of compensation for their losses in natural resource use, land tenure control etc. This does not conform to a substantive definition of CBNRM, given that the empowerment of communities is rarely part of the conservation project's objectives, and limited or no transfer of authority over communal resources occurs during the course of these initiatives.

Some PA projects have gone further, setting up community conservation zones on the PA periphery (Parnell 2006). These zones are areas that either link a number of PAs in a broader landscape (e.g. the Zakouma National Park ecological corridors in south-east Chad (Binot *et al.*, 2007) or support community-based tourism activities (e.g. the Lossi Gorilla Sanctuary near Odzala National Park in Congo (Gami, 2003). Several countries in Africa have also experimented with community based hunting zones largely inspired by Southern African experiences – such as the village hunting areas in northern Africa. These community conservation zones have the *potential* to fulfill both conservation and development objectives creating 'conservation corridors' within a PA mosaic, while at the same time bringing in development aid, the formal recognition of community structure and rights, and protection against international logging companies for the communities within the community zone. At the other end of the spectrum, community-driven PAs (Community Conserved Areas – CCAs), are beginning to appear within the African context. Two forms of CCA currently exist: those set up by external agencies (donors/ government/NGOs) and co-managed with community management committees; and those set up by communities themselves. Within donor driven projects, donors are increasingly incorporating traditional management structures and practices into management plans and reserve design (WCS, 2006). CCAs set up by communities bypass many of the problems of 'outsider' management, but seem to have sustainability issues, with many reporting the need for donor support and training to navigate legal requirements (Gami, 2003).

3.5.3 Ecosystem Services Based Approach

Ecosystems provide the geographical space that allows biodiversity to thrive. Ecosystems are defined as the complex of living organisms and the abiotic environment with which they interact at a specified location (CBD, 2005). However, there are severe pressures on ecosystem health, as human populations in most African countries expand. Already, increases in appropriation, consumption and disposal of resources to meet the growing demand are not matched by corresponding replenishment and growth in the environmental base (UNEP, 2007). At the same time climate change is posing substantial risks to the health of ecosystems and compromising their ability to provide services. Such a combination of environmental, climatic and economic pressures leading to food, water and energy shortages has the potential of brewing into a ‘perfect storm’, given that natural resources form the basis of subsistence for several poor communities in developing countries. It goes without saying therefore that healthy ecosystems are unquestionably the foundation of sustainable development and how they are governed significantly impacts not just environmental sustainability but also human well-being.

Building on ecology-focused frameworks (CBD, 2005), the Millennium Ecosystem Assessment articulates the dominant interpretation of ecosystem services (Milder *et al.,* 2010; Norgaard, 2010), defining it as pertaining to “the benefits people obtain from ecosystems. These include provisioning services such as food and water; regulating services such as regulation of floods, drought, land degradation, and disease; supporting services such as soil formation and nutrient cycling; and cultural services such as recreational, spiritual, religious, and other nonmaterial benefits”. The ecosystem approach to management therefore, is a holistic, inter-disciplinary approach that takes into account the inter-connectivity between environmental, social-cultural, economic and institutional systems. Unlike single-sector or single-species management, this approach defines management strategies for entire systems and not simply for individual components of the ecosystem. The approach allows analysis of the link and interaction between people and the environment they are integrated in. However, the benefits people derive from ecosystems are not given adequate consideration in development decisions, since they are not captured in the current economic model and system of national accounts. This it has been argued, leads to the over exploitation or destruction of natural resources rather than their sustainable and efficient use (Aronson *et al.,* 2010). Without full valuation of benefits from ecosystems, their exploitation will remain unsustainable and degradation remains inevitable leading to the potential collapse of important ecosystem functions (Zander *et al*., 2010).

Various researchers including Aronson *et al.*(2010), Liu *et al*. (2007) and Zander *et al*. (2010), are in consensus that ecosystem service based management tends to require some form of quantification, having difficulty incorporating qualitative or intangible factors. As a result, discussions and analyses of trade-offs are overwhelmingly reliant on extending existing methods of quantification and commoditization of resources to services. In general, ecosystem service is used to extend quantification to more of the environment than has been typical, though environmental economists have long promoted this objective (Tisdell, 2007). Assertions by Bennett (2000) are representative of the assumed strengths of this approach, arguing that "research that quantifies the provision of multiple services and the trade-offs and synergies among them and examines the ecosystem processes that link services will lead to a better understanding of how the relationships among ecosystem services can change over time and space".

By extending consideration to the supporting processes, ES helps to describe the limited capacity of the environment to attenuate the impacts of consumption. According to Brauman *et al*. (2007), the ecosystem services framework makes explicit the complex feedbacks and trade-offs among services and human beneficiaries. The desire to influence the perception and management of socio-ecological issues is a priority within the ES discourse (Aronson *et al.,* 2010; Butler and Koontz, 2005; Milder *et al.,* 2010; Norgaard, 2010; Pascual *et al.,* 2010; Zander *et al.,* 2010). Carpenter et al. (2006), for example, suggest the need to appreciate "the dynamics of coupled human-natural systems", while Turner *et al.* (2003) argue that a more comprehensive knowledge base is required for effective policy and management. Analyses of how ecosystems influence livelihoods are becoming common, for example with regard to impoverished communities in the developing world (Reynolds *et al.,* 2010). A key example of this trend is the recent £40 million research call by UK government on ecosystem services and poverty alleviation.

Over the years manydifferent approaches to environmental management have been used, with varying success. The Food and Agricultural Organization of the United Nations (FAO, 2006) noted that although human life depends on natural ecosystems, when it comes to the management of natural ecosystems, a one-sided approach was applied generalising rural people and ecosystems as antagonists. Conventional sectoral approaches also did not give opportunities for local communities to participate in the management of natural ecosystem on which they depend for their livelihoods. Fabricius *et al.* (2007) also found that despite local communities for many years living with the natural ecosystem in a compatible manner, the conventional top-down management approach let these communities feel that they were not part of the ecosystem, leading to intensive degradation of the environment.

Efforts to shape human perceptions and governance are however thought to have been unsuccessful. Pattanayak *et al.* (2010) reviewed the ES literature, finding no evidence that the commoditization of services benefits vulnerable individuals. In another review, Liu *et al.* (2010) declared that the contribution of ecosystem services valuation to ecosystem management has not been as large as hoped nor as clear as imagined. This requires Ecosystem Service researchers to do more than simply develop good ideas to influence policy. There is need to understand how the political process affects outcomes and actively market the use of appropriate and feasible methodologies for promoting environmental policy.

Contemplating the few instances in which the ES concept has been applied to management, Brauman *et al.* (2007) emphasise the difficulty of bridging natural and human systems. They argue that trade-offs raise political and ethical considerations that are not suited to the ecological sciences as typically applied. Similarly Pearce and Seccombe-Hett’s (2000) asserted that individual self-interest may undermine the protection of common resources, while Balvanera *et al.* (2006) were of the opinion that the inclusion of human wellbeing requires a step beyond the scientific community. Norgaard (2010) on his part asserted that institutional and ethical questions are most important. It is within such admissions that researchers of ecosystem services are seeking to add the human dimension to the existing ecological-economic framework. Perhaps Brauman *et al.* (2007) best summarizes this agenda, by declaring that modern environmental problems have accentuated the need to move beyond simple recognition of human dependence on the environment.

Steffen (2009) argues that without improved knowledge of the dynamics of social-ecological systems, it is almost impossible to design appropriate management tools or even the adaptive intervention experiments needed to inform policy and management. Arguments such as these exhibit the desire to recognize the social nature of management, but they also expose the assumption that poor management is rooted in a poor understanding of the natural environment. The implication is that the solution rests in further integration between science and governance (Aronson *et al.,* 2010; Brauman *et al*., 2007; Liu *et al*., 2010; Zander *et al*., 2010).

Arguably, by emphasizing the merging of conservation and livelihoods in both conservation and development, sustainable development marks the end to an exclusive reliance on the protected area model for environmental protection. It shows that most conservation theorists and practitioners no longer believe in a single solution to the problem of natural resource degradation. Indeed, writing in 1993, soon after the Rio Conference, Primak (1993) remarked that the danger of relying on parks and reserves to protect environmental resources is that it creates a ‘siege mentality’ in which species inside the parks are to be rigorously protected while species outside can be rapidly exploited. He notes that the crucial element in conservation strategies must be the protection of biodiversity outside, as well as inside protected areas.

Another statement that reflects this disappointment with the protected area conservation model among conservation theorists is presented by Van Tighem (1988) who notes that reserves and parks do not draw a more thoughtful relationship with the habitat; they do not show that land is to be used frugally, and with good sense. They encourage the belief that conservation is merely a system of trading environmental write-offs against large protected areas. They have more than failed, in fact, they have become a symptom of the problem (Primak, 1993). These views render support for a new conservationism that goes beyond protected areas to encompass various types of socio-ecological systems, including agricultural environments, where lands can be used for multiple purposes (Scherr and McNeely, 2008; Mery *et al.*, 2005). This thinking received further support when the notion of ecosystem services, as a concept for linking conservation with production of ecosystem services in various landscapes, entered the lexicon of sustainable development and reconfigured the way in which conservation is reviewed. As a critique of the traditional way of managing resources, the focus on ecosystem services broadens the conservation agenda in two ways. First, it shifts the attention of conservation from a narrow managerial pre-occupation with pristine environments and the protection of material resources to a broad range of ecosystem services, and hence emphasizes new conservation values. The Millennium Ecosystem Assessment (2005), for example, lists about 24 ecosystem services of importance that need attention in order to improve human welfare and arrest environmental degradation. Secondly, this notion holds that it is not just the traditional spaces of conservation that are important for conservation, but also environments previously neglected by the protected area model. It views both protected areas and production spaces (such as agricultural environments) as important arenas of biodiversity conservation, carbon sequestration, water conservation and maintenance of other ecosystem services.

3.5.4 IWRM Approach to Environmental Governance

The Global Water Partnership's (GWP) defines Integrated Water Resource Management(IWRM) as a process which promotes the coordinated development and management of water, land and related resources in order to maximise the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems (GWP, 2000). This definition prioritises environmental health and its connections to individual, economic, and societal wellbeing (Banuri, 2009; Falkenmark, 2004; McDonnell, 2008; Medema *et al.,* 2008; Mitchell, 2005), while Jonch-Clausen and Fugl (2001) with economic efficiency, social equity, and environmental and ecological sustainability being the primary objectives. Implementing IWRM requires water governance that is coordinated across levels and promotes and facilitates consensus building. It also requires creation of platforms for stakeholders to come together to transparently agree and define rights and responsibilities. It also needs to ensure that institutions are accountable to their commitments, while decision-making incorporates the realities of political processes. IWRM was designed to replace fragmented management of water and encourage sustainable use. Planning for IWRM takes place using inclusive, participatory processes. The big challenge is to implement IWRM. The International Union for the Conservation of Nature (IUCN) Water and Nature Initiative showed that implementing IWRM is made practical by explicit strategies to demonstrate what works, how to deliver results on the ground and learning-by-doing. Real progress is built by combining demonstration and learning with empowerment of communities, and actions that support and catalyze national and basin-level water reforms with financing and investment that can be sustained.

Reviewers of IWRM underscore its role as a forerunner to ES. For instance, Savenije and Van der Zaag (2008) state that IWRM must include both natural and human dimensions of water while Banuri (2009) emphasizes on trade-offs to maintain socio-ecological integrity. Just like ecosystem services, IWRM is used to emphasize the integration and balance of social and physical factors while, somewhat hypocritically, also arguing that water is central to social, economic, and environmental sustainability. IWRM is used to explore complex human-environment relations and to stress that competing interests must be integrated in order to implement successful policy. Medema *et al.,* (2008) pointed out that IWRM involves a continuous process of balancing and making trade-offs between different goals and views in an informed way. Users of IWRM recognize increasing or more likely recognize increasing recognition of complexity within socio-ecological relationships. It is this complexity, characterized by nonlinear relations and criticisms of reductionism, within which IWRM is used to situate socio-environmental challenges. For example, Jonch-Clausen and Fugl (2001) argue that complex relations are paramount for the resolution of water crises, there being “a need to find appropriate ways to co-ordinate policy making, planning and implementation in an integrated manner across sectoral, institutional, professional and basin boundaries and to take into account the even more complex co-ordination issues over the management of international watercourse systems”. Savenije and Van der Zaag (2008) also provided a similar assessment, noting that the scope and complexity of water issues has driven management toward integrated approaches. This is similar to a comment by Mitchell (2005), who explained that complex and interconnected factors represent the rationale for IWRM.

However, critics of IWRM state that it tends to be ambiguous in its objectives, difficult or impossible to verify, and idealistic in its agenda (Biswas, 2004; Petit and Baron, 2009). For example, Medema *et al.* (2008) argued that clarity is needed in terms of the claims, coordination, and integration of knowledge, rather than vague calls to cross boundaries or draw together disparate disciplines. Many critics of IWRM focus on the impediments to integrating the range of knowledge needed to manage controversial environmental problems. For example, Savenije and Van der Zaag (2008), list: equity, poverty alleviation, gender relations at multiple scales, harm reduction, food security, and health as just some of the competing issues. In response to the overwhelming range of potential factors, the often cited White (1998) concludes that the problems of accurate analysis of inter-sectorial linkages and of achieving institutional reforms in the planning process are formidable, and that it would be sanguine to expect early or easy solutions.

IWRM is also criticized for being unable to explain the dynamic role of social influences on management, including factors such as competition, conflict, bias, subversion, interests, and active opposition (Bellamy and Johnson, 2000; Braga and Lotufo, 2008; Chéné, 2009; Das Gupta *et al.,* 2005). Society, it is argued, is an active participant that produces, distorts, and opposes knowledge and practice (Ako *et al.,* 2010; Anderson *et al*., 2008; Braga and Lotufo, 2008; Mitchell, 2008; Petit and Baron, 2009). The inability to integrate and make sense of society's influence, then, is seen as a fundamental flaw. IWRM is also criticized for assuming that it can be easily transferred from concept to governance (Brown and Farrelly, 2009; McDonnell, 2008). For example, it is argued that developing nations lack the capacity to enforce IWRM, leading to wasted resources in locations where improvements to water management are most needed (Merrey, 2008).

IWRM is commonly interpreted as a means of resisting the neoliberalisation of water resources, with many authors using IWRM to encourage social development through pro poor initiatives that challenge reliance on free markets (Brown and Farrelly, 2009; Rahaman and Varis, 2009). The failure to accommodate socio-cultural elements results in a situation where such factors are presumed to be important but cannot be included. Chéné (2009), for instance, citing the committee for sustainable development, argues that water issues are not only technical and institutional issues, but also have intrinsic political content, which has to be explicitly considered in order to be able to solve effective difficulties linked to competition and interests among stakeholders. All these arguments touch upon the difficulties that arise when social and natural elements are considered in tandem.

3.5.5 Sustainable Development (SD) and New Conservation Paradigms

Sustainable development was brought into the international political agenda by the Brundtland Commission, through the publication of 'Our Common Future' in 1987, which framed it as a paradigm for merging the environment and development in order to achieve win-win solutions for environment-livelihoods problems. The publication of this report was preceded by the Stockholm Conference (also known as the United Nations Conference on the Human Environment) in 1972, which was the first ever 'global' conference on the environment, and one that signaled the ascendancy of the 'environment' as a subject of international law and policy. One of the key characteristics of sustainable development is that there is no accepted strictly fixed definition (Berger *et al*., 2001). However, discussions of sustainable development revolve around the popular definition by the Brundtland Commission. The Commission (WCED, 1987), in its report, 'Our Common Future', define sustainable development as: "Development that meets the needs of the present without compromising the ability of future generations to meet their own needs". The report continues to point out that sustainable development implies 'limits' (although not absolute limits) imposed by the present state of technology and social organisation on environmental resources and by the ability of the biosphere to absorb the effects of human activities. This definition incorporates two important notions, 'needs' and 'limits', which give sustainable development its character and mark an important departure from the traditional narratives discussed in the proceeding sections (Carvalio, 2001; Kates *et al.,* 2005). The goal of sustainable development is to meet the basic 'human needs' while respecting 'ecological limits'. In this definition, the Brundtland Commission clearly sought to bridge the gap between the concerns of environmentalists (i.e. ecosystem limits) and those concerned with human welfare. Devkota (2005) also notes that, despite diverse opinions on sustainable development, many definitions meet here – ‘betterment of human society’ and ‘well-being of the habitat of non-human-species’ (Kates *et al.,* 2005). In this regard, SD extends the debates dealt with in the previous sections by proposing to marry conservation and human development, and thus repositioning the relationship between nature and society. Sustainable development is premised on the assumption that conservation policies and programmes are only sustainable when they have the dual purpose of protecting and improving rural livelihoods, as well as ecological conditions (Slater, 2002).

Although the term sustainable development was first used by the IUCN in 1980 (Carvalio, 2001; Holden and Limerud, 2007) and then defined by the Brundtland Commission in 1987, it is at Stockholm that the links between development and the environment were first tabled as an important agenda. Since then, several other global and regional conferences have taken place and nearly two hundred multilateral environmental agreements (MEAs) have been signed by the international community in order to address various environmental challenges facing the world. The defining moment in the development of the SD discourse was the Rio conference held in 1992. The conference had several important outcomes with a bearing on natural resource conservation today, including the signing of the United Nations Framework Convention on Climate Change (UNFCC), aimed at addressing greenhouse gas emissions and the United Nations Convention on Biological Diversity (CBD), constructed to halt the loss of biodiversity world-wide. In addition, Agenda 21 was unveiled as the global plan of action for sustainable development. While the concept of sustainable development is often subject to conflicting interpretations, the reality is that sustainable development simply seeks to link human conservation and human welfare. Adams and Hulme (2001) note that since the publication of ‘Our Common Future’, the goal of sustainable development has been about a search for conservation paradigms that link conservation with development (i.e. posit a win-win scenario). In addition, it has also been about developing conservation strategies that meet the global goals outlined in the MEAs discussed in the preceding section. This search for win-win solutions has seen the rise of a new language in conservation, encompassing ‘participation and devolution’ and, more recently, the notion of ‘ecosystem services’. These represent the two most important conceptual shifts in the new conservationism.

3.5.6 The sustainable livelihoods perspective

The concept of ‘sustainable livelihoods’ has its beginnings in the Brundtland report that sought to merge the notion of sustainable development with that of livelihoods. The report referred to the idea of ‘securing the livelihoods of the poor’ and ‘providing sustainable livelihoods for resource-poor farmers’, but never clarified what was meant by ‘sustainable livelihoods’. While it also emerged as a central concept in Agenda 21, it was Chambers and Conway (1992) and other scholars such as Scoones (1998) from the Institute of Development Studies who have been credited with shaping the ideas that form what is today termed, the ‘sustainable livelihoods framework’. Chambers and Conway (1992) offered the following definition of ‘livelihoods’ and what constitutes a ‘sustainable livelihood’: “A livelihood comprises the capabilities, assets (including both material and social resources) and activities required for a means of living. A livelihood is sustainable when it can cope with and recover from stresses and shocks, maintain or enhance its capabilities and assets while not undermining the natural resource base”.

In the development and environment literature, this definition of sustainable livelihoods has become the dominant definition accepted by many scholars (Scoones, 1998; Kirby, 2001; Rigg, 2007; Assan et al., 2009). In this definition, people draw on different types of resources (for example, natural and economic resources) which are combined in the pursuit of different livelihood strategies (for example, agricultural intensification or extensification, migration and livelihood diversification) to cope with vulnerability and achieve sustainable livelihoods (Scoones, 1998; Kirby, 2001; Ellis, 2000). The main values of a livelihoods approach are that: it provides an explicit focus on what matters to poor people; synthesises perspective of different disciplines; broadens the scope of enquiry from cash flows, direct impacts and positive impacts to other important issues; the sustainable livelihood framework is a useful analytical tool; and livelihoods analysis generates practical recommendations to enhance the design and implementation of initiatives.

The sustainable livelihoods approach, has however, been criticized for lacking a focus on politics and power and how these influence local livelihoods and resource management system (Scoones, 2009; Simon, 2008). Some of the main challenges that emerge are: limitations in the framework (complexity and gaps); difficulties for partners in implementing the approach; high resource inputs needed; and the difficulties of quantifying contributions to livelihoods.

3.5.7 Devolution and Participatory Natural Resources Management

In an apparent departure from centralised systems, Agenda 21 (UN, 1992) called for the reorganization of decision-making structures to ensure a collaborative approach to the management of natural resources. In particular, Agenda 21 calls for participation of a range of other stakeholders in resource management, such as local communities and their constituents (women, youths etc), local governments, NGOs and the private sector. This participation is envisioned in the form of decentralised resource management. Barry *et al.* (2010) define devolution or democratic decentralisation as “the transfer of power and resources from central government to authorities representative of and accountable to local populations”. In this conceptualization, decentralization is aimed at expanding the arena of public participation in the process of governance in order to meet local needs and aspirations (Barr *et al.,* 2006). This is premised on the assumption that decisions closer to local people should be more equitable, efficient, participatory and accountable and environmentally sustainable (Barry *et al.,* 2010; Ribot *et al.,* 2010). These are viewed as the central tenets of participatory or decentralized governance (Child and Lyman, 2005; Batterbury and Fernando, 2006).

The notion of decentralization as a political process was extended to environment and natural resources, as global discourses on rural development and conservation began to emphasizes decentralization and local empowerment. In particular, the discourse of sustainable development subscribes to the principles of fairness and equity, participation and empowerment of local communities (UN, 1992). In addition an array of studies documenting sustainable forms of collective natural resource management systems based on traditional norms and rules have played a significant role in transforming many conservationists' thinking about common property rights and institutions (Roe *et al.*, 2009; Ruddle, 1992). Within this discourse, older models of natural resource governance, where decision-making was dominated by the state and adopted in a top down approach, were no longer viewed as acceptable (Mery *et al.,* 2005; Berkes, 2004). According to Shackleton *et al.* (2002), devolution can be thought of as a process that shifts the decision-making space related to natural resources from centralised government to local communities or local governments. The decision-making space is thought of as multi-dimensional and encompasses the ability to control decisions about the extent and quality of natural resources, livelihoods and income, and political processes related to natural resource management (Edmunds and Wollenberg, 2003).

3.5.8 Community Based Natural Resource Management (CBNRM)

The devolved models of natural resource management are known broadly as community-based natural resources management (CBNRM). The variety of names embraced by the concept of CBNRM includes community-based conservation, community centred conservation, community-based forestry, sustainable forest development and joint forest resources management (JFM) (Buchy and Race, 2001; Adams and Hulme, 2001; Berkes, 2004). Although different names are used in different circumstances and places, conceptually, these CBNRM models can be identified by the following major characteristics: (a) reduced state involvement and transfer of some degree of authority to local actors (local authority, communities etc) (b) a holistic approach to natural resource management that recognises complexity, interrelatedness and connections among ecological processes and components, multiple uses and jurisdictions (Berkes, 2004); (c) a participatory approach where a range of actors with varying political and economic interests participate in resource management (Shackelton and Campbell, 2000); and (d) a focus on conservation, poverty reduction and democratization (Child and Lyman, 2005).

In all instances, CBNRM involves some degree of co-management between central authorities, local government and local communities which share rights and responsibilities through diverse institutional arrangements (Roe *et al.,* 2009; Edmunds and Wollenberg, 2003). Theoretically, the state retains the role of coordinator and catalyst and mediates conflicts, steering people towards the achievement of CBNRM goals (Mery *et al.,* 2005; Campbell *et al.,* 2004). Perhaps, a major distinguishing mark of CBNRM is that it is not just a conservation paradigm, but also a rural development paradigm, as well as a strategy for promoting democratisation (i.e. a win-win solution for both the environment and development). In short, it is a multi-pronged paradigm that fits well with the SD thinking of internalising social, economic and environmental externalities in order to increase equity in the management of natural resources. According to Child and Lyman (2005), CBNRM works at the nexus of conservation, governance, institutional development and justice. Many CBNRM practitioners and scholars believe that sound conservation outcomes are but one component of a process that uses the value of natural resources to empower land-owners fiscally, and to build effective governance structures (Child and Lyman, 2005). For these scholars, CBNRM represents a democratic assertion of people's rights and an institutional expression of these rights (Hobley, 1996; Barr *et al.,* 2006). In this regard, it is argued that to make an impact, decentralization needs to allow local resource users and their representatives to exercise these rights, which include the rights to retain benefits, the rights to allocate and dispose of resources to the best advantage, and the authority to manage the resources (Child and Lyman, 2005). In this regard, decentralised natural resource management is simply viewed as a means of enhancing local democracy, increasing equity and empowering disenfranchised segments of the society (Fidelman, 2006; Mery *et al.,* 2005; Barr *et al.,* 2006).

In many African countries, community-based natural resource management (CBNRM) is regarded as a major innovation in the conservation and management of natural resources (Fabricius, 2004; Turner, 2004). Namibia has gained prominence as a 'good practice' example of success in CBNRM programmes. In Namibia, legally formulated wildlife conservancies are run by elected committees with technical support from government and NGOs. Income from hunting, tourism, jobs, craft markets, and game meat has improved livelihoods, along with infrastructure, empowerment, and new skills. It is estimated that 120 000 km^2 of land is now managed by conservancies. One in eight Namibians (or 220 000 people) is a member of a conservancy and the gross revenue earned by conservancies is over US$2 million per annum (NACSO, 2007).

Equity and democratization are assumed to be achieved through the participation of local communities and other stakeholders in the decision-making process. However, participation, as one of the panoply of terms spawned by the natural resource and development discourse, requires careful examination as it may mean different things to different users of the term (Sullivan and Homewood, 2004; Jones, 2006; Ribot *et al.,* 2010). According to Hobley (1996), what is termed as participation is highly context-specific and its effects range from manipulation to full local control (Buchy and Race, 2001).

One of the major positive outcomes that most writers agree on is that CBNRM has resulted in fundamental shifts in the way rural people are viewed. Instead of ‘poachers’, ‘squatters’, ‘criminals’ and ‘encroachers’, rural people are now viewed as legitimate resource users and managers (Sullivan and Homewood, 2004; Adam and Hulme, 2001). In addition, rural communities are made more visible to NGOs, donors and service providers who take more notice of them and provide technical assistance in community capacity building, and small enterprise development. In this way, devolution opens more channels for rural people to communicate their priorities to government decision-makers and others (Campbell *et al.,* 2002).

Much has been written in support of CBNRM as a radical and effective tool for managing natural resources (Roe *et al.,* 2009; Child and Layman, 2005; Fidelman, 2006). However, literature focused on investigating the process of designing and implementing CBNRM shows that CBNRM is far from being a panacea for natural resource governance. In terms of improvement in the resource base and material benefits, multiple outcomes have been reported (Ribot *et al.,* 2010). Campbell *et al.* (2002) report a turnaround in the resource base, from a degraded and overused woodland to a regenerating woodland in CBNRM programmes established in Tanzania, while CIFOR (2004) showed that in Cameroon, this had not produced the positive outcomes anticipated, although communities were given greater authority in the management of forest resources. Instead, CIFOR (2004) noted that decentralization helped in the creation of a new social elite, increased the level of degradation and increased tensions between CBNRM institutions and other local level institutions.

The practical implementation of community based natural resource management (CBNRM) initiatives, however, has frequently fallen short of expectations. A number of reasons have been identified including a tendency (despite rhetoric to the contrary) for the ``intended beneficiaries' to be treated as passive recipients of project activities (Pimbert and Pretty, 1995); a tendency for projects to be too short-term in nature and overreliant on expatriate expertise; and a lack of clear criteria by which to judge sustainability or success in meeting conservation or development goals (Western, *et al.,* 1994). Others suggest that the interests of certain social groups have been consistently marginalized (Hobley, 1992; Sarin, 1995).

3.5.9 Traditional Knowledge & Customs

There is a long tradition across many countries of the world as well as in the African continent, for customary or traditional approaches to the management of natural resources. Local groups of people across the African region possessed a wide array of indigenous resource management knowledge and expertise, most of which were never documented or recorded. Nevertheless many resilient local resource management systems and conservation practices still remain in place, and are a central element of CBNRM in practice across East Africa. In addition to formal decentralization processes, traditional management systems have continued to dominate in many rural areas (Kasanga, 2002; Edja, 2001) Traditional knowledge and local customs may represent important components of good resource management practices at the ‘grassroots’ level, although caution should be exercised as traditional management practices are not always appropriate (Chalmers and Fabricius 2007). Many traditional resource management systems and everyday uses of resources fall under this sphere of customary governance. Local knowledge about ecosystem processes, such as the effects of fire, has enabled communities to manage rangelands in the more mesic parts of sub-Saharan Africa, with local pastoralists keenly aware of the benefits of different forage species and of tools such as fire for forage management (Kepe & Scoones, 1999; Kassahun, 2008). Ideally, social institutions and networks that are organised around the use and management of ecosystem services bring people together and encourage them to find common solutions to resource management problems. In these networks, people share traditional and ecological knowledge and common cultural rituals and practices which are critical in building social cohesion and "a sense of community". Collective action in Machakos (Kenya) by the traditional institution of the *mwethya* or mutual assistance groups is an example of a long tradition of ecosystem management in Kenya. Some of the perfect examples of the use of traditional or indigenous knowledge in environmental and natural resource governance Include. the sacred groves (*khayas*) found along the Kenyan coast, traditional forests in the Pare Mountains of Tanzania and traditional grazing areas managed through transhumant pastoralist land use systems by the Maasai, Samburu, Turkana and Oromo pastoralists (and others) of Tanzania, Kenya, and Ethiopia. For example, Bassi (2006) describes the way that Borana communities in southern Ethiopia and northern Kenya protect key springs and montane forests through customary measures. Known (by the international conservation community) as CCAs, they are essentially areas where the communities are the primary managers of the resource, they have undertaken the protection and conservation of the resource on a voluntary basis (i.e. they are not paid to do so) and for objectives defined by themselves which range from basic livelihood needs to spiritual and religious concerns (Blomley *et al.*, 2007).

In the African region's semi-arid lands, pastoralism is based on sophisticated systems of traditional or customary natural resources management – based on mobility – which were initiated and are maintained without external support, but which have evolved along different trajectories reflecting differences in the political and legal context between countries. Importantly, it has been reported in West Africa that traditional pastoralist resource management systems probably generate greater economic benefits for local communities and the region's national economies than any formal or centrally driven CBNRM processes or programs in East Africa. In Kenya, pastoralism is estimated to be worth about $800 million in milk, meat, and leather production to Kenya's economy (Hesse and MacGregor, 2006) – roughly equivalent to the value of the national tourism industry. Although pastoralism in Kenya and Tanzania is oriented to livestock management, it also benefits wildlife as dry season grazing reserves are effectively un-used by people for extensive periods, and conservation of vegetation is an express local management objective. By enabling the maintenance of wildlife habitats outside government controlled protected areas, pastoralist land management practices provide important ecological services, estimated at in excess of $80 million annually, at the macro-economic level in northern Tanzania

3.5.10 Ecosystem Services and Agri-environmental Management

One of the key concepts to have emerged as a way of linking ecosystems to human welfare in the past decade is that of ‘ecosystem services and goods’ (CRA, 2006; Dailey and Matson, 2008; Fisher and Turner, 2008). The emergence of the concept was driven by the need to make the services provided by the environment more visible to the market and policy makers. According to Fisher et al (2009), the notion of ecosystem services was first hinted at when Westman (1977), in a paper *‘How much are nature’s services worth?,*suggested the enumeration of the social value of the benefits provided by ecosystems so that society can make more informed policy and management decisions. Westman referred to these social benefits as ‘nature’s service’. It is these nature’s services that are now called ‘ecosystem services’ (and also referred to as ‘environmental services’), a term first used by Fisher *et al.* (2009). The concept of ecosystem services was popularised by the publication of a paper on global ecosystem valuation by Costanza *et al.* (1997) and then by the Millennium Ecosystems Assessment (MA) report of 2005. Costanza *et al.* (1997) and the MA reports provided definitions of ecosystem services that are among the most widely cited in the ecosystem services literature.

Costanza *et al*. (1997) define ecosystem services as “ecosystem goods (such as food) and services (such as waste assimilation) which represent the benefits that human populations derive, directly or indirectly, from ecosystem functions”. For the MA, ecosystem services are simply the benefits that people obtain from ecosystems. These two definitions capture the general notion of ecosystems benefiting human populations. Some of the ecosystem services categories include :Provisioning services like food, water, pharmaceuticals and energy; Regulating services such as carbon sequestration and climate regulation, waste decomposition and detoxification, water and air purification, crop pollination, pest control and disease control; Supporting services such as Nutrient dispersal, seed dispersal and primary production and Cultural services such as intellectual, cultural and spiritual inspiration, recreational experiences, including eco-tourism, and scientific discovery.

In contrast to the traditional conservation paradigm, where material stock (forests, trees and wildlife) are regarded as the primary target of conservation, the concept of ecosystem services broadens the goals of conservation to capture ecosystem services. Further, the MA (2005) points out that more than 50% of the ecosystem services worldwide are in a state of degradation. The report argues that in order to avoid the devastating impacts of this degradation on human welfare, substantial changes have to be made in the way in which society values and deals with natural resources. In other words, it calls for new ways of thinking about natural resources and the maintenance of ecosystem services.

Over the past two decades, the question that both academics and conservation practitioners have been grappling with is: how, and in what type of environments, can ecosystem services be enhanced and maintained. In response to this, some scholars, such as Scherr and McNeely (2008), have argued for an extended thinking about environmental conservation that goes beyond protected areas to encompass socio-ecological systems, in order to conserve and sustain ecosystem services (Reeves, 2011; Batary *et al.,* 2011; Zwaan, 2010). These scholars assert that conservation of natural resources cannot rely on protected areas alone, as maintenance of ecosystem services requires new strategies for managing entire landscapes, including lands reserved for production (Batary *et al.,* 2011). Agricultural environments, in particular, have emerged as the most important focus of this new conservation debate. Batary *et al.* (2011), for example, draw attention to the fact that “more than half of the earth’s surface is molded by agriculture, so the contribution of agriculture is critical for successful long-term conservation” (Amdur *et al.,* 2001). According to Cunder (2007), forestry and agriculture are the two most important land-land uses that affect the quality of the rural environments. Consequently, it is argued that combining conservation in forest reserves with that on farmland is a well-balanced way of doing conservation (Batary *et al.,* 2011). Another factor that justifies the emergency of agri-environmental initiatives is that consumers in Western countries are increasingly questioning the benefits of modern agriculture. Kleijn and Sutherland (2003) point out that there is a clear and public mistrust about some aspects of modern agriculture, particularly in terms of its environmental impacts. This shift towards agri-environmental management implies that agriculture areas must be viewed as multi-functional landscapes which do not only produce food and fibres, but also various ecosystem services being demanded by society (Milestad *et al.,* 2011; Melania and Sayid, 2011).

The idea of extending conservation to agricultural environments heralds a new era of environmentalism and should be seen as a radical shift from the protected area thinking which viewed agro-landscapes as “biological deserts or a hostile matrix of isolated habitat fragments” (Batary *et al.,* 2011). In this wave of environmentalism, agricultural environments and related landscapes are seen to be worthy of conservation because they assert, rather than deny, the value of socially induced change on the environment (Barker and Stockdale, 2008). Indeed, Dailey and Matson (2008) note that with the notion of ecosystem services, there is a growing renaissance in the conservation community, such that: conservation efforts now are expanding into realms well beyond reserves, beyond charity, and beyond biodiversity – and into the mainstream.

There are various types of measures that can be adopted in agri-environmental initiatives. However, one element defines them is that they have at least two objectives, reducing environmental risks associated with modern agriculture and preserving nature or delivering a range of ecosystem services, while at the same time improving the livelihoods of farmers (Scherr and McNeely, 2008; Dumanski, 2006). Reducing environmental risks associated with farming may imply reducing inputs, such as fertilisers and pesticides, preventing land abandonment, preventing soil erosion and biodiversity loss (Latacz-Lohmann and Hodge, 2003). Conservation agriculture, for example, is one of the agri-environmental measures that is aimed at reducing environmental risks (i.e. through minimum tillage, reduced farming inputs and agro-forestry practices), while at the same time improving the productivity of farm plots (Dumanski *et al.,* 2006; Prosperi *et al.,* 2011). This type of measure is common in parts of South America and the USA but is now being deployed to other parts of the world such as Africa (Baudron *et al.,* 2007).

The idea of addressing environmental risks on farmland has also drawn considerable attention to the rehabilitation or restoration of degraded lands (Morse, 2007; Dailey and Matson, 2008), something seen as vital for enhancing both livelihoods and ecosystems in order to achieve the goals of sustainable development. It improves the availability of ecosystem goods such as food, timber, fibres, and biomass energy that are critical for rural livelihoods, and at the same time allows land users to avoid deforestation and other land-uses with deleterious effects on ecosystem services (Dailey *et al.,* 1997). In the EU, however, agri-environmental measures also take the form of non-productive land measures such as the conversion of arable land to grassland, set-asides and care of woods and hedges (Kleijn and Sutherland, 2003; Scherr and McNeely, 2008; Borsotto *et al.,* 2008), aimed at preserving the rural landscape and enhancing biodiversity. Farmers who engage with nonproductive land management practices derive livelihood benefits from such initiatives through payments for ecosystem services.

Much as agri-environmental initiatives have been reported as successful in some areas, there are several issues of concern that have come up. The first issue concerns the place or role of local actors' experience and knowledge in the decision-making process surrounding the implementation of agri-environmental measures. In other words, who gets to decide what has to be done on the farm plot and whose knowledge is important in the process (Amdur *et al.,* 2001; Doody *et al.,* 2009). Lessons generated from several studies show that the implementation of agri-environmental initiatives is largely characterized by a top-down approach to policy development and implementation in which experts make the interpretations of the environmental issues to be addressed by farmers (Doody *et al.,* 2009; Herzele *et al.,* 2011). According to Doody *et al.,* (2009), this poses many challenges for the effective implementation of agri-environmental measures as it is seen as imposing solutions, and local actors (farmers) are often opposed to many of the regulations and recommendations developed by central actors. Similarly, Lenihan and Braser (2009) noted that as centrally defined approaches, agri-environmental measures fail to account for local actors' knowledge and their diverse agro-ecological practices that may be important in the implementation of these initiatives.

In Doody's view, agri-environmental policy and practice rely heavily on a top-down process because their development is based on first order research and development (R&D) which relies on the objectivity of scientific research to develop objective data through experiments and monitoring. However, although such a process can be seen as 'good science' and objective, Doody *et al.* (2009) note that it fails to account for the human factors that will impact on the implementation of proposed measures, and the differences in perception of how the problem should be solved. Indeed, what most studies show is the need for alternative means of developing agri-environmental measures in which local actors play an important role in interpreting the environmental measures to be implemented. The importance of local ecological knowledge in sustainable natural resources management has been highlighted by other authors (Briggs, 2005).

It is argued that the knowledge of local actors, in particular, can help build a more complete information base than reliance on science alone (Berkes, 2004). As agri-environmental initiatives are now gaining a foothold in developing countries, it is important to examine whether or not agri-environmental initiatives in developing countries are accommodative of local actors' knowledge and experiences. Finally, another important issue concerns the question of how to motivate farmers to adopt agri-environmental measures in order to produce environmental goods and services that benefit society as a whole (Guy, 2006). This has been partially resolved in developed countries through payments for agri-environmental measures, in which farmers receive payment for modifying landscapes in favour of environmental services.

3.6 Markets for Environmental Services

Ecosystems provide important environmental services as well as offering direct and indirect economic opportunities for communities. Landell-Mills (2002), suggested that the most significant factor driving demand for Environmental Services has been increased public recognition of the role played by ecosystem services, keeping future options open and insuring against unexpected shocks or negative impacts. Several instruments are used to regulate human use of natural resources and thus the flow of environmental services (Ravnborg *et al.,* 2007). These instruments include (i) regulations and restrictions sanctioned either culturally or through formal laws; Regulation typically involves command-and-control measures, prescribing actions that must or must not be undertaken (i.e., restrictions, regulations). (ii) increasing the level of information and awareness by informing people on ecosystem interactions. Relying on people to do the right thing has not worked in the past, and there are no reasons to expect this to change in the future; and (iii) economic instruments in the form of sanctions, resource use fees and direct payments to encourage specific human activities.

In recent years there has been a growing interest in the creation of markets for environmental services, to provide financial incentive for environmental protection, as well as to improve the welfare of resource dependent rural communities. Markets can be used to offer rewards to encourage communities to protect and supply ecosystem services. Market-based approaches change financial incentives in favour of the supply of ecosystem services. Heal (2000) believes that economic incentives are more appealing, have worked in the great majority of areas where they have been applied, and are therefore most likely to be applied on a large scale.

Environmental services affect the wellbeing of individuals and the performance of firms, yet this is rarely reflected in the financial incentives that parties face. Traditionally society did not recognize environmental services in making and implementing decisions because they were thought of as free goods, abundant and under no threat. Such perception of environmental services resulted in the markets for such services being neglected and taken for granted. As a result, no efficient price mechanisms arose for scarcity and deterioration of most environmental services except for the provisioning services such as timber. In the absence of a market mechanism, those who supply environmental services are not rewarded for all the benefits they provide to others, and those who reduce environmental services do not bear all of the costs they impose on others. This allows parties to act in their own private interest which results in fewer environmental services than is optimal for society as a whole (Murtough *et al.,* 2002). Markets is broadly defined as any context in which the sale and purchase of an item takes place. As a result, market failure related to environmental services occurs because they are public goods (e.g.

Natural heritage) and non-excludable, are affected by externalities (e.g. pollution) and have undefined property rights (e.g. open access resource).

Market Based mechanisms could be used to promote the production, sale and purchase of Environmental Goods and Services, or minimize environmentally damaging effects, with minimum government intervention. Markets create incentives for investing in the long-term flow of ecosystem services because the services are positive externalities (Markandya *et al.,* 2002). Market creation as it relates to environmental services is any “government intervention to form markets for environmental services that are non-excludable in consumption” (Murtough *et al.,* 2002). Such intervention involves the definition of a new *property right* that is both linked to an environmental service and can be exchanged for reward. A property right is an entitlement to use a particular good or service in a certain way. The core of this approach is to transfer a non-excludable environmental service into something that is excludable and therefore, can be traded in a market (Murthough *et al.,* 2002). This transformation is done by first defining a new commodity that is excludable and therefore a proxy for a non-excludable environmental service. Next, a market is generated for this proxy commodity, which means that effectively a market is created for the corresponding environmental service. The proxy commodity is defined by constructing a new property right such as Carbon Certificates (Murthough *et al.,* 2002).

The tools that make use of market-based approaches are varied and range from simple coercion (taxes) to ongoing remuneration for environmental goods and services by their sale on a market such as the one for offset credits. Different types of markets for ES have been described ranging from voluntary contractual arrangements to marketable permit systems (Kosoy *et al.,* 2007). The idea of taxes and subsidies is to change the incentives of market players, so that they reflect the costs and benefits to society of certain actions. A present example is taxes on carbon dioxide emissions in Switzerland. These taxes can be imposed so that emitters bear the cost of any climate change they cause. On the other hand, subsidies for green house gases (GHG) could reward market players for their contribution to stop climate change. The advantage of this approach is, that at a certain point in time, parties will be willing to provide an environmental service. This happens because at that point, it is more cost effective to provide the good or service than paying the taxes that would otherwise be incurred (Murtough *et al.,* 2002).

Market creation schemes can be divided into four categories based on whether the relevant property right is *tradeable* and if it involves an *offset arrangement* (Murtough *et al.,*2002,). A tradable property right can be bought by one party and sold to another one. On the other hand, a non-tradable property right cannot be exchanged more than once. An offset arrangement means, that one party can undertake an action that reduces environmental services if it also undertakes action that increases environmental services by at least the same amount. Under a non-offset arrangement these conditions don't exist (Murthough *et al.,* 2002). Some examples are:

- **Non-tradable and no offsets**: This situation is found in an auction, where farmers compete to receive biodiversity conservation grants for maintaining native vegetation on their land. The farmer who offers the most ecosystem services per dollar receives the grant.
- **Non-tradable and offsets**: This situation is found, when a firm increases emissions from one factory, but reduces them by at least the same amount at another factory.
- **Tradable and no offsets**: This situation is found when tradable permits to emit carbon dioxide are launched.
- **Tradable and offsets**: This situation is found, when one firm increases its carbon emissions and pays another party (via a broker) to sequester at least as much carbon in a forest plantation.

The need to achieve more integrated long-term incentive systems for NRM has led to the emergence of a number of market-based mechanisms. Such long-term incentives are crucial to overcome initial transaction costs of land-users and to stimulate the adaption of e.g. sustainable land management tools (Vallee, 2010). Voices from the environmental economics side focused on the internalization of environmental values in production and consumption decisions through applying market-based incentives (MBIs) (PREM, 2010; Stiglitz & Walsh, 2002). The notion underlying market-based incentives for sustainable resource management is to link land-users to the market and to provide positive incentives and enhance economic viability of management regimes.

Market-based approaches are based on the assumption that in general prices provide signals of scarcity of natural resources that will consequentially lead to economic efficiency and efficient usage rate (Stiglitz & Walsh, 2002). Overall, two different categories of market incentives can be identified: (i) Improved market access for SLM products and (ii) compensation payments to the service provider/land-user through either (a) direct payments or more (b) indirect through a governmental mechanism (Buerli, 2006). Examples of direct environmental MBIs are: pollution taxes and tradable air and water permits, deposit-refund schemes, payments for set-aside land for conservation as well as charges for road use (congestion) (PREM, 2010). Options for incentives vary according to the socio-economic setting and the present agro-ecological zones. In the agricultural sector tradable water user rights can be allocated, and commercial global/voluntary carbon sequestration and trading schemes are developing. Furthermore, labelling, fair trade schemes and certification also belong to the voluntary marked based mechanisms.

3.7 Payment for Environmental Services

As increased attention is paid to mechanism for integrated natural resource management, Payment for Environmental Services (PES) has increasingly become a more prevalent tool, being presented as contributing towards sustainable development - a positive incentive to combine nature conservation and livelihood development (UNEP & IISD, 2004; Gross-Camp *et al.,* 2010). The PES approach takes the lead in striving to attain both goals of economic gain and environmental nourishment. The aim of PES is to complement and replace weak environmental conservation measures in protecting the world’s dwindling biodiversity. At the same time it considers the welfare of the community’s conservators and services providers, who are in most cases rural poor farmers, with these natural resources as their main source for livelihood. It provides more benefits to biodiversity than community-based interventions such as Integrated Conservation and Development Projects (Ferraro and Kiss, 2002).

Gross-Camp *et al.*(2010) consider Payment for Environmental Service (PES) a tool to supplement regulatory government approaches to Sustainable Land Management and Natural Resource Management. Recognizing PES as an appropriate tool to address environmental problems, Pagiola *et al.* (2010) provided three reasons that make PES particularly attractive namely: i) it can be implemented as a development program that has the ability of generating its own finance; ii) it can be economically efficient, since efforts can be focused where benefits of conservation are highest and costs are lower; and iii) it can be more sustainable in the long-term, since it relies more on self-interested users than on external supporters such as governments, NGOs or donors. It follows from this that in a situation of high environmental concerns and limited financial resources, PES can generate additional alternative resources, allocate funds to environmentally friendly management practices and sustainable production patterns, create incentives for investments, and increase the involvement of the private sector in environmental protection (WWF, 2012).

Innovative financing mechanisms, such as PES, continue to be recognized as essentials for addressing some of the identified failures in environmental management. According to Wunder (2005), PES is part of a new and more direct conservation concept, which clearly identifies the need to bridge the interests of landowners and communities in rational use of natural resources. Originating from the forest conservation area PES has found their way into a growing field of application for NRM. High interest of international donors, organizations and NGOs to promote PES capacity building and pilot projects prevails (Wunder, 2010). Successful application of the PES approach in different parts of the world in solving environmental problems and at the same time used to alleviate conflicts among stakeholders between land resource uses and conservation of ecosystems, have made it favoured among environmental practitioners, donors and local communities (Pagiola, 2003). As a result, PES-like policies have been put into practice in a number of countries since 1980s – in developed countries usually under designation of agri-environmental measures (OECD, 2005). Currently, we are witnessing application of many PES and other market-based approaches in managing natural ecosystem (Pagiola *et al.,* 2005). Most PES schemes in developing countries can be found in South America and Asia, with some of the earliest PES schemes found in Costa Rica. However a caution, some authors have noted that PES should not be taken as panacea for all conservation problems (Engel *et al.,* 2008). PES schemes should be seen as playing a complementary role to other instruments rather than a substitute.

Payment for environmental services (PES) evolved on the idea that sustainable resources management generates environmental services and that consumers may be willing to pay. The basic principle behind PES (Figure 3.1) is that resource users and communities that are in a position to provide environmental services should be compensated for the costs of their provision, and that those who benefit from these services should pay for them, thereby internalizing these benefits.

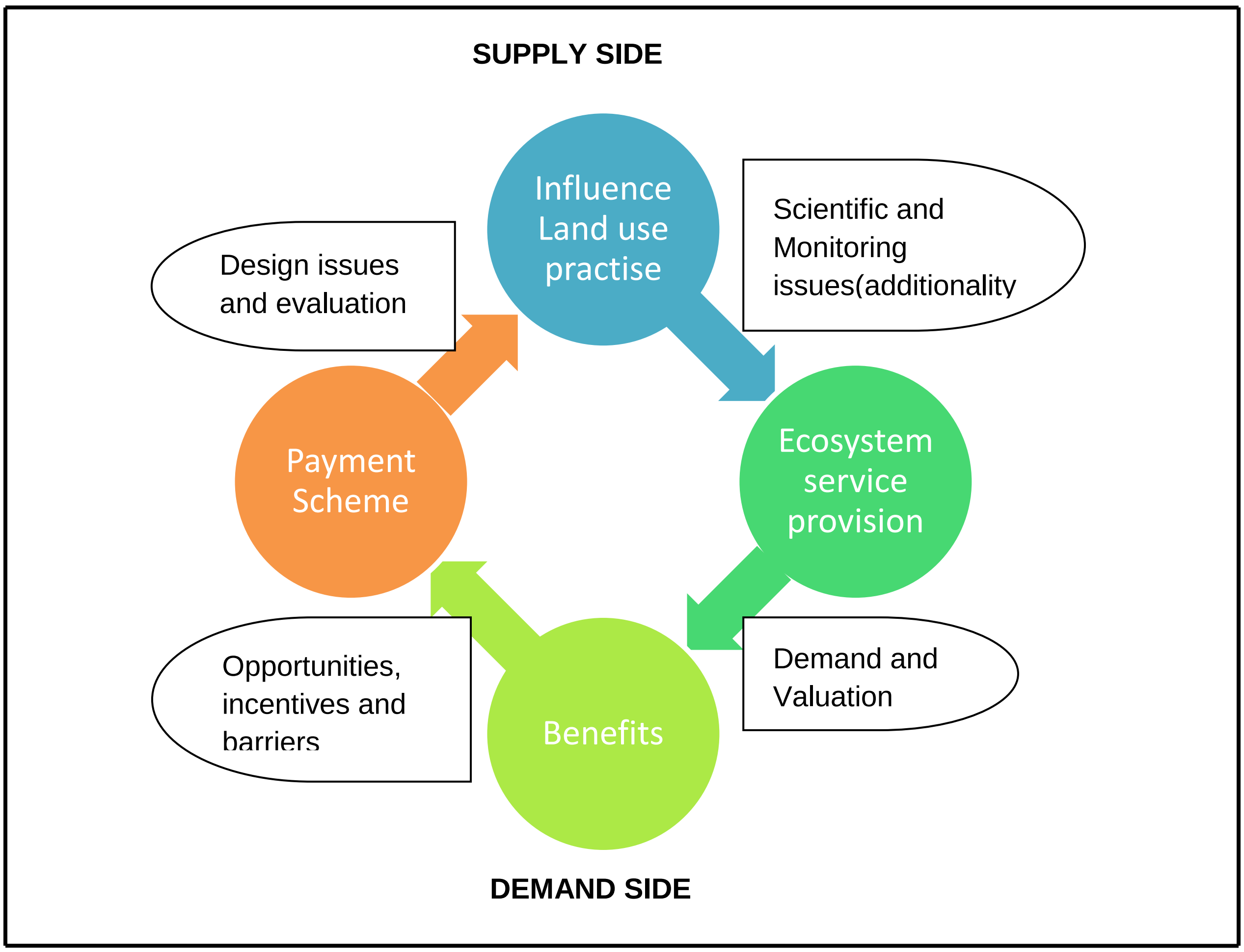


Figure 3.1: Illustration of PES

3.7.1 Definition of PES

PES approach is being hailed worldwide as an innovative conservation tool for providing an efficient and sustainable solution to environmental problems. Broadly speaking, Payment for Environmental Services (PES) are policy instruments that combine the transfer of monetary resources directly to farmers or other rural actors in exchange of a land-use or management practice that increases or secures the provision of an environmental service. This distinguishes PES from other conservation approaches based on its direct targetting of conservation as opposed to integrating it into broader developmental approaches and its reliance on economic incentives.

The most widely applied definition of PES given by Wunder (2005) refers to PES as ***"a voluntary transaction in which a well-defined environmental service (ES), or a land-use likely to secure that service, is being bought by at least one well defined ES buyer from a defined ES provider if, and only if, the ES provider secures ES provision"***. While there is no consensus on this definition of PES schemes, it introduces basic principles that differentiate PES schemes from other market-based policy instruments. Wunder, (2005) stipulates that PES schemes should meet the following basic principles:

(i) A **voluntary transaction** between environmental service buyers and sellers: Voluntarism emphasizes the existence of options for the provider, implying that contracting parties must have the possibility to terminate and/or re-negotiate the contractual agreements at any time. This element of PES differentiates it from regulatory policies in which compliance is mandatory.

(ii) A **well-defined environmental service**: Signifies that both parties have sufficient knowledge on the service being traded, either the environmental service itself or the land use that secures the service.

(iii) Is being bought by at least one **well defined environmental service buyers** from a **defined environmental service providers**: The existence of buyers and providers, indicates that the parties involved in PES policies are more specifically defined than in other public policies.

(iv) If and only if the service provider **secures service provision**: The conditionality element strengthens the character of PES transactions by categorically stating that providers must deliver the service buyers are paying for.

While the definition of Wunder (2005) is acknowledged and widely applied, it is increasingly considered to be too narrow in some aspects and thereby excluding PES-like incentive and effective rewarding schemes that do not adhere strictly to these principles (Sommerville *et al.,* 2009; Swallow *et al.,* 2007; Pagiola, 2005). Since 2005, efforts have been undertaken to refine and improve the concepts (Karousakis, 2010; Swallow *et al.,* 2007; Wunder *et al.,* 2008; Sommerville *et al.,* 2009). This has resulted in the development of a number of alternative and extended concepts such as: Markets for Ecosystem Services (MES) (Pagiola & Platais, 2007), Compensation for Ecosystem Services (CES) (Noorwijk & Leimona, 2010), International Payments for Environmental Services (IPES) (UNEP *et al.,* 2006) or Compensation and Rewards for Ecosystem Services (CRES). Compensation and Rewards for Ecosystem Services (CRES) are defined as negotiated and contractual agreements between ES stewards, ES beneficiaries and/or intermediaries aimed at maintaining, enhancing, reallocation or offsetting of damage to ES (Swallow *et al.,* 2007).

Operationalization of these various components is characterised by vaguely defined terms, that are sometimes used interchanging, indicating that alot of common ground exists or can be established. These various definitions and terms reflect differing perspectives on the value of Environmental Services (ES), the role of the state and the prime objective of rewarding mechanism (i.e. efficiency or combining development and conservation/poverty reduction) (Berttram, 2008). The attempts to find a new term is also due to the fact that most case studies in literature on PES are mainly focused on forestry issues. Authors focusing on different fields of application have attempted to find a new term. Furthermore it can be seen as an attempt to lose the negative connotation connected to financial payment aspect of PES often brought in connection to a new term for subsidies of different sectors (Sakuyama, 2005). The use of terms as rewards or compensation is another attempt to enable the application of the concept in environments that are not open to market-based sentiments (Bond *et al.,* 2008).

However, PES remains the most widely recognized and used term and it is also applied in this research based on the definition of Wunder *et al.* (2008). Highlighting PES schemes as having mainly four undelying functions namely:

i. Provide an incentive for the adaptation of sustainable land-use practices or resource/ES conservation;
ii. Innovative approach to combine conservation and development objectives;
iii. Supportive source for funding of environmental conservation and SLM programmes;
iv. Diversification of livelihoods for the rural population and ES stewards (poverty reduction).

3.7.2 Application of the PES Concept

Central to the implementation of PES are two key aspects (i) The service being provided and (ii) the Transaction of buying and selling that service.

3.7.2.1 Service being exchanged

According to the FAO (2010) measures for improved natural resource management and additional Environmental Services (ES) considered in projects of PES are mainly: af- and reforestation, as well as other land-use and production change. PES can contain (i) use-restricting land-use technologies, reducing agricultural expansion, rehabilitation, reduced deforestation, reforestation of degraded lands and forest set-aside conservation; or (ii) use-modification based on improved cropping or land-use technology and practices as e.g. reduced logging, afforestation and reforestation including Clean Development Mechanisms (CDM), agroforestry, silvo-pasturing, improved/conservational agricultural practices as e.g. no-tillage, no-burn, organic agriculture (Wunder & Boerner, 2010). Use-modifying schemes contain the risk that they reduce the livelihoods of participants especially in the initial phases. Active land management is also more complex to monitor than use-restricting schemes (ibid). Noorwijk & Leimona, 2010 presented a similar idea saying that the Payments or incentives in PES schemes are based either on (i) commoditized ES (CES); (ii) rewarding avoided actions (compensation for opportunities skipped (COS), primarily connected to use-restricting PES); or be in form of (iii) co-investment of environmentally beneficial activities (co-investment in ecosystem services (CIS), primarily connected to use-modification schemes).

Although it is now well known that ecosystems generate services, such as nutrient cycling, provision of water etc. (Millennium Ecosystem Assessment, 2003), some of these services are inherently more marketable than others. Their marketability lies in their tangibility or measurability, and in the context of PES, the ability to prove that changes in management lead to changes in the output of economically valuable services. FAO, 2010 stipulate that the application of PES can be focussed mainly on ES such as: (i) biodiversity conservation; (ii) carbon sequestration; (iii) watershed management; (iv) bundled services, combining payments for a combination of water, carbon and biodiversity services.

3.7.2.1.1 Biodiversity Conservation Services

The Convention on Biological Diversity, Article 2, (CBD, 1992) defines biodiversity as " *the variable among living organisms from all sources including inter alia, terrestrial, marine and other acquatic ecosystems and the ecological complexes of which they are part; this included diversity within species, between species and of the ecosystem*." The process of commercializing the diversity of nature is complex making biodiversity one of the most complex ES to include in a PES scheme. Biodiversity provides a wide range of services including maintenance of ecosystem functioning; option value in stock of genetic and chemical resources; insurance value against external shocks; choice value and existence value (Landell-Mills and Porras, 2002). It is difficult to quantify/ qualify these benefits since they are multi-dimensional and it is therefore difficult to select proxies to assess the increase/conservation thereof (Forest Trends & Ecosystem Marketplace, 2008). Most biodiversity schemes are aimed at use-restriction of the land through incentives to communities (Wunder & Boerner, 2010), to decrease human activities and threat and are confined to protected area rich of biodiversity

Biodiversity services markets are to be found at local, national and global scale. These payments result from recognition of the important role played by biodiversity in the functioning of ecosystems as well as their continuing degradation. Specific land uses that are thought to protect species, ecosystems or genetic diversity are adopted and paid for, for instance some land use practices such as silvipasture which are more compatible with conservation than others. Some of the mechanisms under biodiversity market include paying to access habitat or species e.g. ecotourism and bio-prospecting, biodiversity conserving management e.g. community concession on public protected areas and conservation lease (Ferraro, 2007). The community benefits come inform of certification of products coming from areas adjacent to protected areas. The growth potential in these markets is in the field of eco-labelling for products from tropical countries. Biodiversity offsets by corporate are also rising at an estimated annual growth is 25% (Ecosystem Market Place, 2006)

Current approaches that are identified as PES include co-management of protected areas and buffer zones and targeted fees for tourism (Ruhweza *et al.,* 2008). Biodiversity projects are also usually considered under supplementing integrated conservation and development programmes (ICDPs) (Masiga, 2010). It is, however, difficult to assess if these approaches are truly conditional on a specified ES and thus PES. Other examples of PES-like schemes that focus on biodiversity protection include: (i) **Shade coffee:** Involves the Intercropping of native trees into coffee plantations. These shade trees increase biodiversity in agroecosystems in a form of agroforestry. In East Africa this has been tried by an ICRAF project CAFNET in southernUganda and some emerging initiatives in Rwanda. And (ii) **Organic production**: Certification for organic production is slowly gaining ground in Eastern Africa. In Uganda some 206,803 producers were certified in 2007, and in Tanzania 90,222 making these two countries together with Kenya the fastest growing and most important organically certified producing countries (UNEP-UNCTAD, 2010). National policies on organic farming are being developed. (iii) **Revenue sharing programmes** connected for example to national parks or protected areas. Here it is important to differentiate between existing revenue sharing programmes and PES. In PES projects payments have to be conditional to a specific service delivered and attached to this service only. Revenue sharing programmes are therefore no PES “unless there is an exact conditional (and monitored) arrangement about things local people agree to do and/or refrain from doing, which they are being rewarded for or not” (Wunder, 2010). And

(iv) **Sustainable/eco-tourism**: Tourism is an important sector in East Africa with an increasing contribution to the national gross domestic products (EAC, 2011). (Eco-) tourism with special attention to biodiversity conservation, community projects etc. can be enhanced in the form of PES if fees are earmarked to specific ecosystem services (Ruhweza *et al.,* 2008).

3.7.2.1.2 Carbon Sequestration

Global warming resulting from a build up of greenhouse gases(GHGs) forms the basis for Carbon markets. The signing of the Kyoto Protocol (1997), set the stage for the emmergence of a market for Carbon offsets some based on forest sequestration and storage. The Protocol defines four potential carbon commodities, namely: (i) Assigned amount units achieved through emission reduction in Annex B countries that may be sold to other annex B countries; (ii) Emmission reduction units achieved through emission reduction activities by one annex B country in another annex B country; (iii) Certified emmission Reduction achieved through emmission reduction activites by Annex B countries in non-Annex B countries; and (iv) Removal Units generated through investment in carbon sinks in Annex B countries for use in the existing compliance period (Landell-Mills and Porras, 2002).

Carbon sequestration services of the ecosystems are also marketable. Ecosystems sequester carbon dioxide from the atmosphere, which helps in climate change mitigation. Carbon markets are global in scale, well developed and most transactions involve international buyers. Demand for these services may arise from government, individuals and Industries who can pay landowners and communities to adopt land use practices that promote carbon sequestration. The market can further originate from Industries under offset regulations, companies, agencies, and municipalities seeking to improve air quality. These markets for carbon are either regulated or voluntary.

Most PES schemes in operation are focusing on carbon sequestration through agroforestry, reforestation projects or alternative renewable energy projects. Carbon projects are financed through the subsequent sale of generated carbon credits currently exclusively on the voluntary market. The credits are primarily sold to companies valuing Corporate Social Responsibility and aiming to off-set their carbon emissions. Carbon PES are largely based on global payments and therefore offers additional sources of funding outside the restricted sources in the region. One key challenge with carbon market will be the uncertainty if its capacity is large enough to have a growing number of farmers participating and still find sufficient potential buyers. Currently it seems easier to access the voluntary market for carbon trade as source of finances than finding potential and willing buyers for water services or biodiversity services.

Clean Development Mechanisms (CDM) and Joint Implementation Procedures fulfil PES criteria as they are conditional and based on measurable additional emission reductions (Sommerville *et al.,* 2009). Reducing Emissions from Deforestation and Forest Degradation (REDD) projects are also likely to act as PES scheme approach within the international climate regime. The contribution of East Africa to the global carbon offset market is increasing slowly, Uganda being most advanced in making large-scale contributions (Masiga, 2010). Uganda was also one of the first Sub-Saharan countries together with South Africa to engage large scale in the global carbon market. Projects at the moment are focusing primarily on voluntary markets rather than regulated or compliance markets. Some examples in East Africa include the Kibale National Park project in Uganda and the Ecosystems Restoration Associates (ERA) reforestation project in the Gishwati area in Rwanda (Ruhweza *et al.,* 2008; Zukowska, 2010).

3.7.2.1.3 Watershed Management

Watershed management provides environmental services that have pioneered the use of payment schemes. Though the services produced vary from site to site, they include amongst others, protecting water quality, regulating water flows, preventing floods, controlling soil salinisation and maintaining aquatic habitats (Landell-Mills and Porras, 2002). Water management PES schemes are typically named Payment for watershed environmental services (PWES) (Kiersch *et al.,* 2005). Markets for watershed protection involves financing land uses that generate watershed benefits and are mostly localized. These schemes involve payment to upstream landowners to carry out management activities that improve or stabilize land use in the catchment to ensure beneficial outcomes to downstream water users. These include paying land owners not to harvest trees on their land, convert forest land to other uses, construct roads/ buildings, or carry out activities that could adversely affect water flow (quantity) or concentration of sediment and chemical elements in the water flow (quality).

The improved water quantity and quality will be used by downstream users for irrigation, drinking water, or hydro-electric utilities. The beneficial uses derived from these management activities are thus defined as environmental services to downstream users. Both conservation and development organizations have growing interest in the development of PWES, from which the primary motives have been to create a steady flow of funding needed to achieve conservation objectives; to contribute to poverty alleviation by creating economic incentives for conservation; and to reduce disparities in the costs and benefits of management actions needed to produce ecosystem services (Tognetti *et al.,*2003). Payments for watershed services stem from five general sources: industrial water users, municipal water suppliers, hydroelectric power suppliers, and tax revenues (Ferraro, 2009). This is because they are the ones concerned about its quality and quantity as it becomes scarce.

Because of the local nature of demand and the presence of a limited number of well-organized beneficiaries (e.g., water or hydroelectric utilities, irrigation commissions), it is relatively easy to mobilize downstream beneficiaries and involve them in PES schemes (Mayrand, 2002). The payments mechanisms can be in form of cash, technical assistance and sharing benefits accruing from the protection of the watershed. There is potential for growth in watershed markets to encourage watershed conservation especially in developing countries because of increasing need of clean water caused by growing population, many people living downstream making them susceptible to watershed degradation and finally investment in sustainable watershed conservation are cheaper than in water supply and treatment facilities.

The most prominent example of a water service PES is the public scheme in Costa Rica that is often taken as learning example all over the world and referred to in many articles on PES. Another example is the Working for Water Programme in South Africa, a national programme for watershed management financed largely through the national Poverty Relief Programme. Only one established watershed management schemes have been identified in the East African region, the Uluguru Mountains project in Tanzania (Mayrand, 2002), several others are under development including some in Kenya and Rwanda.

3.7.2.1.4 Bundled Services

Finally ecosystem services can be bundled and sold though environmental service bundling receives minimal attention in literature, however, practical experience is expanding as market players seek to capitalise on complementarities between services. The idea here is to target not one but multiple ES on different geographical scales. Ecosystems provide many kinds of ecosystem services simultaneously. For example ecosystem such as forest can sequester carbon, provides water services, scenic beauty and conservation of biodiversity. Consequently these services can be sold in bundles because it may not be possible to separate them. Local conservation practices normally produce many different ecosystem services. In this case merged bundles of ecosystem services are easier to manage and reduce transaction costs associated with PES schemes.

Bundling and layering of ES into one scheme can be beneficial to (i) include more potential ES buyers; (ii) simultaneously target multiple ES that coincide spatially; (iii) reduce transaction costs; (iv) enable to include ES into a scheme that are more disadvantaged to attract buyers (Karousakis, 2010). Two approaches to achieve this have emerged one is a merged bundle that cannot be sub-divided and sold individually and the other is the shopping basket approach which permits sellers to subdivide packages of services for sale to different purchasers. Bundling can be especially applied on developing payments for Reducing Emissions from Deforestation and Forest Degradation (REDD), which has the potential to both mitigate climate change and maintain biodiversity. Bundling biodiversity with other ES is an approach that is considered in the Rwoho Central Forest Reserve in Uganda.

However, they are less effective since merging services makes it impossible to target payments to individual services and buyers. For example some ecosystem services like watershed may have localized buyers while others like carbon and scenic beauty may have global buyers. The problem with bundled services is lack of complimentarity in some ecosystem services whereby for instance increasing the production of one may lower the supply of another e.g planting monoculture tree plantations that may increase carbon yield while lowering watershed services.

3.7.3 PES Transaction Mechanisms

As mentioned above, the second key aspect of the PES is the transaction involved in the exchange of the service. The payments or incentive included in PES are aimed at moving away from the perception of conservation as sacrifice and cost-intensive, and to internalizing benefits of environmental objectives (Farley and Costanza, 2010).It is a mechanism to re-distribute costs and benefits of environmental services. The incentives or benefits of PES are directly connected to the income of ES stewards. They are thus a policy option for compensating ES stewards for produced positive externalities that are usually not taken into consideration. Thereby incentives are provided to ES stewards that are consistent with the benefits they provide to ES consumers.

Depending on the structure of the service provider (Groups, community, individuals, NGOs etc), land-use, land ownerships and rights, kind of environmental services to be bought by ES buyers and the like, incentives can be (i) direct monetary payments to resource/land managers as stewards of a particular or bundled ES or (ii) in kind as for example land-use rights, access to markets, access to training and information, and access to protected areas (Swallow *et al.,* 2007). They can be further differenciated depending on the structure of the service provider since payments can be made to individual farmers, groups of farmers or even to governments (Sommerville *et al.,* 2009). They can be uniform, with every participant of a PES scheme receiving an equal amount, usually based on the average opportunity costs and agreed in initial meetings, or be based on individuals' opportunity costs and adopted land-use technologies, and specific biophysical factors (size, location, etc.) of the land. Table 3.1 shows the principal forms of payment made in PES schemes.

Table 3.1: Principal forms of PES payment mechanisms

Community based payments	Individual participants payments
Uniform payments	Individual payment level
Cash rewards	Voucher & in-kind rewards
Performance based payments (ES delivery based)	Effort based (actions adopted by participants)
Use-restricting	Use-modifying
Public payment scheme	Private scheme

The diversity of PES mechanisms can be further broadly classified into four main types (PRESA, 2010; Wunder *et al.,* 2008; Swallow *et al.,* 2007; Richard and Jenkins, 2007).:

i. Public payment schemes to private land owners for maintaining or restoring ES (Government financed schemes on behalf of ES users as e.g. Costa Rica; large size, national, multiple services and side-objectives; co-management);
ii. Open trade agreements in formal markets between providers and receivers under either a regulatory cap, voluntary or floor based on ES to be provided (tradable permit/credit system);
iii. Private agreements, self-organized and self-negotiated direct contracting of individual beneficiaries of ES with providers (small scale; often individual private-sector as buyers; usually targeting one or two services; more targeted); and
iv. Eco-labelling of products assuring that the products and production processes involved have a positive or neutral effect on ES and thus fetching a premium price.

The inclusion of labeling as PES is debated. Sommerville *et al.* (2009) e.g. emphasise that there is no guaranteed positive relationship between certification and positive incentives for SLM as price premium of it is not guaranteed but depending on an existing market. Schemes providing a guaranteed price premium for the provision of ES would be PES as e.g. include certified product where the price for the PES is included into the product.

3.8 PES in Kenya

While PES are being promoted across the developing world to support environmental stewardship in agricultural and forest-based landscapes (World Bank, 2004; World Resources Institute, 2005), the development of PES mechanisms in Africa still lags behind the rest of the world. A number of factors attributed to this scenario include lack of technical and market information, limited institutional experience, inadequate legal framework, limited successful business models, suspicion of markets for public goods and equity concerns (Ferraro, 2007). In the East African region the mechanism and its potential is only slowly gaining ground in the awareness of regional and national actors. Yet more recently, especially due to a very active role of international networks and organisations, a growing number of PES pilot projects, networks and cooperation are being formed in the region.An inventory study in 2005 by Katoomba group highlighting PES status in the Eastern Africa, documented 13 projects in Kenya. Few of these projects meet the PES criteria and were being carried out on pilot basis with support coming mainly from donors. The PES schemes in Kenya deal with carbon, biodiversity and water project (Mwangi, 2008). The majority of the biodiversity projects fall within the area of ecotourism. Though most of the PES projects are at early stages it suggests that significant potential and interest exists for PES schemes in Kenya

However, a large share of PES projects developed in Kenya like in most of East Africa, do not succeed in proceeding beyond the conceptual phase (Masiga, 2010). This has a negative impact on the potential up-scaling of existing projects (E& SA KG, 2008). Kariara (2009) cited some of the key barriers impeding establishment of PES schemes in Kenya to include poverty, insecure tenure and property rights over ecosystem services, inadequate information, lack of technical and institutional capacity, and inappropriate policy and regulatory regimes for PES. Generally the potential providers of ecosystem services are unaware or have little information on PES opportunities. Some of the suggested PES opportunities in Kenya could include upland poor providers of watershed protection services via sustainable agriculture, reforestation and small farmer agroforestry in the voluntary carbon market, sustainable charcoal production as an avoided deforestation strategy, certified organic products which should earn market premiums;

'conservation concessions' in situations where communities are sufficiently empowered and experienced; participatory eco-tourism approaches (Kariara, 2009). The PES in this area could either go towards supporting the existing management of natural resources especially by the community and to encourage conservation actions through economic incentives.

PES has the potential to offer the Kenyan rural people rewards for restoring and maintaining ecosystem services and many benefits can accrue to the rural people participating in PES schemes.

3.9 Advantages/ Benefits of PES

PES presents many advantages and opportunities which make them a promising conservation tool when compared to other traditional and conventional conservation approach such as integrated conservation and development projects (ICDPs), command and control regulations and environmental taxes. There are multiple recognized benefits that PES projects have been found to achieve for ecosystem stewardship and communities. First, PES is a direct approach to conservation and target project outcomes leading directly to improved resilience of local ecosystems (Wendy, 2008). Further, key on-site environmental benefits of PES programs (e.g., reduced dependency on chemicals, water savings, increased soil fertility, and shade) are often initially overlooked by landowners, but these benefits can be quickly realized once a program is implemented on their land (Pagiola *et al.,* 2004).

Other good aspects of PES schemes include improved ecological conservation and numerous studies have demonstrated that PES can protect and restore ecosystem services more cost-effectively than alternative human-built, technological approaches (e.g., Ferraro, 2001; Ferraro & Kiss, 2002; Ferraro & Simpson, 2002; Pattanayak, Wunder, & Ferraro, 2010). Related to this is the potential for PES to result in equal or greater net economic benefits than alternative approaches due to the opportunity for the PES program to protect ecosystem services (what is often termed *co-benefits*) on top of the targeted service (e.g., a payment for watershed services program may also enhance carbon sequestration and habitat for biodiversity) that result from changes in land use and land management practices (Goldman *et al.,* 2007; Kroeger & Casey, 2007; Naidoo, Malcolm, & Tomasek, 2009). PES has also been seen as an alternative source of financing for conservation programs in developing countries from new financing not previously available for conservation for instance REDD.

PES schemes have been widely implemented to support improved livelihoods for poor people (Landell-Mills and Porras, 2001). Some of the Livelihood benefits expected from these schemes include increased income/ profits from sale of ES; diversified production base so lower risks of shock and employment gains from new jobs associated with emerging markets. Other economic benefits have been associated with efficiency gains from removal of market failures; improved infrastructure accompanying market development; technology transfer and achievement of environmental targets at least cost when compared to use of other methods.

PES can positively impact landowners' perceptions of environmental protection and increase participants' awareness of the linkages between ecosystem services and human well-being. Many ecosystem services are considered externalities from the perspective of landowners, which gives landowners little incentive to produce these services (Goldman, Thompson& Daily, 2007; Pagiola *et al.,* 2007). Accordingly, placing a monetary value on these services can demonstrate to PES participants the value of conserving such services (Pagiola *et al.,* 2007; Engel *et al.,* 2008), this increased knowledge will translate into increased adoption of sustainable resource use practices (Wendy, 2008). Another positive social outcome is attained through increased cooperation among participants in a PES schemes. PES programs can also be beneficial in facilitating increased communication amongst diverse stakeholders. PES can be useful for alleviating upstream and downstream stakeholder tensions, indicating its potential as a conflict resolution tool (Kosoy, Martinez-Tuna, Muradian, & Martinez-Alier, 2007). Some PES program results have shown increased community self-policing, regulating, law enforcement, and landowner awareness, which highlight the important role of PES in community self-empowerment (Kosoy *et al.,* 2007; Pagiola *et al.,* 2007). PES also provides an opportunity for information and knowledge creation through rural-urban collaboration and the connection of ES providers and consumers; and training and capacity building through PES intermediaries and extension services;

Strengthening of institutional capacities and the internal organization finally leading to an institutionalization of ecosystem investments combining ecology and economics; as well as possible public grants and tax reductions and increased awareness on the governmental level on the value of ES and PES mechanisms (Lopa, 2010; Sánchez-Azofeifa *et al.,* 2007; Pagiola, 2005; Sommerville *et al.,* 2009; Swallow *et al.,* 2007; FAO, 2010c; Ferraro, 2009).This makes it a valuable mechanism in a setting of land-use policies and projects. Next to the direct incentives non-income co-effects on the socio-economic context are important benefits of PES. These include: Increased land/resource tenure security; improved health from investment in medical facilities and an improved living environment; social institution strengthening like local cooperative arrangements to support evolving markets; skills development in related fields like sustainable forestry, ecotourism, organic agriculture; improved land management ect; and improved recreational and cultural opportunities with a more pleasant environment for recreation and protection of cultural and religious sites (Landell-Mills and Porras, 2001).

Empowering local landowners with education and a monetary incentive to redefine their stewardship practices can be a sustainable investment in community self-sufficiency. However, these benefit come with associated costs as outline in table 3.2.

Table 3.2: Benefits and costs of payment for environmental services schemes

BENEFITS	COSTS
ECONOMIC	
Income/profits from sale of environmental service	Costs of supply - forest protection, certification
Diversified production base – lower risks of shocks	Transaction costs – searching for buyers, negotiations, contracting, establishing new intermediaries, monitoring and enforcement
Employment gains – new jobs associated with emerging markets	Opportunity costs – e.g. markets replace existing payments, lost agricultural output when forests planted in agricultural land, lost values when protected, e.g. timber and NTFPs
Efficiency gains associated with removal of market failure	

Improved infrastructure associated with market development, e.g. research facilities, transport, communications	
Technological transfer	
Achievement of environmental target at least cost - cost savings vis a vis command and control approaches	
SOCIAL	
Increased land/resource tenure security -where deals result in the formalisation of land tenure to minimise risks to buyers	Loss of rights to forest resources, especially for poor people – where projects involve forest protection or lead to privatisation of rights to common lands
Improved health - investments in medical facilities, environmental improvements (e.g.reduced water and air pollution), more diverse diets, etc.	• Reduced health – where loss of access to forest based foods that provide variety in local diets. Also where projects involve fast growing plantations and reductions in water supplies
Social institution strengthening - e.g. local cooperative arrangements to support evolving markets may provide a basis for cooperation in other areas	Risks of domination by the wealthy since they have highest weight in a system based on ability to pay.
Knowledge and research – environmental research and education through support to local schools, universities and research bodies;	Land acquisition schemes may push up local land prices and undermine local communities
Skill development – in related fields, e.g. sustainable forestry, forest-based Industries, ecotourism, carbon monitoring, certification, global warming, project management	Negative cultural impacts associated with monetizing environmental services
Improved recreational and cultural opportunities –more pleasant environment for recreational activities and protection of cultural heritage and religious sites	
ENVIRONMENTAL	
Improved supply of marketed services: biodiversity conservation, carbon sequestration, watershed protection services and landscape beauty	Negative spin-offs for non-marketed services: e.g. reduced biodiversity or water supplies where monoculture plantations for carbon sequestration
Positive spin-offs for the non-marketed services	

3.10 Critic/ Challenges of PES

While there are many benefits to PES schemes, the development and spread of PES is burdened by several technical and conceptual challenges. These challenges will need to be addressed for PES to continue to advance as an effective conservation strategy and policy tool. The position PES holds on the international platform as a new paradigm; a strong innovative market-based mechanism that is able to approach all the issues in natural resource management and livelihood diversification of rural poor, presents is first challenge. This bears the danger of being seen as a panacea, a role that PES alone are most likely not able to fulfil (Vallee, 2010; Wunder, 2010; Kosoy & Corbera, 2010). It is also likely to result in a bandwagon effect since it is a concept that is appealing and therefore used broadly as it is attractive for funding at the moment. (Wunder, 2010). PES has also be connected to the debate on the valuing and commodification of nature as well as common pool resource management issues. Furthermore, a question on the compatibility of PES with the often use-restricting nature of the schemes with cultural and social aspects arises (Fisher *et al.,* 2010; Bracer *et al.,* 2008). Discussions prevail on how to classify ecosystem services as well as whether PES can be beneficial for the poor rural population and how to fulfil attached conditionality (Costanza *et al.,* 1997; Jourdain *et al.,* 2009; Kosoy & Corbera, 2010).

In literature as in practice no single definition or one consistent use of the term payments for environmental services prevails. Scientists continue to debate the definition of PES from Wunder (2005) deciding whether it is too narrow and thereby excludes valuable approaches for natural resource management (Sommerville *et al.,* 2009; Swallow *et al.,* 2007). Others voice the concern of over-loading the concept beyond its capacity and intention (Garcia, 2010; Wunder, 2010). A 2009 report by Ecosystem Marketplace claims that a majority of schemes labelled as “PES” are similar to PES but do not actually fulfil the entire PES definition. They point out two major areas of where PES-type schemes fail to follow-through: (1) failure to cultivate buyers, and (2) avoiding the PES provision of conditionality (Wunder, 2009). Many PES projects have failed to look elsewhere besides external donor assistance for funding options; they do not explore the potential for long-term funding among the actual ecosystem service beneficiaries. Second, many PES implementing teams are concerned about altering their carefully constructed relationship with the ecosystem providers, who are often poor landowners, by enforcing a formal business practice of conditionality which is to pay providers only when they deliver the service(s) they previously agreed to deliver (Wunder, 2009). Further, another central challenge based on the definition of PES is that it should be based on voluntary agreements. It is however, debatable if the management of critical natural resources and ecosystem services is a matter that should be depending on voluntary mechanisms (Anderies *et al.,* 2004).

Development scholars and professionals have long debated on the use of PES as a development tool. Proponents argue that, development is too focused on objectives like poverty reduction and therefore undermines efficient environmental outcomes (Engel *et al.,* 2008, Pagiola 2008, Wunder 2008). Following this logic, they blame the development agencies, especially the donor organizations as they are only interested in PES for their hoped-for- pro-poor effects, rather than their environmental impacts (Wunder, 2008). On the other side, the critics are cautious about the ability of PES to promote equitable outcomes (Corbera *et al.,* 2007, Proctor *et al.,* 2008). They have pointed out a trade-off between efficiency vis-à-vis equity outcomes and often found evidence of compromise of the later for the sake of the former.

One other central challenge posed by aspects of the definition of PES is additionality. Lack of additionality refers to situations such as when payments are provided to landowners who were already going to conserve their land or supply targeted ecosystem services for another reason either for financial, legal, or environmental reasons (Engel *et al.,* 2008; Ferraro & Pattanayak, 2006; Pattanayak *et al.,* 2010). To add to this an irreducible uncertainty prevails on the dynamics of the interaction between human activities, environmental services (ES) and land-use technologies as well as on the complexity of ecosystems and drivers of change (Anderies *et al.,* 2004; Constanza *et al.,* 1997). The impact of PES schemes is difficult to establish as they are not operating in a vacuum but coexist with other natural resource management mechanism including regulatory or community based conservation projects. This makes it difficult to measure, ensure the additionality of PES schemes and to guarantee a specific level of ES delivery

(Dosteus, 2010). In turn this forms a hurdle for building strong business cases that are able to convince the private sector or governments to invest in PES. This makes it more likely private PES schemes will depend on the good-will of the private actors.

Theoretical analysis and analysis of existing programs point towards potential programmatic inefficiencies, such as leakage, and incorrect payments (Engel *et al.,* 2008; Pattanayak *et al.,* 2010). Leakage or spillage occurs when activities that damage ecosystems (e.g., land clearing) occur outside the PES programmatic region due to market pressures and/or increased land demand (Engel *et al.,* 2008; Robertson & Wunder, 2005; Pattanayak *et al.,* 2010). As such, leakage can offset the positive environmental outcomes that may have been achieved within the project region. Leakages may occur when ES are preserved in one location, yet simultaneously the pressure on ES in another location is increased or other major challenges are expected to arise from the scheme that impact its success (Karousakis, 2010). The valuation of ecosystem services as well as the calculation of rewards for ES is difficult to estimated and certainly to be mainstreamed for PES designing frameworks (Wunder & Buerli, 2010). This leads to incorrect payments that can occur one of two ways. First, landowners could be paid an insufficient amount for their land, thus keeping poor land use practices or degraded lands in production. Second, payment amounts could be too high, resulting in an inflated payment price for the services being produced (Engel *et al.,* 2008). It can also be due to incentives being too small to actually cover the opportunity costs of individual ES stewards that may vary greatly (Gross-Camp *et al.,* 2010).

For landowners, altering production practices to meet scheme requirements to supply environmental services into a PES scheme, can result in an income loss to the producer (Pagiola *et al.,* 2007; Swinton *et al.,* 2007). This loss is often due to high upfront costs for activities such as planting trees (or other vegetation changes), or the need to diversify crops and the necessity of capital investment into new technologies which imply the need of credit facilities (Branca *et al.,* 2009). While high upfront costs can be addressed within the program design with inbuilt larger upfront payments to landowners to cover these upfront costs, it still remains a notable challenge for PES projects to address. This is a particular concern for poor populations who would face disproportionate financial challenges in covering upfront costs to participate in and benefit from a PES contract. An additional concern regarding PES schemes raised by Engel *et al.* (2008) is a lack of permanence, meaning that scheme benefits will be realized for a sustained period of time, which is defined differently in different programs, but common time periods are, for example, 10 -20 years, 50-100 years, or in perpetuity. Permanence might be affected by external factors such as market or agricultural demands that compel landowners to reverse adopted land uses or land management practices resulting in negative impacts on ecosystem services. Lack of secure, long-term funding sources for a PES program can also jeopardize permanence (Engel *et al.,* 2008; Swart, 2003).

In order to ensure stability and long-term consistency of PES schemes, resource access and ownership of ES have to be clearly regulated. This is yet a point of conflict in many developing countries where land tenure and ownership often are customary and in a fast changing context (Groppo, 2010). As PES may also increase the attractiveness of land, it may even fuel competition over land and lead to a crowding out of pro-social attitudes and common pool resources management structures (Fisher *et al.,* 2010). However, despite the challenges and limitations of the concept PES can be beneficial tools for providing incentives for sustainable resource management when the contextual conditions are supportive and appropriate (Gross-Camp, 2010).

3.11 Chapter Summary

Environmental governance approaches have continued to evolve over the year moving in tandem with the theoretical development and discussion. The Hardins era came with protectionist and nationalization approaches. There were changes with the findings of Ostrum and others that communities could contribute to environmental management. This led to the proliferation of decentralized approaches to management that were more participatory like the community based natural resource management approaches. The sustainable development thinking highlighted the economic angle of the problem of environmental management and made interdependence central to the policy formulation process. This led to governance approaches that incorporate economic consideration into environmental management. Work therefore increased to making environmental goods and services marketable, through valuation and using this information to inform policy making. It is from this that the concept of payment for environmental services grew.

That there is no single recipe to the development of PES schemes is demonstrated by the benefits and challenges to PES outlined in the previous section. PES is therefore an entire toolbox with a variety of tools/ instruments for different situations. It is apparent then, that thorough research is required when developing PES schemes to support the selection of the most suitable conservation tool. This should be done keeping in mind the contextual factors that may influence design and implementation of the PES scheme. Carroll & Jenkins, (2009) stated that to achieve the sustainable management of environmental services, PES schemes must be designed and implemented carefully, intelligently, and adaptively. Motivated by this, this research was designed to investigate the various aspects of PES and assess their suitability for the management of the Natural Resources in the Mt. Elgon ecosystem. To set the stage, the next section discusses the context in which PES can operate focussing on the stakeholders involves, institutional, legal and regulatory frameworks.

CHAPTER 4
AN ENABLING ENVIRONMENT FOR PES

4.1 Introduction

Payments for Environmental Services (PES) schemes require clear and enforceable rules and transaction mechanisms to foster trust and confidence among stakeholders (Robertson and Wunder, 2005). The key ingredients are effective institutions and reliable contract law, supported by good governance, effective transaction capacities and credible enforcement (Rojas and Alyward, 2003). Hence, designing the rules for a payment scheme calls for development of an institutional framework for the scheme. This includes the clarification of rights, agreement of obligations among parties, establishment of contractual arrangements and mechanisms for ensuring compliance and enforcement (Echavarria *et al.,* 2004). The institutional and legal environment and the feasibility of PES as an effective NRM tool remains little explored. It is therefore important to gain a better insight and understanding of the institutional and legal environment in which PES operates in the region. The study reviewed literature to provide a background for further analysis in this area and this chapter gives an overview of the institutional and legal environments that have worked elsewhere. The chapter examines the enabling factors for sustainable institutions, the required actors for an all inclusive PES scheme, and the roles they would play. The chapter then looks at what would constitute an enabling Legal environment, covering appropriate legal instrument and concludes with possible content and scope of a specific law for PES.

4.2 Background

The ecosystems and the services they provide are in decline because they are not recognized adequately in economic markets, government policies or land management practices. Local, state, and national governments rarely consider ecosystems as valuable providers of services. The Millennium Ecosystem Assessment (MEA) reported worldwide declines in nearly two-thirds of the services provided to humankind (MEA 2005b). Constanza *et al.* (1997) also stated that society must begin to give the natural capital stock that produces these services adequate weight in the decision-making process, otherwise current and continued future human welfare will drastically suffer. The same sentiments were echoed by Daily (1997) when he said that safeguarding ecosystem services represents one of the wisest economic investments society could make. There is need therefore, to find innovative solutions to the imperfect delivery systems of environmental services that are not only based on economic failures, but also on underlying institutional and policy failures (GEF & UNEP, 2003).

One approach to combat resource degradation and therefore supply of environmental services is through sustainable management approaches, which combine policy, economics, and science to study, manage and restore ecosystems. Sustainable natural resource management is consequently connected to the prevailing social organization, processes and interactions (Allison & Hobbs, 2010). An improved approach to natural resource management (NRM) has to ensure: (i) development of policies that lead to sustainable resource management; (ii) strengthening of institutions involved in NRM; (iii) improved and strengthened systems for planning, management, as well as monitoring and evaluation; and (iv) mechanisms that facilitate a participatory community based approach (FAO, 2010d).

Payment for Environmental Services (PES) is an instrument used to implement sustainable natural resource management approaches. PES can only work with good governance in place, comprising an effective institutional as well as political and legislative system. PES schemes demand a well-developed institutional framework in its design and development (Bracer *et al.,* 2008; Pagiola & Platais, 2007). These include adequate legal and regulatory frameworks; facilitating administrative bodies; well-established and levelled cooperation between different authorities and local bodies; financial intermediaries and brokers; certification bodies; and national registries for ES. Certification and monitoring bodies are especially important to verify and monitor ES delivery as well as the scheme to evaluate and to adapt the design to emerging obstacles and challenges.

The importance of good governance to implementation of successful PES cannot be overemphasized. Trust is fundamental to the long-term success and sustainability of PES programmes. Good governance – in particular public participation, transparency and access to information, as well as accountability and the rule of law – helps to build trust and is therefore key in the context of PES (Geiber Thomas (ed.), 2009). This report says public participation is essential to PES design, particularly during initial scoping and negotiations. It advocates for the creation of PES management committees that can provide a stable forum for stakeholder participation, build a platform for engaging different PES interests, allow stakeholders to learn from one another and engage directly in the process. The report goes further and stipulates that Transparency and access to information are essential during the planning stage of a PES programme, as well as once the programme moves to implementation. In projects carried out at smaller and more manageable scales, it will be easier to achieve appropriate transparency and access to information. Finally the report advocates for high level accountability and respect for the “rule of law” which will increase the reliability and predictability of the PES scheme and in turn facilitate its overall development.

Payment schemes for environmental services need clear and enforceable rules and transaction mechanisms. Without an understanding of these and agreement by all parties, a payment scheme will not operate successfully. Failure to establish appropriate rules and transaction mechanisms is likely to erode trust and confidence among stakeholders. The key ingredients therefore are effective institutions, reliable contract law, supported by good governance, effective transaction capacities and credible enforcement. Hence, designing the rules for a payment scheme calls for development of an institutional framework for the scheme (de Groot *et al.,* 2006).

4.3 Institutional Environment

An enabling environment for PES is connected to the prevailing institutional structures, financial resources and the nature of the ecosystem services contained in the context of a possible scheme (Pagiola & Platais, 2005; Wunder, 2005; Buerli, 2006). According to FAO (2007), the institutional framework for payments for ecosystem protection depends on the size of the selected ecosystem, the number of providers and users of the service, and their social, economic and cultural situation. Corbera *et al.,* (2009) consider the key factors of PES from an institutional perspective stating that PES are perceived as institutions shaping and regulating the interaction of humans with the environment or natural resources, with the aim to change the behaviour of the resource stewards. Therefore, PES schems are influenced by institutional dynamics and interactions and needs to be based upon a shared understanding and agreed rules.

Implementing any conservation intervention, including Payments for Ecosystem Services (PES), in the context of weak institutions is challenging. The majority of PES programs have been implemented in situations where the institutional framework and property rights are strong and target the behaviours of private landowners. Clements *etal.,* (2009) compares three PES programs from a forest landscape in Cambodia, where land and resource rights are poorly defined, governance is poor, species populations are low and threats are high and concluded that PES programs are more sustainable when they act to empower local institutions and reinforce intrinsic motivations.Ostrom (1990) synthesized key enabling factors for sustainable PES insititutions, which are outlined in table 4.1.

Table 4.1: Enabling factors for sustainable institutions

Enabling Factors	**Description**
Clear defined boundaries	The resource system and involved households and individual units have to be clearly defined and demarcated
Costs and benefits are in equivalence	Allocated resource units have to be based on specifying rules that are context-dependent and consider the opportunity costs etc.
Rules based on collective-choice and easy to monitor	The group that is able to modify the rules for resource harvesting and conservation consist of members of affected individuals
Accountable officials and monitors	Monitors of user behaviour and biophysical conditions are either resource users themselves (participatory monitoring) or are liable to some degree to the users
Sanctioning system	A context-dependent and gradual sanction system in case of breach or non-compliance by either facilitators/officials or resource users
Conflict-resolution	Low-cost mechanisms or local arenas have to be in place
Rights to organize are recognized by external governmental authorities (institutions devised at multiple levels)	Clear long-term tenure or user rights to the resource as well as the right to form user institutions have to be guaranteed by the government
In larger systems: nested enterprises	In a larger system rules and mechanisms need to be organized in nested enterprises in several layers

Source: Ostrom (1990)

Institutions are the rules of a society, or, constraints on human interaction created by the people themselves (North, 1992). According to the *Institutions of Sustainability* (IoS) framework, the main purpose of institutions is to find a way to regularize human actions that lead to transactions, affecting the relationship between natural and social system (Hagedorn, 2008). The IoS framework assumes that institutions (set of rules) and governance structures that make them effective emerge either spontaneously through self-organization or intentionally by human design. Hagedorn (2008) stipulates that how institutions and governance structures are socially constructed depends on the properties of the transactions (attributes of physical entities) and the characteristics of the actors involved in such transactions (actors' behaviour). Consequently, both provoke institutional changes.

Ostrom (1990) defines institutions as the set of working rules that are used to determine who is eligible to make decisions in some arena, what actions are allowed or constrained, what aggregation rules will be used, what procedures must be followed, what information must or must not be provided, and what payoffs will be assigned to individuals dependent on their actions. Under the conceptualization explained above, institutions cannot be considered as organizations.

According to de Groot *et al.*(2006) the institutional framework for a payment scheme is a combination of organisations, social structures and mechanisms that support order and cooperation in relationships between parties. Institutions make and enforce the rules, which are the legislative, customary and/or contractual norms used in implementing a payment scheme. Rules specify the rights and obligations of parties and the responsibilities and powers of institutions. Institutions can be Formal or informal. Formal institutions provide 'the rules of the game' and include for example, water law and water policy as well as formal administrative mechanisms in the water, land and wider natural resources sectors. Informal/Customary institutional arrangements are 'the rules in use', or how people actually deal with each other according to customary law and traditions. Payment schemes interact with both types of institutions and their associated rules and transaction mechanisms. The relative strength of one over the other, however, strongly influences which options are available in practice for developing and implementing a payment scheme for environmental services.

4.3.1 Actors in Payment for Environmental Services Schemes

In order to come to an agreement on a PES scheme it is imperative that the right parties are involved in the planning, negotiation and implementation processes. Therefore, designing, implementing, and maintaining a PES scheme requires the involvement of a set of key principal actors. Once the selected ecosystem boundaries have been demarketed and its associated environmental services defined, the next step is to carry out an analysis to establish that the key actors of PES are present and willing to collaborate in a scheme. Lopa (2010) established that there are three key actors; (i) ES stewards; (ii) potential buyers benefiting from the ES in question holding the necessary financial capacity and demand for the ES; and (iii) institutional structures that facilitate the cooperation and create dialogue and trust between the local level and the PES scheme. This is supported by Wunder's (2005) PES definition which indicates that PES is a transaction that involves at minimum one ecosystem service buyer and one ecosystem service provider. While providers (or sellers) and users (or buyers) are the two main actor categories, a third group – generally called *intermediaries* is often needed to connect these two. Figure 4.1 illustrates the principle actor groups in a PES scheme, with providers and users on opposite ends connected by intermediary organizations.

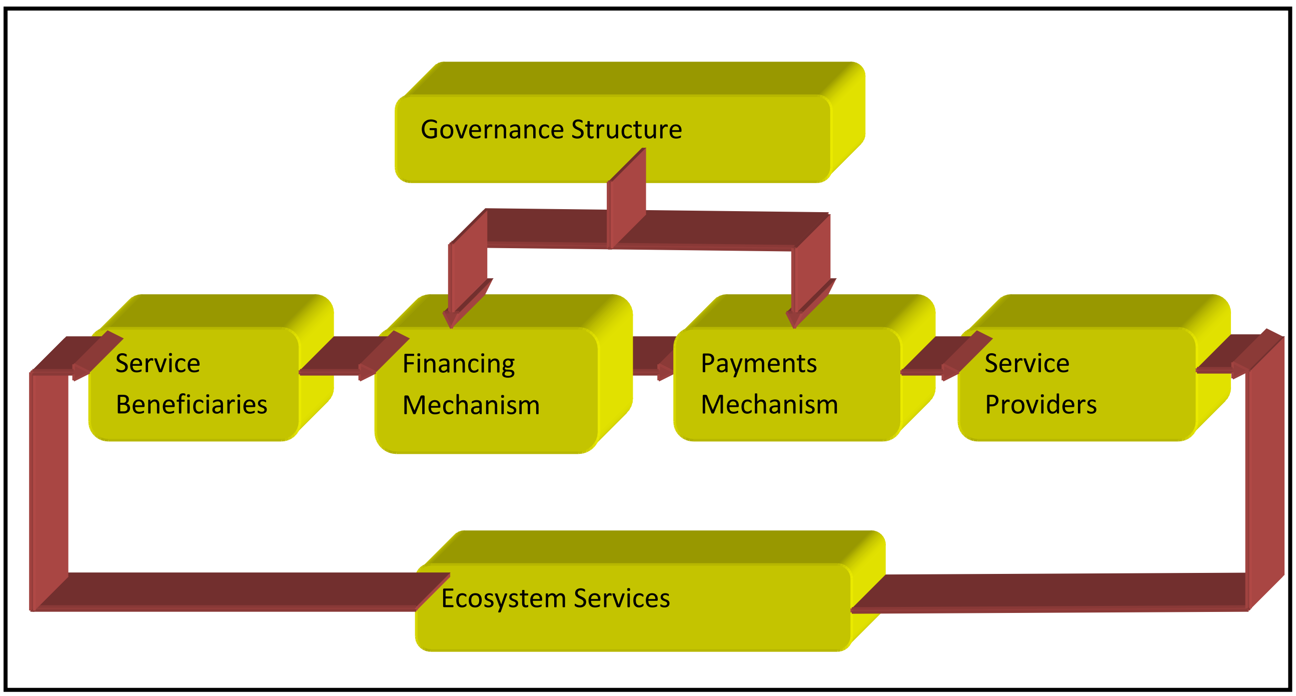


Figure 4.1: Principle actor groups in payments for environmental services
Source: Pagiola and Platais, (2005).

Similar categorization was done by Porras *et al.*(2008); and Smith, de Groot & Bergkamp (2006) who distinguished four categories of stakeholders adding donors as a separate group. The authors said donors provide the funds for the provision of environmental services, and commonly include: (i) Governments, through municipal/ local government and national government funding; (ii) Private sector who make voluntary and required payments for environmental services; (iii) Private individuals through paying household and agricultural fees for use of environmental services like water; (iv) Charitable foundations through making donations from their assets.

According to Engel and Palmer (2008) a wide variety of buyers and providers and their potential relationships are important to consider in the design of a PES. Choosing the most appropriate provider may be of interest, for example, when multiple providers have legitimate claims to a single service. This may be the case when local community members have customary rights on government property. As a result, it is not always immediately clear whether payments should be made to individuals, the community, or government. Further, within an agreement between two or more parties, there are a wide variety of characteristics that can describe the relationship. These can relate to spatial, temporal, legal and power components of the relationships (Corbera *etal.,* 2009). While the voluntary nature of an agreement has been used as a defining characteristic of a PES, this criterion is frequently not met in interventions commonly considered as PES (Robertson and Wunder, 2005) and there are many examples where payments are used to alter behaviours that are already illegal.

Additionally, previous studies have identified a set of four sequential criteria that must be met for actors to participate in PES. These are; (i) eligibility to participate, (ii) desire to participate, (iii) ability to participate, and (iv) competitiveness relative to prospective non-poor sellers of ecosystem services (Pagiola *etal.,* 2005, Wunder 2008).

4.3.1.1 Providers of Environmental Services

Actors on the provider side are “those organizations and individuals who govern the land and therefore can influence the level of ecosystem service flow” (Koellner *et al.,* 2008). Engel *etal.* (2008) also describes providers as those actors who are in a position to safeguard the delivery of the ecosystem services. Providers can include the individual landowner small or largescale; private/business sector (e.g. agricultural plantations companies, forest companies), government organizations (e.g. a national park administration), or non-governmental organizations (NGOs) (e.g. land conservation group) (Koellner *et al.,* 2008). For providers to be eligible to participate in PES they must manage land or resources that provide or could provide ecosystem services demanded by buyers. People who provide services that are ecologically valuable but not demanded by specific buyers are unlikely to benefit from PES (Southgate and Wunder 2007).

Providers who are eligible to participate in PES will generally desire to do so only if they perceive such participation to be economically beneficial. This will often be the case when the opportunity cost of participation is low or negative (Milder, 2010). For example, in "asset-building" PES schemes (Wunder, 2008), land stewards receive payments for investing in management activities that may yield long-term livelihood benefits, such as agroforestry or conservation agriculture. Indeed, such co-benefits are often critical for motivating participation in PES with low per-hectare payment amounts, such as soil carbon sequestration on agricultural lands (Antle and Stoorvogel, 2008, Graff-Zivin and Lipper, 2008). The desirability calculus for many low-income households includes not only the opportunity cost of participation, but also the effect on household risk, labor requirements, and income diversification and timing (Lipper and Cavatassi, 2004). Household decisions may also be subject to higher discount rates than conventional economic analysis.

Further, providers who are eligible and wish to participate in PES must still possess the skills, knowledge, resources, and tenure rights to enter into PES agreements and to deliver ecosystem services reliably. These factors are especially critical if the payment is contingent on actively implementing specific management activities, such as reforestation.

4.3.1.2 Buyers of Environmental Services

Buyers of environmental services, also referred to as users or beneficiaries, are actors benefiting directly or indirectly from ecosystem service provision. Users generally are identified as being in the private sector (e.g. hydropower producers who benefit from land management practices and land uses that reduce sediment erosion affecting hydropower production) or government agencies acting on behalf of the public good (e.g., supporting reforestation or forest conservation to protect wildlife habitat). At present, only a few companies and industries are stepping into this domain to protect their brand, reputations and supply chains. Richards *etal.* (2007) and Scherr *etal.* (2004) have classified PES users into four main categories:

i. Public sector buyers which include local, regional, and national governments, as well as quasi-public agencies such as the World Bank.
ii. Private sector buyers under regulatory obligation to offset their environmental impacts.
iii. Private sector buyers acting voluntarily to support their business operations, to maintain a “green” brand image, or to adhere to principles of corporate social responsibility. This category also includes philanthropic buyers such as conservation nongovernmental organizations (NGOs) and individual consumers.
iv. Consumers of eco-certified products: These buyers participate in ecosystem service markets by paying a premium for products produced in more environmentally benign ways.

Public sector buyers have historically been the largest purchasers of ecosystem services (FAO, 2007), but this is changing as cap-and-trade programs for carbon, as well as various habitat mitigation schemes, promise to increase the role of private sector buyers acting under regulatory obligation. With this change, the global portfolio of PES is shifting from government programs financed by tax revenue, foreign aid, and loans to a greater share of true market instruments driven by private demand and facilitated by the maturation of supporting institutions (Bracer *etal.,* 2007).

4.3.1.3 Intermidiaries in Payment for Environmental Service Schemes

The conflicting interests of stakeholders who nevertheless have to work together have created a role for ‘honest brokers’ that can stimulate and facilitate PES (Pham, Campbell, Garnett, Aslin, & Hoang, 2010). Intermediary actors facilitate the connection between buyers and sellers and influence the design as well as the sustainability of PES. They fill the role of a trustworthy agent, brokering information, negotiations, and representing interests for all involved actors (Howells, 2006; Moss, 2009; Moss *et al.,* 2009; Pham *et al.,* 2010; van Noordwijk *etal.,* 2007). Intermediaries often perform a 'balancing act' between buyers and sellers of ecosystem services. They can represent a range of interest sets, and they can function as boundary organizations bridging biophysical, political, cultural, and administrative boundaries.

The term intermediaries is used in a multitude of ways across disciplines, to describe individuals as well as groups (Medd & Marvin, 2008; Moss *et al.,* 2009). Intermediaries can vary from individuals to organizations to a collection of collaborative groups that are connected in some way to different PES stakeholders. These intermediary actors span scales including local, regional, national, and transnational. Intermediaries perform a variety of tasks, depending on their strengths or abilities, the context in which they are working locally and regulatory measures (van Noordwijk *etal.,* 2007; Pham *etal.,* 2010; Pagiola *etal.,* 2005; Mike & Simon, 2008; Moss *et al.,*2009).

This study adopts the thinking of Moss *et al.,*(2009) in defining intermediaries by the work they perform instead of their organizational characteristics and define PES intermediary actors as those actors who play a connecting role between users (or buyers) and providers (or sellers) in a PES scheme. This definition does not limit the type of actors involved, and they could be actors from government agencies, NGOs, local organizations, municipal offices, private consulting groups, regional or transnational foundations, as well as other organizations.

It has been found that in order for PES projects to succeed, recognition of competing viewpoints from diverse actors involved in environmental decisions must be acknowledged to promote legitimate decision-making (Corbera, Brown & Adger, 2007). An information gap often exists between providers and users; both are interested in understanding how they will be affected by a PES scheme but are cautious of their information source(s). To enable legitimate decision-making the 'mediating organization', or intermediary actor serves as an honest brokers, trusted by those in the community (Corbera *et al.,*2007).

Van Noordwijk *et al.*(2007), found that intermediaries are involved during four stages of PES design namely; scoping; stakeholder analysis; negotiations; and implementation and monitoring of agreements. The authors went on to describe three major roles of PES intermediaries in bridging the relationship between buyers and sellers: First intermediaries are considered as environmental service supporters who can clarify the 'real' interests of potential buyers and sellers in scoping and stakeholder analysis stage and facilitate negotiations to speed up agreements. Second, intermediaries can act as public advisors who give opinions to influence regulatory frameworks or the decisions or actions of other stakeholders in the process. Third, intermediaries can be involved as certifiers who (formally) confirm and guarantee the robustness of contracts.

Intermediaries can perform a range of institutional tasks, including: promotion of programs, administration of paperwork, funds and support, supervision, payment distribution and monitoring (measurement) of ecosystem services (Pagiola *et al.,*2005). They also transfer knowledge and resources between groups, increase market competition, and exert political influence. Table 4.2 summarizes the multitude of roles that an intermediary could play in a PES scheme.

Table 4.2: Potential roles for PES intermediaries

	Role	Explanation
1	**Information Exchange**	Providing accessible information about the PES concept to stakeholders and public Providing information to potential participants about how the program works. Assisting with information sharing between buyers, sellers, and other groups involved in the PES program.
2	**Administration & Program Implementation**	Promoting and publicizing information about the PES program. Project administration, managing contracts, and administering program funds. Monitoring and evaluation Providing assistance with paperwork, and program eligibility requirements
3	**Networking, Representation & Mediation**	Convening stakeholders to for input into program design and contract negotiation Representing interests and concerns related to program participants. Where appropriate, acting as a neutral third party. Serving as honest brokers of information and resources across program participants. Helping to establish trust between program participants. Facilitating connections among organizations.
4	**Program Design**	Informing program design (e.g. target ecosystem services, landowner eligibility, payment structure, geographic boundaries). Developing program standards and guidelines, including a protocol for monitoring & evaluating the program.

Sources: (Peskett et al., 2011).

Effectively linking users and providers through a PES scheme is challenging given the complex environmental, geographic, political, economic and social contexts in which PES operates. Intermediaries, playing their role effectively, have the potential to be key to the proper design of a PES program (Moss *et al.,* 2009). Intermediaries have the potential to contribute constructively to PES design and implementation; however the complexity, diversity, and diverging interests among intermediaries and their associated relationships can result in negative impacts of intermediary involvement, particularly on the poorest populations (Rosa *et al.,*2004; Pham *et al.,*2010; van Noordwijk *et al.,*2007). Intermediaries can reduce the amount of benefits that producers and communities receive, contribute to a power imbalance, be influenced by the potential to increase their profit margin with the transaction, or negatively impact local culture or customs (Pham *et al.,*2010).

Transaction costs can be high in PES programs (Hecken & Bastiaensen, 2010), so decisions about which intermediaries to involve can help minimize transactions costs. Examples include using intermediaries who foster community trust and engagement (Vatn, 2010), and intermediaries who coordinate activities across multiple sellers in PES transactions (Jack *et al.,*2008). Some ecosystem service studies advocate the use of pre-existing, and preferably experienced intermediaries in order to minimize program costs, such as government agencies or NGOs already working within the region (Kemkes, Farley & Koliba, 2010).

4.3.2 Enabling Institutions

Institutions are established to support the implementation of policy and law. It therefore goes without saying that an enabling institutional framework is a prerequisite for the effective and efficient implementation of a PES scheme. A suitable institutional framework is constructed from a variety of institutions with different mandates in terms of functions and administrative levels. However, it is important that the institutional framework:- (i) supports the development of PES projects through, for example, scientific research and project planning; (ii) fundraises including collecting and managing financial resources; (iii) manages access to information, participation and conflict resolution through among others, capacity building, stakeholder dialogues, facilitation of negotiations; (iv) monitoring compliance by supervising contractual obligations and management of public funds; (v) resolve conflicts; and (vi) enforce laws, regulations and contracts (IUCN, 2009). An appropriate institutional framework must above all reflect the reality in which it operates taking into account national and local circumstances and governance structures.

A wide range of institutions with varying mandates take part in natural resources management and by extension are involved in the development and implementation of PES schemes. They include both public and private institutions (Moss *et al.,*2009).

4.3.2.1 Public Institutions

Typically, public institutions are state controlled and operate at local regional or national level. At each of these levels they play key roles in the PES scheme. Some examples are:

Local authorities: For PES schemes established at the micro-level, like water related PES schemes, local environmental authorities are key actors in the PES institutional setup due to their proximity geographically to the resource and their social interaction with local level stakeholders. They identify and respond to local realities like those dealing with property rights; facilitate decentralized PES management; create trust; and simplify PES development and implementation even without a highly developed legal and policy framework (Pagiola, 2008). Furthermore, Buerli (2006) stated that local authorities may also participate directly in PES schemes as service buyers (investing local funds), service providers (as they own or manage relevant land or natural resources), or intermediaries (being responsible for registering PES projects, monitoring their implementation and reporting on progress to relevant authorities at the provincial and national level) .

Regional authorities: Ecosystem boundaries do not match political/ administrative borders, therefore regional authorities serve to overcome this, ensure strategic planning and provide integrated management of natural resources. Regional authorities bring together the public institutions within the ecosystem; ensure a broad representation and widespread support of resource users and organized civil society; and develop complementary policies for different local level institutions in the same ecosystem. These authorities are best placed to map and keep inventory of ecosystem services; Formulate ecosystem-wide plans; dictate appropriate use fees; and deciding on investments to be made in the ecosystem (IUCN, 2009).

National authorities: The institutional framework of PES requires national institutions to provide: (i) political guidance through developing and implementing a national PES strategy; (ii) general PES support like approval of methodologies for identifying and monitoring ecosystem services; (iii) leveraging additional funding for example by bundling ecosystem services; and (iv) Coordination through promoting synergies between existing PES schemes and harmonizing/integrating different governmental policies that have an impact on the provision of ecosystem services (IUCN, 2009).

Public institutions are complemented by private institutions in the development and implementation of PES schemes. Private institutions bring in increased flexibility, independence, external capacities, as well as additional financial resources.

4.3.2.2 Private Institutions

Private institutions are governed by their individual mandates and private law and include mainly non- state organization including Nongovernmental organization and other civil society organizations (FAO, 2007)

Nongovernmental Organizations (NGOs): several studies of existing PES schemes highlight the crucial role played by NGOs in creation of PES initiatives. NGOs have unique capacities that make them better able to raise awareness about the actual value of environmental services; analyze specific needs and ways to conserve or improve environmental services; identify concrete opportunities to establish PES schemes; provide independent (scientific, legal, social, etc.) technical expertise for their design; and participate in schemes as PES buyers (paying upstream landowners), sellers (owning and conserving upstream ecosystems to provide their services to others) and intermediaries (creating trust). NGOs bring to the table a different institutional structure and mandate that allow greater independence and flexibility. This allows them to explore and react immediately to PES opportunities and challenges (Johnson et al., 2004).

Other civil society associations: Implementation of PES schemes also involves the participation and acceptance of private entities, such as local cooperatives, as well as indigenous groups, irrigators, and other 'rural' associations. Case studies have shown their most common role include establishment and management of public-private seed funds for ecosystem protection. Others support coordination at local level and build trust among the actors.

Overall, designing an institutional framework for implementation of PES schemes starts with Identification of the institutions needed to support implementation and operation of the payment scheme. Groot *et al.* (2006) advised that to ensure an enabling institutional environment for PES, practitioners should endevour to (i) utilize formal and informal institutions as appropriate and ensure compatibility with customary law and practices; (ii) ensure that the institutional framework is appropriate to the legal and wider institutional context in which the scheme will operate, and to the scale and the extent of public or private involvement in the scheme; (iii) establish good governance to build credibility and demonstrate the fairness of the payment scheme

4.4 Legal Framework for PES

Despite their obvious importance to our economic and social well-being, environmental services have largely been ignored in both domestic and international law and policy. General environmental laws were not primarily intended to provide legal standards for conservation of natural capital and the services that flow from it and, in practice, they usually do not (Whitten *et al.,* 2003). Recently however, Policy instruments for conservation and rural development based on Payments for Environmental Services (PES) have been increasingly applied by different actors responsible for natural resources conservation. The greatest challenge is that defining tangible rules for PES systems which apply all around the world is hardly possible, because of the differences in the legal and institutional framework of countries, and these need to be included in the policy instrument. Therefore studies analysing the legal frameworks for PES continue to be general and sometime vague. The draft Code of Conduct on PES in Integrated Water Resources Management which has been prepared under the auspices of the UNECE Convention on the Protection and Use of Transboundary Watercourses and International Lakes is an example of an attempt to develop a global PES legal framework. It is therefore more common to find legal frameworks developed for specific PEs schemes and probably at national level.

The establishment and operations of institutions is set up based on laws and policy at different levels. The laws and policy determine the powers and responsibility of institutions, their legal status; and their integration and collaboration within a framework of transparency, public participation, equity and legal certainity. Specifically they (i) Identify key state actors involved in PES transactions; (ii) Clarify their functions and powers related to the development and management of PES schemes; (iii) Set rules for the establishment and operation of specific PES institutions; and (iv) Establish general administrative guidelines (IUCN, 2009). An appropriate Legal framework can enable the successful development and implementation of PES schemes. Conversely, inappropriate legislation can be cumbersome and even obstruct efficient and effective PES projects. The establishment of a legal framework depends on particular type of PES scheme and the legal personality of the parties involved in the PES deal, the objective behind the use of PES as an instrument, as well as the scale at which the PES scheme shall be established. Three types of PES schemes have to be distinguished: Private (self-organized) PES; PES trading schemes; and public (government driven) PES, whose legislative requirements differ (Greig-Gran, 2006).

Private PES schemes involve private sector actors as buyers and sellers of environmental services and therefore their transactions are governed by market forces of supply and demand. This type of schemes do not therefore require a specific legal framework beyond basic contract law, and basic legal principles of civil and international law that agreements must be kept, general acceptance for the rule of law and the absence of any legal provision that outlaws the PES contracts. However, these schemes are usually limited to local level environmental problems and when scaling their positive results up through a nested approach may require a specific policy and legal framework (Greig-Gran, 2006).

PES trading schemes refer to the establishment of markets in which established rights (or permits) and/or quotas can be exchanged, sold or leased. In such a scheme an individual who restores and/or protects an ecosystem services will be issued credits by a responsible authority (Greig-Gran, 2006). These credits can then be sold to another party that is responsible for a negative impact on ecosystem services elsewhere and thus faces a mitigation obligation imposed by statutory law. These schemes require a specific legal framework as they are rather complex and will require among others: (i) Clear definition of those activities that have a negative impact on ecosystem services and thus lead to mitigation obligations; (ii) Development of transparent standards to quantify the unit of exchange (e.g. based on their actual value and/or function, or based on the size and/or geography of the concerned land); (iii) Determination of units of restored, created, enhanced or preserved ecosystem services which will be converted into tradable credits; (iv) Establishment of procedural frameworks for opening, managing and closing mitigation banks, for protecting the resulting ecosystem services in perpetuity, and for ensuring fair trade; (v) Creation of insurance and liability systems to guarantee long-term offsetting and stewardship success. Furthermore, such trading schemes will usually be developed at the regional or national scale in order to allow the participation of a critical mass of people and ecosystem services. If the number of potential traders and tradable services is too limited, no efficient and effective trading scheme can ever develop. All this clearly indicates the need for a comprehensive and coherent legal framework in order to establish and regulate a PES trading scheme (Greiber, 2009).

Public PES schemes have the highest level of involvement by public entities, as they are defined by the involvement of at least one public entity as a contract party. A municipality or local or national government acts as the sole or primary purchaser or provider of a specified ecosystem service or a related land use or management practice (Greiber, 2009). To date, public PES schemes are the most common form of PES schemes. These schemes have mostly evolved on an ad hoc basis due to initiatives by NGOs and overseas development corporations which have brought together the different parties, directed their attention toward PES, collected the necessary financial resources and facilitated the development and implementation processes. The schemes are also highly fragmented and mainly limited to the local scale (De Groot *et al.,*2006). While this approach might be sufficient to address specific local level environmental problems at a small scale and for a certain period of time – as is the case with private PES schemes – it limits the real potential of PES as an innovative instrument that might be applied more often, more efficiently and at a larger scale to combat prevailing environmental problems. However,, an appropriate legislative framework which regulates public PES schemes has the potential to stimulate the development of trustworthy markets and to ensure good governance (IUCN, 2009).

4.4.1 Appropriate Legal Instruments

PES schemes can be promoted through different legal instruments at different levels as outlined below.

Constitution: The constitution is a set of rules establishing the overall conception, character, and organization of a state's government, prescribing the extent of its sovereign power and the manner of its exercise, introducing the most basic legal principles that can 'never' be abolished, and guaranteeing certain rights to the people. The constitution is thus the fundamental and organic law of a state (Hawkins, 2011). As such, its objective is rather to build the basic national order than to introduce specific environmental policy instruments or regulate their details. Given its role, the constitution does not have to expressly recognize or provide regulation for PES, However, it can still be an important instrument to indirectly support PES development. By introducing a legal provision which gives people a right to a clean and healthy environment, or that recognizes the value of nature and its environmental services can be important to build an enabling political environment and a strong legal basis from which PES can be developed. These general enabling provisions will then need to be complemented by specific comprehensive legal provisions (Porras *et al.,*2008)

Specific Laws: An enabling legal framework could include a specific law for PES or environmental services. The objective of such a specific law would be to introduce PES as an accepted policy instrument, to promote its use, and to regulate the further particulars of its implementation (Pagiola, 2008). This is however, not yet common practice with very few countries like Costa Rica having specific laws. Having a specific law has several advantages one being that it can heighten awareness of government and the public to the institutionalization of PES as a policy instrument. Regulating PES in a special law also provides the possibility to draft a comprehensive and well structured legal framework from scratch. This makes it easier to compile, arrange and systematize the different PES related provisions in an ordered way, tailored to the particular legal and market environment (IUCN, 2009). A consolidated set of PES provisions included in one legal document can improve the understanding of PES, clarify its scope and content and support its implementation. However, drafting of a specific PES law might present the danger of fragmenting or complicating the existing environmental legal framework if it is not properly aligned to it. Properly integrating a specific PES law to the overall legal and institutional framework already in place and specifically those that regulate the different ecosystems and their relevant services can be a great challenge because there are too many existing legal instruments that will need to be checked for potential legal conflicts and aligned as required (Asquith & Wunder (ed.), 2008).

Sectoral Environmental Legislation: Amending already existing sectoral environmental legislation (and/or policies) to introduce specific PES options would be the preferred option to create an enabling legal framework for PES. These amendments require less legal drafting and synchronization work and yet provide an opportunity to clarify or further develop existing economic instruments (Hawkins, 2011). Sectoral environmental legislation includes laws which regulate environmental protection and nature conservation in general (such as general environmental laws, or environmental framework laws), laws which address specific ecosystems that provide relevant services, or related implementing regulations (Porras *et al.,* 2008). Most sectoral environmental legislation today, includes references to the concept of ecosystem services and to economic instruments for their conservation. This provides a window through which more detailed PES provisions could be introduced. PES related amendments might provide an opportunity to further clarify and thus improve the existing legislation with the least interventions (Asquith & Wunder (ed.), 2008).

Indirectly Relevant Laws: An efficient and effective legal framework for PES requires compatibility with other indirectly relevant laws. Indirectly relevant laws are those related to natural resources management or financial issues (Asquith & Wunder (ed.) 2008). Some examples of this are land laws, agricultural laws, mining laws, planning or land development laws and fiscal laws. Agricultural laws, for example, tend to create perverse incentives which clash with the objectives of watershed PES initiatives like promoting use of chemical fertilizers to increase yield. Fiscal laws also have a clear potential to introduce perverse incentives, by exempting certain activities with a negative impact on environmental services from tax payments or providing outright subsidies for destructive activities. The planning of human settlements, agricultural land use, or different kinds of infrastructure projects (such as roads) is again subject to land development legislation.

IUCN (2009) sharing experiences from Latin America stated that depending on the way such land development legislation is drafted, it can introduce an environmental (services) approach, value environmental services projects or promote the establishment of ecosystem inventories. On the other hand it can completely ignore ecosystem services, give priority to other activities, or create perverse incentives promoting land use changes and advancing the further degradation of ecosystems and their services. There is need to assess these pieces of legislation to determine how to use their full potential to promote PES and /or remove perverse incentives that obstruct PES

4.4.2 Scope and Content of PES-Related Legislation

When drafting PES-related legislation two main questions arise: (i) at which level of government do we need to introduce PES legislation? (Scope) and (ii) what shall be regulated in such legislation? (Content)

4.4.2.1 Scope

Legal provisions at all levels, from local to national, can play an important role and have an added value in the further promotion and implementation of PES. The appropriate level for PES legislation will depend on two main factors;experiences and the prevailing government system (Geiber ed., 2009).

Experiences with PES development gained through a policy-practice loop (‘learning-by doing’): This experience gaining process starts with the development and implementation of a PES project. During this stage capacity is built through trial and error.

This stage ends when the first stories have been documented outlining the successes, failures, challenges and lessons learnt. This then leads into the up-scaling phase, from local level to basin wide or replication to other similar ecosystems. This allows for a strategy to build and a first official framework for PES. At this stage PES policy and legislation can then be developed either for the ecosystem or the larger administrative unit eg province. This should then feed into national level legislation that will go a long way to promote PES development at the most efficient and effective level, and create a common nationwide understanding and vision of PES as an instrument (Geiber ed., 2009).

Specific government system prevailing in the country: The system of government provides levels at which PES legislation can be anchored. In this regard one can distinguish unitary versus federal systems of government. A unitary Government structure centers laws and policy at the national level, while the federal structure creates an interface between the sub-national (local government) and national levels of executive and law-making authority. By implication the PES legislation in a unitary structure will be introduced at National level, and in federal structures this legislation will most likely be developed at all levels (Geiber ed., 2009)

4.4.2.2 Content

The content of PES provisions depends on the type of legal instrument as well as the jurisdictional level where such provisions are introduced. A comprehensive legal regime should comprise provisions regulating general issues, such as scope, cross-cutting principles or terminology, as well as finance, institutional and implementing issues (Greig-Gran, 2006).

A legal framework for PES should include general regulations on:

(i) **Purpose, scope and 'cross-cutting' principles**: PES-related provisions should be linked to and embedded in the greater nature conservation, water and development policies. This can be done by clarifying the purpose, scope and certain cross-cutting principles of PES legislation. The most appropriate and effective scale for PES schemes should be clarified upfront (IUCN, 2009).

(ii) **Terminology:** Effective implementation of and compliance with legal provisions depends to a large extent on how well they are understood. It is important to precisely define the terms which will be key for the development and implementation of the legal instrument (Porras *et al.,*2008). There is need to specify the different types of environmental services recognized within the legal framework. It is also useful for definitions to distinguish different types of PES schemes: private PES schemes, public PES schemes and trading schemes (Greig-Gran, 2006)

A long-term sustainable PES programme, requires adequate funding and hence the need for a 'fundraising strategy' that relies on legal provisions. Donations are the main source of funding for most PES, but these are usually one time payments or payments over a specific period of time. Such revenue is helpful in meeting start-up investment costs, but cannot meet long-term needs (Chomitz & Constantino, 1998). Some other funding sources are:

(i) **Sustainable PES funding sources:** Green taxes and water-related fees or charges can provide sustainable sources of funding. A new tax, charge or fee might be introduced, or an already existing one might be dedicated to PES funding (Morrison and Aubrey, 2010). Levying such revenues requires concrete regulation if it is to be dedicated to PES funding rather than general revenue. For example, revenues can be collected for both abstraction and pollution of water. Abstraction fees can be calculated by volume, or they can be associated with an abstraction permit or concession and based on the maximum quantity of water to be abstracted by the water user as laid down in the permit or concession (Hawkins, 2011).

(ii) **Percentages to be dedicated to PES**: Here a percentage of Government revenue is dedicated to PES, this can raise a considerable amount of revenue for PES. Depending on the circumstances, the percentage amount is determined and enforcement will be required to ensure this amount is deducted and used for PES. Therefore, regulations need to stipulate what percentage of each type of revenue will be dedicated to PES schemes and to other funding purposes (Greig-Gran, 2006).

(iii) **Establishment of specific PES funds/accounts**: Traditionally, the main focus of revenue collection from most natural resources like forests and water have been on financial cost recovery. This revenue needs to take into account the services produced by the Resources and ensure that at least part of the collected financial resources is earmarked for PES purposes, perhaps to a specially created PES fund or account (Geiber ed., 2009). This account can become an instrument to collect and bundle different types of revenues in so doing diversifies the financial resources will and ensures greater resilience of the overall funding system. Regulations are needed to clearly identify how these funds will be spent and distributed between covering transaction costs and paying for the provision of the environmental service (Porras, 2008).

Institutions are either created or influenced to support PES schemes. An efficient and transparent institutional set-up starts with determining individual institutions/agencies and their specific duties and authorities in PES schemes (Pagiola & Platais, 2007). This ensures that each institution brings to the tables its area of comparative advantage and the institutional set-up then selects institutions to ensure all specialists' are involved, and that a system of checks and balances is set up to prevent arbitrary decision-making. (Moss *et al.,* 2009). In the set-up institutions included need to cover functions that : (i) support PES development like research and planning; (ii) fundraising including collection and management of funds; (iii) Managing access to information, participation and conflict resolution (e.g., capacity building, stakeholder dialogues, facilitation of negotiations); (iv) Monitoring compliance and (v) enforcing laws, regulations and contracts (Vatn, 2010).

The twin objectives of such regulations will be to establish new institutions or agencies specialized on PES and to harmonize the roles and responsibilities of already existing institutions horizontally and vertically to achieve synergies. Any new institutions created will purposely address institutional gaps which need to be closed to ensure efficiency and effectiveness in PES development and implementation (Swallow *et al.,*2009).

An effective PES legal framework should include regulations that focus on the implementation and sustainability of PES schemes. Such regulations could address:

(i) **Contractual issues**: These depending on the jurisdiction, may address the need to register PES contracts, the legitimate parties for each PES type, as well as specific criteria for participation in them, different groups of individuals and entities which are targeted as potential service providers and beneficiaries, accepted types of payments (recognizing in cash and in-kind compensation), among others (IUCN, 2009). One needs to be very careful, however, not to over-regulate and take away flexibility required to craft PES arrangements suited to local needs. Hence, it is important that PES regulations find the right balance between creating a clear framework for the development of PES contracts on the one hand, and ensuring freedom of contract on the other hand (Asquith & Wunder ed., 2008).

(ii) **Property and tenure issues:** Environmental services are closely tied to the management of ecosystems and their natural resources this brings up the issue of property and tenure rights over land, its natural resources and by extension, the provided services. Legislation here need to define the property rights one needs to participate in a PES scheme, the recognition/application of statutory and/or customary rights and the registration and updating of such rights (WWF, 2010). This legislation may need to go further and regulate land use change after termination of PES contracts to ensure sustainable provision of the environmental services (FAO, 2007)**.**

(iii) **Land use planning issues**: Land use and spatial planning regulations play an important role in conserving ecosystems and their services. These include proactive processes such as the preparation of spatial plans, which are based on ecosystem inventories and implement planning policies by identifying favoured areas for developments (e.g. residential expansion), areas where developments should be avoided or limited, and areas where PES schemes should be developed (FAO, 2007). For example, the designation of green belts around towns and cities is a common practice for protecting green space for amenity, landscape, drinking water and environmental purposes. Planning regulations can also provide an effective mechanism for protecting specific landscape features that provide environmental services (IUCN, 2009).

(iv) **Compliance and enforcement issues:** Legislation that supports PES should also establish a framework for compliance and enforcement. This could include regulation mandating awareness-raising activities that ensure availability of relevant information about the existing PES legal framework, to organize stakeholder meetings and promote codes of conduct in consultation with stakeholders (Greig-Gran, 2006). Compliance and monitoring is an integral part of PES contracts, however, Hawkins (2011) found that depending on the circumstances it may be necessary to assign specific institutions with the responsibility to monitor compliance with PES legislation. Adding to this discussion, Wunder and Pagiola (2008) said that in order to deter non-compliance and to support enforcement, regulations can also define PES violations, create dispute settlement mechanisms and introduce remedies and sanctions as response measures.

(v) **Legislative conflicts:** As is the case with all new legal text, the introduction of PES-related provisions could lead to conflicts with existing legislation. Therefore, PES regulations should include a provision that determines which law prevails in cases of conflict or inconsistency between legal texts (Geiber ed., 2009). While agreeing that PES-related regulations can build a basic framework which supports the development and implementation of PES contracts and creates legal certainty for PES schemes, Asquith and Wunder (2008) said the challenge is to provide guidance and a supportive framework through legislation and regulation while allowing flexibility at the local level for the PES parties to craft agreements that best suit local needs.

4.5 Chapter Summary

Environmental degradation and the associated decrease in provision of environmental services to mankind continue to be issues of global concern. Sustainable approaches to Environmental management have been proposed as solutions to this challenge. This calls for an integrated approach that will ensure a combination of environmental, economic, policy and institutional concerns are addressed. PES is a tools used for sustainable management of natural resources and can work effectively and efficiently with good governance in place which comprises effective institutional and legislative systems.

Implementing PES in the context of weak institutions is challenging. It is therefore important to ensure existence of sustainable institutions that will support PES. This will be enabled if (i) there are clearly defined boundaries for the resource system and associated households; (ii) Costs and benefits are in equivalence; (iii) rules based on collective choice and easy to monitor are in place; (iv) Accountable officials and monitors; (v) A sanction system; (vi) a conflict resolution mechanism; and (vii) recognized user rights are in place. In an enabling environment, it is imperative that the right actors are involved at all stages of the establishment and during implementation of the Scheme. Lopa (2010) said there are three main actor groups; the ES stewards; the potential buyers; and an intermediary institutional structure to facilitate the transfers. The chapter has looked at prevailing institutional setup from experiences across the world and concludes that a suitable institutional environment needs to be constructed from variety of institutions with different mandates and administrative level. This could ensure all round support to the PES in terms of scientific research, resource mobilization, information collection and dissemination, capacity building, conflict resolution, monitoring and enforcement. Above all the institutional structure must reflect the reality in which it operates taking into account national and local circumstances and governance structures.

Studies analyzing the legal frameworks for PES tend to be vague because defining tangible rules for PES systems that are applicable all around the world is a great challenge, given the differences in legal and institutional frameworks of countries. Laws and policy determine the powers and responsibility of institutions, their legal status, and their integration and collaboration within a framework of transparency, public participation, equity and legal certainty. PES schemes can be promoted through different legal instruments at different levels including the Constitution, specific PES laws, sectoral environmental legislation and indirectly relevant laws. An enabling legal environment for PES should therefore ensure linkage with all relevant laws, provide guidelines to support financial transaction, provide grounding for the institutional structure, and legislation that supports implementation and sustainability of a PESscheme.

CHAPTER 5
RESEARCH METHODOLOGY

5.1 Introduction

This chapter describes the research methodology incorporating data collection and analysis for the study. A description of the background of the study areas in Western Kenya includes sub-sections on Kenya, the Lake Victoria North Catchment Area, the Mt. Elgon ecosystem and the River Nzoia. The final sub-section gives a description of the study area on the River Kuywa watershed detailing topography and climate, socio-economic activities and issues of environmental governance. The research design and the description of the models used follows, outlining the conceptual framework for the study and the mathematical representation of the models used. The data that was used is then described and this is followed by the details on the sampling techniques, sample size and data collection methods. The chapter concludes with the outline of the data analysis techniques.

5.2 Description of the Study Area

The study was carried out in the Kuywa River watershed, which is a tributary of the Nzoia River that Flows from Mt. Elgon to the Lake Victoria. The study area is located Bungoma County in Western Kenya.

5.2.1 Kenya

Kenya is an East African country located between latitudes 5^0N and 4.4^0S and between Longitudes 33.83^0E and $41.75.5^0$E it is almost dissected in half by both the equator and by Longitude $38◦0^0$E. It shares boundaries with Uganda to the west, Tanzania to the South West, Sudan and Ethiopia to the North, Somalia to the East and Indian Ocean to the South East. Kenya has an area of approximately 582,646 KM^2 (Kenya National Bureau of Statistics (KNBS), 2009), of which land surface covers approximately 569 250 KM^2 and inland waters 11,230 KM^2. Two third of Kenya land is either semi arid or arid (GEF, UNDP, 2007), with 79% of the country receiving less than 760 mm of precipitation a year (Tattersfield, et al, 2001). About 18% of total land area is of high to medium agricultural potential and supports about 80% of the country's population. The remaining 20% of the population live in the remaining 82% of the total land area, which is Arid and Semi-Arid (ASAL) (GEF, UNDP, 2007).

The country economy is a developing and has gross domestic product (GDP) per capita in 2007 adjusted by purchasing power parity (PPP) been US$ 1200. Agriculture and tourism makes the biggest contribution to GDP 24% (CBS, 2007). The main agricultural products are tea, coffee, wheat, sugarcane, vegetables, fruits and flowers. The main export products include tea, coffee and horticulture. This supports an estimated population of 35, 698,640 growing at a rate of 2.7% (KNBS, 2009), 70% of whom live in the rural area. Fifty-eight percent of Kenyans live below the poverty line. Poverty contributes to the unsustainable use of natural resources and environmental degradation as a result of poor farming practices, overgrazing and growing reliance on forest resources. This is because the survival needs takes precedence over long term needs to preserve and maintain the environment. The main environmental challenges facing the country are water pollution from settlements, farming activities and industry; water hyacinth infestation also a result of pollution, Deforestation, desertification and soil erosion: these are intertwined and is blamed for climatic changes and depletion of water catchment areas. Kenya has five major "water towers" namely Mt Kenya, Aberdare Range, Mau Complex forests, Cherangani Hills and Mt Elgon.

5.2.2 Lake Victoria North Catchment Area

Lake Victoria North Catchment (LVN) is located in the northern part of Lake Victoria basin in Kenya. It has an approximate area of 18374 km^2.The total population in this catchment area is about 8.5 Million according to 2009 population census The catchment experiences annual rainfall that varies between 900 mm and 2 000 mm.The renewable water resources according to NWMP 2030 interim report is about 5168 MCM/year. Out of this 4626 MCM/year is surface water while 542 MCM/year is groundwater constituting 90% and 10% respectively. The per capita water availability is 608 m^3 which is below the 1000 m^3 global bench mark and is categorized as a chronic water scarcity area. This implies that LVN catchment area experiences continual water supply problems which worsen during dry seasons leading to frequent severe droughts. The abundance of surface water compared to groundwater implies that infrastructure development to enhance water availability should focus on surface water storage. Figure 5.1 shows the map and location of the Lake Victoria North Catchment Area.

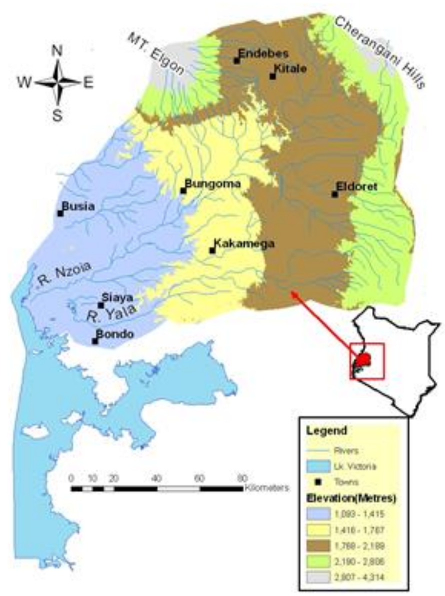


Figure 5.1: Map showing the Lake Victoria north catchment area
Source: WRMA – LVNCA (2013)

The major issues and challenges in Lake Victoria North Catchment area include soil erosion and sedimentation, pollution of water resources both from point and non-point sources and encroachment into water catchment areas; the main ones being Mt Elgon, Cherangani Hills and Kakamega Forest. Consequently these areas and their foot slopes have suffered severe degradation resulting in drying of springs and wetlands, loss of valuable indigenous forest species that are water friendly and landslides. Flooding is a characteristic problem in this area especially in the lower Rivers Nzoia and Yala. Sometimes it becomes disastrous especially in Lower Nzoia where it causes loss of lives, destruction of property and eventually famine and waterborne disease epidemics.

The encroachment is aimed at gaining socio-economic benefits in terms of settlement, expansion of agricultural land, logging among others. These activities destroy surface cover resulting in increased surface runoff and soil erosion. The eroded soils are carried by overland flow and deposited in the rivers, lakes and ponds resulting in reduction in storage and carrying capacity. The increased surface runoff causes increased potential flooding and its associated consequences. Planting of exotic trees which are fast maturing and consumes a lot of water is also another issue. Due to their economic gains and available ready markets, the growing of these trees has been widespread in river valleys and in wetlands and has resulted in reduction of these water resources. In marginal areas of the catchment where livestock keeping is prevalent overgrazing is experienced resulting in desertification leading to poor productivity as a result of soil loss and compaction of the land surface. The byproduct of these activities eventually impact negatively on water resources resulting in water scarcity. WRMA will diversify its programmes and continue to incorporate stakeholders to ensure that water resources are protected.

5.2.3 Mt. Elgon Ecosystem

This study will be carried out in the Mt. Elgon Ecosystem in Bungoma County, Western Kenya. This mountain ecosystem is sits astride the international border between Kenya and Uganda. It is located about 150 km north of the Lake Victoria. The mountain is one of the five water towers in Kenya making it an important water catchment area with the rivers originating in the mountain range feeding other water catchments including the Lake Victoria and Nile River Basin; The Turkwell River and the Lake Turkana. The Ecosystem is renowned for its immense natural resources of significant importance for the local people's livelihoods, such as supplying energy, grazing and a wide range of other environmental incomes. However, these resources are under threat from increased human activities leading to severe deforestation and increased human settlement in the ecosystem.

Mt. Elgon is an extinct volcanic mountain, the fourth highest in East Africa. It is located between the longitudes 30°20'49'' E, 35°3'55'' E and latitudes 0°43'31'' N, 01°02'02'' N with an estimated total area of 2,504 Km². The mountain extends 80 km North-South and

50Km East-West with the 20 Km long Nkokonjeru arm to the west (Okeyo-Owuor, 2008). Though the natural vegetation is not particularly diverse, the Mt. Elgon ecosystem is endowed with exceptionally high biodiversity of renowned global importance (Howard *et al.* 2000) by virtue of their rarity and/or limited distributions. The protected area covers approximately 2045 Km^2 with 1145 km2 on the Ugandan side and 900 km^2 on the Kenyan side. As a water tower, its forest cover is a key determinant of water supply, quality and quantity for several major rivers; the Nzoia and the Turkwel Rivers; and the Malakasi River that waters Lake Albert in Uganda.

The Mt Elgon, Ecosystem is also very important for the many environmental goods and services derived from it by the local communities. From the expansive forest, communities get firewood, medicine, building materials, favourable climate, and fertile volcanic soils. The extensive network of rivers and streams provide water for domestic and industrial use, while supporting a livelihood through the fisheries resources it supports. It also boosts the local economy through foreign exchange received from tourism and the job opportunities created by this industry. Because of the many environmental services derived from the Mt Elgon ecosystem, the areas surrounding the mountain forests have very high population densities reaching 600 people/ km^2 (Okeyo-Owuor, 2008). Many of the residents of this area are poor subsistence farmers who rely on harvesting of various forest products and utilization of environmental services for their survival. As the population continues to grow, competition is created and civil wars perpetuated by resource-use conflicts result. This is a major cause of environmental degradation supported by poaching, encroachment for settlement and Farming.

The management of the Mt. Elgon ecosystem offers a daunting challenge because of its trans-boundary nature and of its economic potential as source of finite goods and services that are critical in the livelihoods of the local communities and national economies. As resource managers attempt to address concurrently environmental conservation concerns and deficiencies in people's livelihoods, the sustainable resource use and conservation efforts are hampered by challenges including: (i) lack of proper conservation and wise use methods, (ii) lack of alternative means of livelihoods and income, (iii) high level of poverty amongst the local communities and over dependence on farming and forest resources, (iv) lack of awareness and education on the ecological importance and long term role of Mt. Elgon Ecosystem, (iv) insufficient financial and technical resources, (v) frequent political and administrative boundary changes, (vi) incoherence and uncoordinated efforts by various conservation organizations, (vii) climate changes and absence of methodologies for valuation, (viii) attribution and compensation for ecosystem services provision that could spur stakeholder participation in conservation, and (ix) inadequate policies and institutional arrangements (Petursson, 2011)These challenges need to be addressed to help reconcile conservation and development goals at both the national and trans-boundary levels.

5.2.4 River Nzoia

Mt. Elgon is a watershed of regional importance and the source of several rivers, including the River Nzoia, which is equally significant in the region as the second largest single discharger of water into the shared Lake Victoria after River Kagera (Okurut, *et al.,*2011). The River traverses five counties in western Kenya including Trans Nzoia, Uasin Gishu, Bungoma, Siaya and Busia and supplies water to major urban centres in western Kenya such as Kitale, Sirisia, Bungoma, Kapsokwony, Busia, Cheptais and Chwele. It has a total length of 334 km (Kirugara and Naveja, 1995) and a catchment of 12,903 km^2 (LBDA, 1987). It dominates the northern half of the Lake Victoria basin with 24 tributaries (Kirugara and Naveja, 1995). Its major tributaries include Ewaso Rongai, Koitobos, Kuywa, Sosio, which originate from Mt Elgon. Others such as Noigamneget, Sergoit, Sosiani, Nureri and Kipkaren originate from Cherangany hills. The river's water basin lies between latitudes 1º 30'N and 0º 05'S and longitudes 34º and 35º 45'E. with an altitude that varies from 1070 m above sea level at Lake Victoria up to 2700 m in the northern end of the watershed (Simiyu, et al., 2009) and an annual rainfall ranging between 900 and 2200 mm.

Most of the Nzoia River watershed has been deforested and the land converted to agricultural use. In Trans Nzoia County, 60% of the land is arable and mostly under cultivation for maize and sunflower (GOK, 2010), while maize and coffee dominate the Bungoma area of the catchment. The few remaining forested areas are Mt Elgon and Cherangany forests, which are threatened by heavy deforestation as the population in the area continues to grow. The steep sloping escarpments are being quickly de-vegetated as charcoal burning and illegal farming on the trust land continues unhindered. This has resulted in high soil erosion and transport of sediments and nutrient loads to the water bodies including Lake Victoria, with the accompanying impacts on the livelihoods of the lake basin communities. Eutrophication in the Lake is now evident as indicated by the water hyacinth infestation, high algal biomass (high productivity) and changes in algal species composition (LVEMP, 2009). This has been attributed to non-source pollution including nutrient loading from the watershed area, different land-based activities such as heavy application of fertilizers, animal grazing, washing in the rivers, and internal loading due to anoxic conditions at the surface-sediment interface among others (Simiyu, 2009).

Land use change has altered the natural ecology and availability of water resources. This is compounded by exogenous factors such as climate change, and associated drought and floods which also impact the already serious water resource scarcity and pollution problems. As degradation continues in the catchment, stream flow especially during seasonal low-flow periods will continue to decrease. The most vulnerable water sources are those that are unmanaged and sources that are already stressed or poorly and unsustainably managed due inadequate watershed governance that has been worsened by conflicts among riparian communities. Several spring water sources normally expected to have clean water are contaminated with thermo-tolerant coliform bacteria, in both developed and undeveloped springs (Simiyu and Adams, 2009). In other incidences, some springs have dried up or have shifted their outlets denying the local communities their normal access to water (Simiyu *et al.,* 2009). The river is further polluted as it absorbs a lot of effluent from Industries established to process coffee, sugar cane and paper in the region. These may soon result into an outbreak of water-borne diseases and adversely affect the communities' livelihoods. However, demand for water is generally increasing with economic development and a growing human and animal population in the region.

5.2.5 River Kuywa Watershed

Given the need to localize natural resource management interventions, this Study confined itself to one watershed; The Kuywa Catchment area which is one of the watersheds within the Lake Victoria North Catchment Area and a major source of recharge to Nzoia River. The Kuywa Watershed originates from the Mt. Elgon forest and drains into the Nzoia River system at Khalala in Bungoma District, which in turn drains into Lake Victoria. Figure 5.2 shows the River Kuywa watershed.

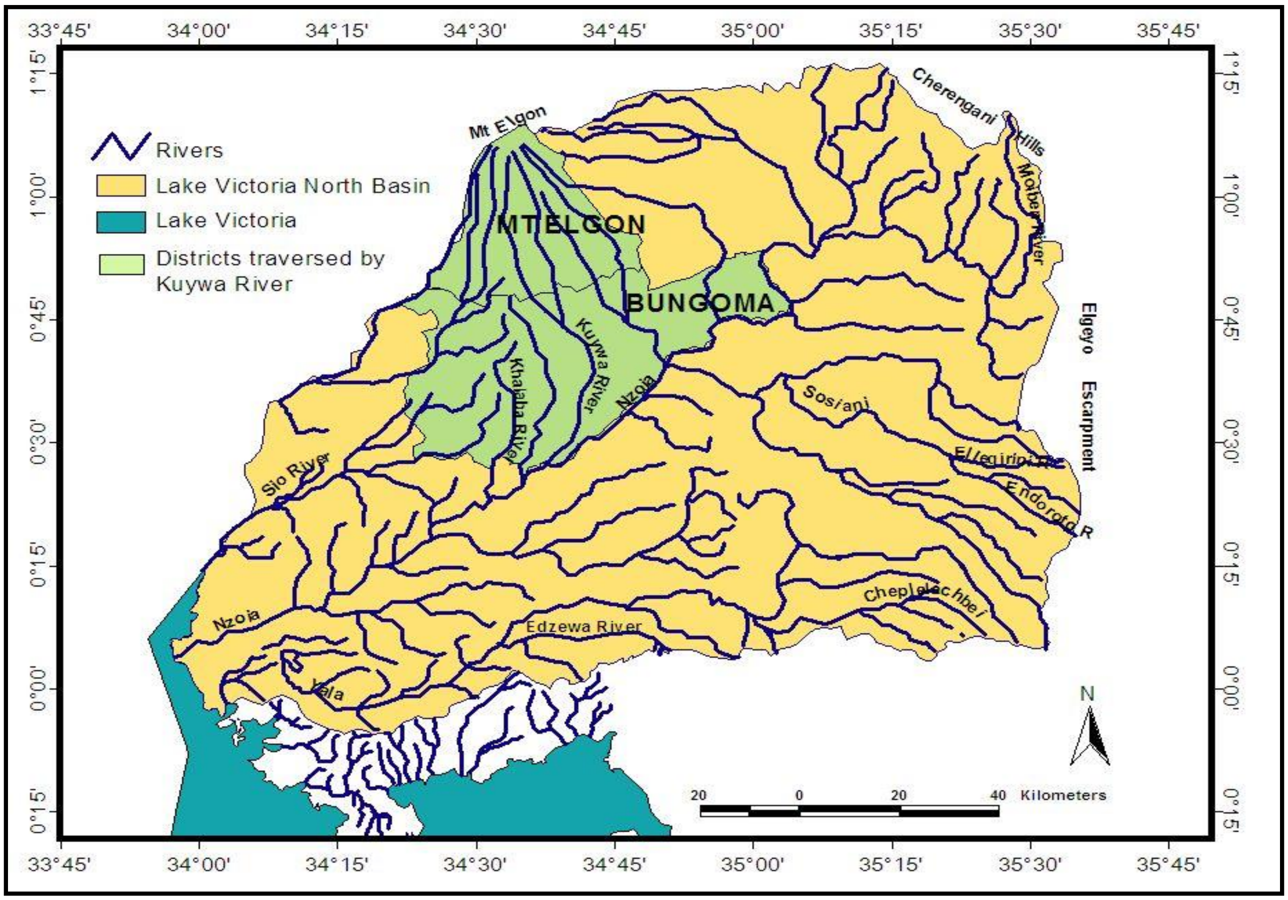


Figure 5.2: The River Nzoia system showing the River Kuywa catchment

Source: WRMA – LVNCA (2013)

The River Kuywa is one of the major tributaries of the middle Nzoia basin. The entire river system is approx 97km long and traverses Bungoma County from Mt. Elgon through Bungoma to Khalala, passing through six main business centres; Nandolia, Kuywa, Matisi, Kapkateny, Bokoli and Chebukaka and several coffee factories and the Nzoia Sugar company. The River has the Water intake at Matisi for the Water supply by the Nzoia Water and Sewerage Corporation to fast growing urban areas of Bungoma and Webuye.

The River Kuywa has a catchment area of 292km^2 serving a mainly rural and agricultural catchment Population is 146,000 people & density of 500 persons/km^2 (WRMA, 2011). The Kuywa River system is made up of three micro-catchments namely Terem, Kibingei-misikhu and Kuywa (Figure 5.3).

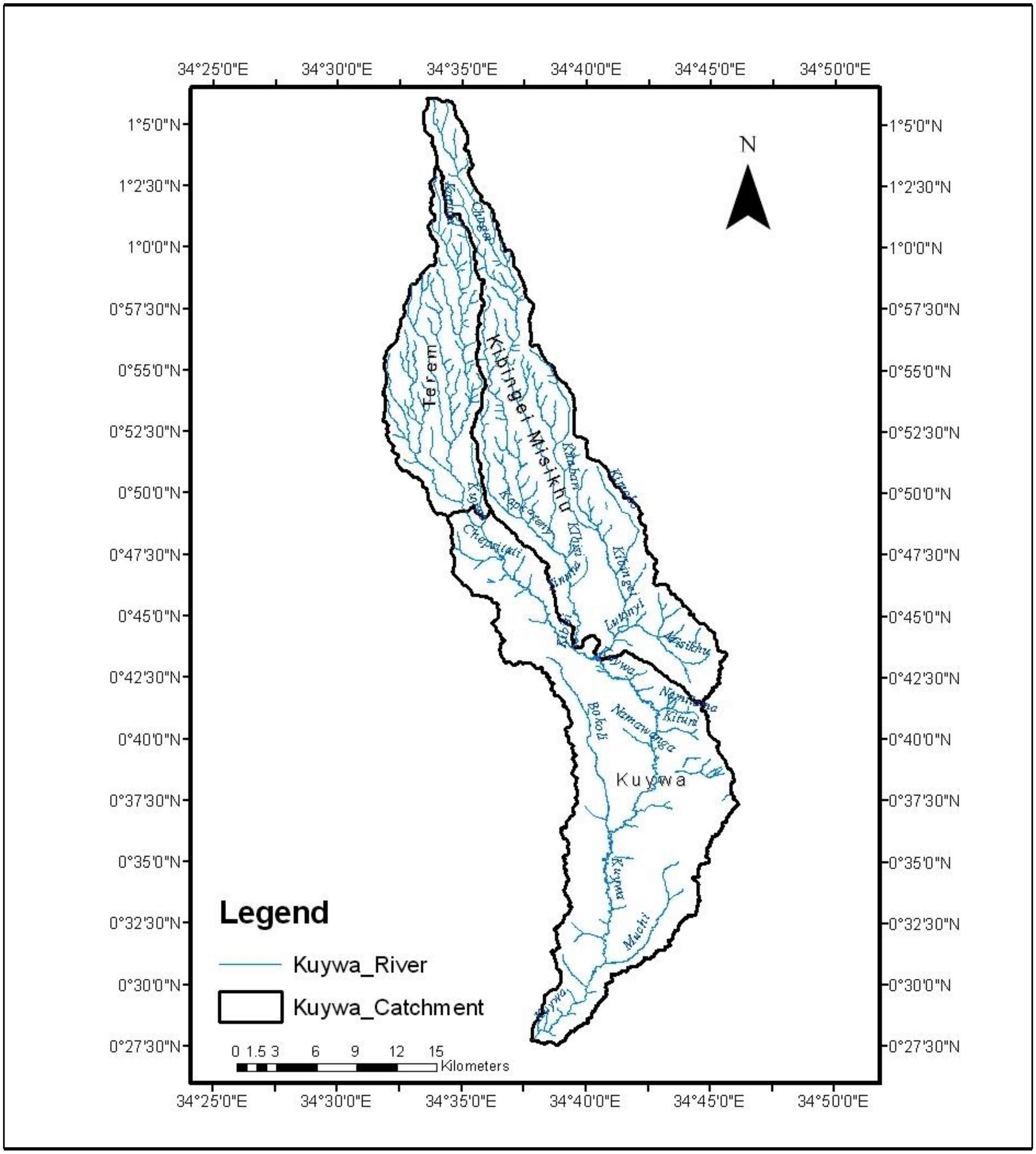


Figure 5.3: The Kuywa River watershed showing its sub-catchments

Source: WRMA – LVNCA (2013)

The Terem drainage system is within Mt Elgon area in the upper reaches of the Kuywa and is of ecological importance in the basin. The Kibingei-Misikhu drainage system form part of the middle reaches of the river together with part of the Kuywa drainage system that starts from the border of Mt. Elgon Forest to the railway bridge on the Kisumu-Bungoma-Malaba railway line. The lower catchment of Kuywa then covers the area from railway-bridge to the confluence with Nzoia River.

5.2.5.1 Topography and Climate

The altitude ranges from 1637m a.s.l to 1505m a.s.l. The area slopes southwards, with the upper parts consisting of steep slopes but the middle and lower section have gentle slopes. The tributaries of Kuywa River include Kibisi, Samita, Chenjeni Namawanga Chebukaka, Chebusitati Sitolola and Ndaret streams which joins the Kuywa River at different points. The watershed is served by 4 boreholes, 15 springs and several hand dug wells. It also has 3 major swamps (Samita, Namakhele and Namawanga). The climatic condition of the catchment is humid. The rainfall pattern is bimodal, with the long rain season experienced from March to June, the short rain season is from September to November and the dry spell from December to February. The hydro-meteorological network in the watershed comprise of 1 miscellaneous River Gauging Station, about 1 km downstream the water falls at Kapsambu village and 1 rainfall station at Mukuyuni chiefs centre. There is a proposal to install an RGS at the bridge along Chwele- Kimilili road. The mean annual rainfall ranges from 1400-1800 mm and the temperatures from 15^{0}C to 30^{0}C. The geology of the area comprises of metamorphic rocks having a strike of E-W and dipping in the north. These rocks are coarse grained foliated gneisses. In some areas they are covered by young black volcanic soils and ironstones from Mt Elgon Eruptions. These soils and ironstones are from weathering volcanic rocks formed during Mt. Elgon volcanic eruptions (WRMA, 2011).

5.2.5.2 Socio-Economic Activities

The Middle and Lower drainage systems of the River Kuywa Watershed, and their catchment has an estimated area of 292km^2 and is under intense land use and cultivation for livelihood and commercial purposes. The Kuywa Catchment is chiefly in a rural setting with an economy driven by agricultural activities. Favourable climatic conditions, good soils, and abundant human resources has supported the development activities in the area and has led to the growth of market centres which provide supporting services and market for the agricultural products. The major industrial crop within the catchment is sugar cane with most farms forming part of the Nzoia sugar factory Out-grower scheme. Coffee milling, apiculture and horticulture are also practiced within the catchment. Although the agricultural sector provides employment and food for the population and the larger western region it is highly dependent on the Kuywa River leading to high levels of water abstraction and water pollution. The Nzoia sugar factory and the coffee factories are major water abstractor and polluters in Kuywa micro-catchment. Subsistence farming involves growing of maize, beans, arrow roots, cassava, sweet potatoes, ground nuts, yams and millet. Irrigation in Kuywa watershed is carried out near riverine areas to support horticultural farming including cultivation of cabbages, tomatoes, and kales. The main challenge is the deforestation of riverine areas, draining of wetlands, river bank erosion and pollution from pesticides applied on the vegetables.

Livestock rearing is another important activity in the catchment where the main stocks are native cattle, sheep, goats, chicken, and turkeys. This economic activity has led to the construction of several cattle dips which are a major infrastructural development in the area. The major source of concern is the construction of dips close to water resources where the over-spills and wash off from the dip pollutes the water. Brick making is another economic activity that is mainly practised by the youths. It takes place near swamps and springs where there is clay soil and the ground is wet. However, if this activity is not done with caution, it can threaten riverine soil stability leading to bank erosion. The Youth also engage in establishment of Tree nurseries and selling of tree seedlings as an income generating activity. These economic activities are serviced by tarmac roads, earth roads with the Trans-African Highway and the Rift Valley Railway traversing the area. The major roads are Bungoma – Chwele – Kimilili – Kitale road, Kuywa – Kapkateny road, Chepkaka – Mpakani road and Terem – Bokoli road

Water scarcity in parts of the catchment has also forced women and children to walk long distances (over 2-3 km) in search of clean water. The demography of the watershed is influenced by the growing of centres such as Kuywa and Chebukaka markets. This has led to increased demand for water leading to challenges of waste disposal. The River Kuywa watershed is severely degraded as a result of environmental degradation and population pressure on the land resources. The watershed previously covered by natural indigenous forest is now a settlement area. Due to increased human activities, the hilly areas are deforested and catchment encroached resulting in rampant soil erosion. This has lead to deterioration of the water quality and quantity over time. During the wet seasons, the available water is highly turbid and unsuitable for human use. The poor quality of the water has led to persistent waterborne diseases like cholera and typhoid. The major contributors to pollution of the water resources include coffee and sugar processing factories, market centres, cattle dips among others. The magnitude of these problems has led to increasing poverty and food insecurity among community members, deteriorating environmental conditions and continued depletion of natural resources in the watershed.

5.2.5.3 Environmental Governance in the Kuywa watershed

The upper part of the Kuywa River Watershed is managed by the Kenya Forest Service in a protected area, the Mt. Elgon Forest reserve. Historically, the control of forests by the government for conservation purposes started in the colonial era and the Mt Elgon forest was gazetted as a government forest in 1932. The emphasis of the colonial administration was conservation of public goods through protection of forests and water resources, this at the expense of the local community, who were displaced. The gazettement brought along changes in management and exploitation of the resources. The Communities that lived within the forest were relocated into settlement schemes, where they felt alienated from forest resource use and management.

The applicable law here is the Forest Act 2005 guided by the National Forest Policy of 2005 that applies the participatory forest management principles that lace the protectionist approaches implied by the gazettement of the reserve. The Kenya Forest Service (KFS), a parastatal under the Ministry of Environment, Water & Natural resources, is responsible for all gazetted forests. The main activities of KFS include active management of plantations, reforestation and afforestation, law enforcement to control illegal extraction, licensing of forest products and fire protection. Other than the Kenya Forest Service, part of the Mt. Elgon Forest is a Game Park, the Mt Elgon National Park, management for conservation of wildlife and biodiversity by the Kenya Wildlife Services (KWS). The Applicable law for this part of the Forest is the Wildlife Act 1989. One of the objectives of KWS is to share revenue collected from tourism with the local community.

Outside the protected area, the watershed is managed by the Water Resources management Authority (WRMA) under the Water Act 2002 that also recognizes community participation in natural resource management and sets up local level structures to support the application of the principles implied therein. WRMA operates in an environment where a number of stakeholders from other government institutions, the general public and private partners are directly or indirectly involved in activities which affect water resources. As the lead agency for water resources management, WRMA has to ensure that actions by all parties are well coordinated and contribute positively towards sustainable management of water resources. To realize this, WRMA has adopted the principles of Integrated Water Resources Management (IWRM), to coordinate management of water resources at top policy level and on the ground. Kenya is divided into five river basins the Victoria Basin, The Rift Valley, the Ewaso Ngiro, the Tana and the Athi Basins. Each of these is managed by at least one regional water catchment management team. The Kuywa Watershed falls under the Lake Victoria North catchment board, which is mandated to ensure sustainable management of water resources which includes the enhancement and protection of natural flow regimes and maintenance of water quality. While catchment boards manage the water resources, the water supply to households and industry is managed by a water services board. In this watershed the Lake Victoria North Water Services Board manages the abstraction, treatment and distribution of water to the urban centers.

With the coming into force of the water Act in Kenya in 2002, which decentralize the functions of the Ministry of Water to improve the efficiency of service delivery to the public, emphasis has been laid on involvement of all stakeholders in water resources management activities leading to the formation of institutions like the Water Resources Management Authority for specific catchments, the Water Service Boards for each supply area and at local level the Water Resource User Association. There are two water resource user associations in this watershed, the Mt. Elgon (Terem) Water Resource users Association and the Kuywa Water Resources Users Association. Terem Water Resource User Association is yet to be integrated in the Micro-Catchment Management Action Planning (MCMAP) process. The Kuywa Water Resources Users Association is well established and already has a catchment management plan in which they have prioritized appropriate water resources management as their first agenda. This is an indication that the community is already aware of the link between suitable land management practices and water quality. The institutional structures above are well entrenched in the Kuywa catchment, this coupled with the high level of awareness of the community provide a good entry point for this study on the viability of a Payment for Environmental Services scheme for watershed in the Mt. Elgon ecosystem.

5.3 Research Design

5.3.1 Conceptual Framework

This study proposes a viable PES Scheme for watershed management. To achieve this, there was a need to clearly link the landholders' decisions upstream to the environmental services received by urban water users. Therefore very specific land use interventions must be selected that affect water quality and quantity downstream. These interventions require the landholder upstream to forego or change the use of part or all of their land. The Landholders' decision is affected by their preferences and attitudes, as well as their economic situation and other socio-economic characteristics. The flow chart Figure 5.4 shows the conceptual framework for the study.

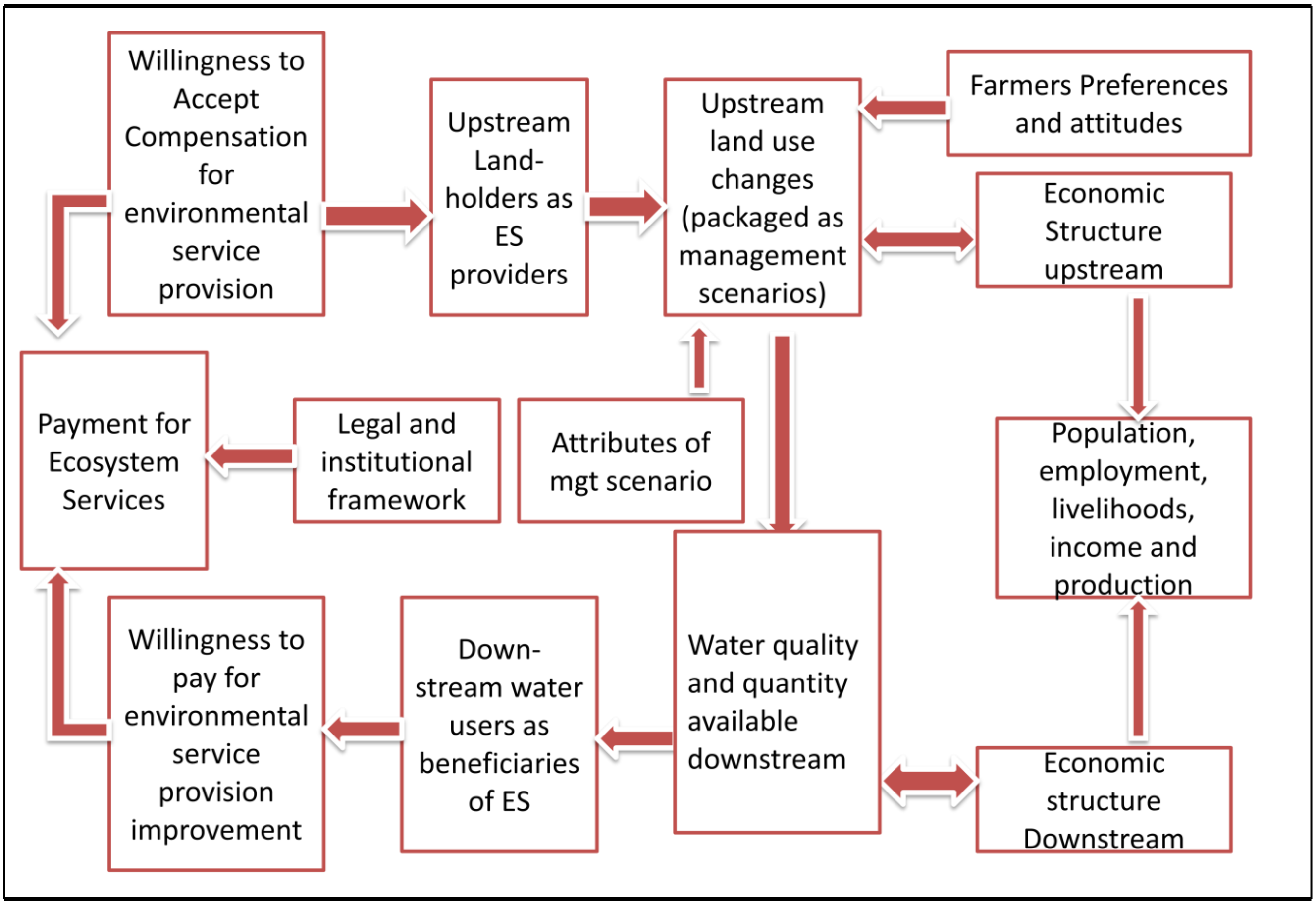


Figure 5.4: Conceptual framework for the study

Source: Field Survey (2013)

The study evaluates the significance of the relationships outlined in figure 5.4 with a view to select the most suitable management scenario. Each management scenario was made up of a set of attributes at specified levels. These were defined and ranked by respondents as an indication of their preferences. The land use upstream was expected to lead to changes in the water quality and quantity available to urban users. This affects the water users economic structure and vice versa. For that reason the urban water user were expected to be willing to pay given their socio-economic situation.

With these two estimates WTA and WTP together with a ranking by landholders on the most suitable management scenario, the study reviewed the legal and institutional framework as they relate to the implementation of PES and proposes a viable PES scheme for watershed management.

5.3.2 Field Design of the Conjoint Analysis Experiment

The term conjoint analysis (CA) refers to an overall approach and group of quantitative techniques that can be used to determine respondent preferences for the attributes that make up a product or service, with the total worth of a product determined by the part-worth of its attributes (Sayadi *et al.*, 2005). A fundamental characteristic of this approach is that the utility derived from a product can be decomposed into part-worth relating to the different attributes of that product (Lancaster, 1966). CA methodology was long associated in marketing research, psychology, and transportation research for evaluating and understanding consumer preference for products or services (Green and Srinivasan, 1978; Anderson, 1982; Louviere, 1988; Hensher, 1994; Roe *et al.*, 1996; Admowicz *et al.*, 1998). Much of the early works in marketing emphasized modelling of behavioural processes to understand how individuals evaluate products or services and form preferences (Green and Rao, 1971; Norman and Louviere, 1974). Today variants of CA are used in many fields including natural resource economics, environmental economics and management, and transportation.

A traditional conjoint question presents each respondent with a product or service descriptions which differ according to the attributes and ask respondents to rank or rate the desirability of each product or service. Most CA applications involve a series of techniques that stem from several common hypotheses which may be summarized as follows (Alvarez-Farizo and Hanley, 2002; Sayadi *et al.*,2005; Louviere *et al.*, 2005):

i. The product or service may be defined using an aggregate of features or attributes that take certain levels or values.
ii. Different levels of the features define different versions of the product or service under consideration.
iii. Product appraisal by individuals is a function of the value or worth which they assign to the product's features.
iv. During the decision-making process, individuals appraise the worth of each combination, and their rating, ranking or choice demonstrates prioritization among the different combinations of features. It is assumed that the total worth of a

particular product choice is determined by the different part utilities (part-worth) of each feature or attribute level.

In a watershed, upstream farmers' land use systems generate negative environmental externalities, including soil erosion and sediment loading, which negatively impact the provision of watershed environmental service. To reverse this trend it is imperative that watershed management is improved, and changes in land use practices by farmers living within the watershed is one of the possible interventions. To facilitate planning for sustainable watershed management, there is need to understand farmers' preferences for the different attributes that make up intended land management /use changes. This information can also be used in developing the Payment for Environmental Services Scheme as it forms the basis for negotiations with potential buyers of the Environmental services. However, there is little information on farmers' preferences as they relate to land management options in the River Kuywa watershed and/or the Mt. Elgon Ecosystem. With no previous experience with this in the River Kuywa Watershed, the starting point was the creation of hypothetical land management scenarios. The field experiments were then implemented in which the farmers were asked to rank the hypothetical land management scenarios, made up of predetermined attributes and levels of attributes. This study then applied conjoint analysis to evaluate farmers' preferences towards a set of unique hypothetical land management schemes.

The experimental foundations for the design of a conjoint analysis is set when attributes and levels of attributes relevant to the study under consideration are selected and defined, by identifying factors are easily communicated and can be put in practice. The selection of attributes and attribute levels for this study was done from a review of literature, focus group discussions and key informant interviews. The study selected six attributes with various levels as shown in Table 5.1:

Table 5.1 Attribute table for land management schemes in River Kuywa watershed

ATTRIBUTES	ATTRIBUTE LEVELS			
	Level 1	**Level 2**	**Level 3**	**Level 4**
Land area to be committed	10% of land	20% of land	40% of land	
Length of commitment period	5 years	15 years	30 years	
Right to harvest products	Permitted	Partially permitted	Not permitted	
Incentive scheme	Provide farming tools distributed annually based on the land size committed to the program	Provide organized , targeted agricultural Extension services to improve farm productivity	Provide a micro credit scheme to support initiation of alternative sources of income. Given to participants according to the size of land you commit	Direct annual cash payment of Ksh.5,000 per acre of land committed
Local scheme administering agent	Water Resource Users Association (WRUA)	Local NGO/CBO	Local office of the Water Resources Management Authority	Rural water supply and sanitation company
Required free labour contribution related to the scheme	1 day	2 days	3 days	

Source: Survey (2013)

Based on findings from discussions these attributes are described below and the hypothesized effect on the ranking is also given.

i. Land Area to be committed: in rural based economies, land is the main factor of production and any scheme must therefore indicate the size of land that the farmer will need to commit to the scheme. Hypothesis: Given the value attributed to land by the community and the insecurity of tenure prevalent upstream the study expects this factor to be very important and have an inverse relationship with the ranking.

ii. Length of commitment period: The dependence on land for livelihood makes the time a farmer commits their land to an activity very important. Given the farmer's expected loss of economic opportunities for the period during which the land is committed, the study hypothesized a relatively important and negative effect on ranking.

iii. Right to harvest products from committed land: With the relatively small land sizes prevalent in the study area, farmers were expected to want to maintain some use rights to the land committed to any scheme. Therefore providing this right was expected to be relatively important and positively affect the ranking of a management scenario.

iv. Incentive Scheme: during pre-visits to the study area discussions with various community groups helped to identify which would be the four most important incentives to the community. Cash level was based on the annual leasing value of the land prevailing at the time. Other selected incentives included the need for credit to support alternative income generating activities, farm tools and extension services to help increase the productivity per unit area for the remaining land not committed to the scheme. It was no possible to hypothesize a relationship upfront since the choice of incentive will differ from farmer to farmer based on socio-economic, demographic and other characteristics.

v. Local scheme administering Agent: to ensure the scheme objectives are met and trust is fosters between parties, literature review revealed that an intermediary organization would be required to facilitate the scheme. This attribute was included to give farmers a chance to select their preferred intermediary. These were also selected during pre-visit discussions and were based on institutions already active in the area. For this attribute it was not possible to hypothesize the effect on ranking since farmers could favour any one of the administrators.

vi. Required Free labour Contribution: Land management schemes that call for change in land use require participation of the farmers in activity implementation including setting up and maintaining required land management structures and also participation in training session etc. This attribute acknowledges this and give farmers a choice on how many days of free labour/time they would be willing to give per month. For this attribute an important and negative effect was hypothesized since it was expected that farmers would prefer to give fewer days of free labour.

Using a factorial design method, previously employed by Arifin *et al.* (2009), on the selected attributes, the study created hypothetical management scenarios from the combination of different attribute levels. From Table 5.1 (the attribute table), of the six attributes, four attributes had three levels and two had four levels therefore (3^4*4^2) generated a total of 1,296 management scenarios. Based on a pre-test of the questionnaire, it was determined that each respondent could comfortably rank a maximum of 9 management scenarios, therefore the full set of scenarios could be handled by 144 respondents. The 1,296 management scenarios were divided among the 144 respondents in a manner that achieved a near orthogonal design using AlgDesign package from R statistical system (Wheeler, 2008). The scenarios thus generated were presented to the respondents as a table with nine scenarios which they were asked to rank on a scale of 1-5 in terms of the likelihood that s/he would participate.

5.3.2 Field Design for the Contingent Valuation Survey

A key issue of any survey is the elicitation architecture, i.e. the way of eliciting information from the respondent. In contingent valuation there are three approaches to elicitation: (i) Where respondents are asked to state their maximum WTP or minimum WTA (open-ended); (ii) Where respondents are asked whether or not they would pay or accept a single sum of money (closed-ended); and (iii) where respondents are asked whether or not they would pay or accept some specified amount and the question is repeated using higher or lower amounts depending on the preceding response (Sequential bids/bidding game). The arbitrarily assigned values in this case vary across respondents (Cameron and James, 1986).

After describing the Hypothetical scenario the Contingent valuation captures how much individuals are willing to Pay for improved water quality and quantity or accept for the provision of required watershed services by changing their land use and management practices. To get the individuals WTP/ WTA, this study used the sequential bids (double-bounded) to elicit responses and each respondent *i* was asked a different initial bid (B_i^1) and asked whether they would be WTP/WTA this amount or not. Depending on their response a follow-up bid which is higher or lower is asked[5]. For each respondent therefore, there is an initial bid (B_i^1) and one of the follow up bids (B_i^L) and (B_i^U) , where (B_i^L) < (B_i^1) < (B_i^U). Each respondent was given a random initial bid and the follow up was dependent on this amount. Regardless of the type of observation, the data was stored in dataset; that is two dependent variables (*LOWERBOUND AND UPPERBOUND*) were used to hold the end points of the interval. If the data is left censored, then the lower end was -∞ and represented by a missing value in *LOWERBOUND;* and if the data are right censored, the upper end is +∞ and is represented by a missing value in the *UPPERBOUND*. The reverse applies for WTP measures. The bid data collected in this study was organized in this way and entered

5.4 Model Description

To ensure accuracy and reliability of the results for the conjoint analysis studies the data collected was analysed using three models; (i) the traditional conjoint rating model; (ii) the Binary Logistic regression; and (iii) the ordered logit model. The traditional conjoint rating model was used to analyze rating data assuming intervals are equal. A binary logistic regression was used to assess the effect of the levels of the attributes on farmer's

[5] For WTA survey the follow-up bid is lower if the first bid was accepted and higher if the first bid was rejected. Conversely for WTP survey the follow-up bid is higher if the response for the initial bid was yes and is lower if the first bid was rejected.

preference to definitely undertake a specific scenario. While the Ordered logit model was used to analyze the rating data assuming intervals are not equal.

For the contingent survey data, the study uses an approach to quantitative analysis which can be viewed as an extension of Turnbull's estimator (Turnbull, 1976) for interval censored data, in which a new estimator is calculated by Belyaev and Kristrom (2010) using a survey on the valuation of public goods. They estimated a survival function based on a Weibull and a mixed Weibull/exponential distribution and proved that a consistent Maximum likelihood estimator exists and that its accuracy can be consistently estimated by re-sampling methods in these two families of distributions.

5.4.1 Traditional Conjoint Rating Model

5.4.1.1 Introduction

The statistical method primarily used in Traditional conjoint analysis is Ordinary Least Squares regression. The underlying assumption of this method is that the rating scale responses satisfy the numerical properties associated with interval scales i.e that individuals can use rating scales to provide meaningful differences between scenario profiles and that the units of the rating scale represent equal differences (Louviere *et al.,* 2005).

5.4.1.2 Mathematical Representation

The landholders' rating for each management scenario is assumed to be proxies for individual utility and assuming (a) rating scale intervals are equal; (b) the individual's utility function is strictly additive and linear in the model parameters; (c) The errors are distributed normally and independently with constant variance; the unobserved latent utility of individual n when he selects management scenario j will be expressed as in equation 1.

$$U_{nj} = \beta_o + \beta_1 R_{nj} + \varepsilon_{nj} \quad \text{...(1)}$$

where

β are unobserved true parameters that linearly relate the observed ratings to the unobserved latent utility

R are the rating given by respondent n to management scenario j

ε is an error term

The ratings provide information about the true utilities, and thus allows one to specify the rating data as a linear regression of attribute levels as shown in equation 2.

$$R_{nj} = \alpha_o + \beta_1 X_{1,1} + \beta_2 X_{1,2} + \ldots + \beta_{m-1} X_{1,m-1} + \ldots + \beta_{k(m-1)} X_{k(m-1)} + \varepsilon_{nj} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Where

β*'s* are utility or preference estimates (part-worth) associated with each attribute level, and

ε_{nj} is an error term that must satisfy the usual OLS assumptions of mean zero, constant variance and independence.

If the assumptions are satisfied, the estimated β*'s* can be interpreted as part-worth utilities, representing the conditional response means associated with each attribute level.

5.4.2 Binary Logistic Regression

5.4.2.1 Introduction

A binary logit model was used to assess the effects of the levels of attributes on farmers' preferences to definitely undertake a specific scenario among the different options presented during the conjoint experiment.

5.4.2.2 Mathematical Representation

The mathematical representation of the binary logit model is presented below. A binary dependent variable Y is created where:

Y = 1 when the individual would definitely undertake a given scenario; and

Y = 0 otherwise.

In this approach only those individuals who said they would definitely undertake a given scenario were counted as participating. Further it is assumed that individual's decisions to participate depend upon program attributes. The rational farmer will prefer to undertake the i^{th}management scenario if the utility he expects to derive from *i* is greater than or equal to the utility he would expect to derive from other alternative contract scenarios.

In other words:

$Y_i = 1$ *if* $U_{ni} \geq U_{nj}$, $\forall_{j\neq i}$ *and*

$Y_i = 0$ *if* $U_{ni} \leq U_{nj}$, $\forall_{j\neq i}$

It follows that the the utility that farmer *n* derives from the observed attributes of the i^{th} land management scenarios can be represented as equation 3:

$$V_{ni} = \beta_i X_{1i} + \ldots + \beta_k X_{ki} + \alpha_i H_i + \ldots + \alpha_R H_R + \varepsilon_{nj} \ldots\ldots (3)$$

Where:

X_{1i} .... X_{ki} are levels of the identified attributes

H_1 ..... H_s are respondent's individual socio-economic characteristics

B_1...... β_k and α_1 ...α_s are unknown parameters

ε_{nj} .... is an error term

Assuming that the error terms (ε_{nj}) are iid and that the utility difference is logistically distributed, the Logit model is an appropriate estimation technique. The Logit model has the advantage over other probability models such as probit, in that the logit parameter estimates are easily interpreted as the logarithm of the odd ratios. For a given attribute an odd ratio of one indicates that the attribute has no effect on the odds that respondents will prefer the hypothetical scenario to another alternative scenario. An odd ratio of less than one would imply that higher levels of the attribute reduce the odds of respondents prefering that specific hypothetical scenario versus the alternatives. An odd ratio of greater than one implies that higher levels of the attribute increase the odds that respondents will prefer the scenario under consideration compared to other alternatives scenarios.

5.4.3 Ordered Logistic Model

5.4.3.1 Introduction

An ordered Logit model will be used in the analysis of the respondents rating for alternative management scenarios. Suppose a rating scale of 1 – 5; it follows that the dependent variable is the rating between **1** (a respondent preferred that he would definitely not undertake) and; **5** (a respondent preferred that he would definitely undertake). The independent variables are the levels of the attributes and the specific characteristics of the respondents.

We assume that any contract that the farmer rates with a higher number is preferred over any contract that he/she rates with a lower number. But unlike in the traditional conjoint model, we do not assume that the intervals between ratings are equal. The ratings are characterized as discrete and ordered, but not ordered by equal intervals and again assuming the error terms are distributed over the logistic function.

5.4.3.2 Mathematical representation

According to the ordered lit model, the utility that farmer *n* derives from the observed attributes of the i^{th} land management scenarios can be represented as in equation 4.

$$V_{ni} = \beta_i X_{1i} + ...+ \beta_k X_{ki} + \alpha_i H_i + ...+ \alpha_R H_R \quad ....(4)$$

Where:

X_{1i} .... X_{ki} are levels of the identified attributes

H_1 ..... H_s are respondent's individual socio-economic characteristics

B_1...... β_k and α_1 ...α_s are unknown parameters

Though V_{ni} , the indirect utility derived from a particular contract cannot be observed, the conjoint rating experiment provides information about farmer's ranking of alternative scenarios. We observe the ranking 1 through 5 where:

Rating = 1 *if* $V_i \leq \mu_1$

Rating = 2 *if* $\mu_1 \leq V_i \leq \mu_2$

Rating = 3 *if* $\mu_2 \leq V_i \leq \mu_3$

Rating = 4 *if* $\mu_3 \leq V_i \leq \mu_4$

Rating = 5 *if* $V_i \geq \mu_4$

and μ_1 ....μ_4 are estimated cut off points

The probability that the farmer will give a rating of j to the i^{th} contract scenario is given as equation 5:

$$\Pr(Rating = j) = \Pr[\mu_{j-1} < (\beta_1 X_{1j} + \ldots \beta_K X_{kj} + \alpha_{1j} H_1 + \ldots + \alpha_{RJ} H_R) < \mu_4] \ldots\ldots\ldots\ldots\ldots\ldots (5)$$

Assuming a logistic function of error terms, ordered logit fitted by maximum likelihood is an appropriate analytical approach (Greene, 1993). Fitting ordered logistic regression with maximum likelihood method with *'ranking'* as an ordered-category variable yields the probabilities for each category of *'ranking'*.

5.4.4 Models Based on Interval Censored Data

5.4.4.1 Introduction

To address objective two of this study, a contingent valuation method was used. It is a widely accepted survey based approach to measure non market values of environmental services. The underlying assumptions are that (i) people have true preferences for all kinds of environmental goods and services; and (ii) people are able to transform these preferences into monetary value (Hoevenagel, 1994). On the basis of these assumptions, respondents' are given descriptions of the proposed hypothetical scenario or environmental change that would alter environmental quality or the provision of a public good or service and they are asked to express in monetary units the maximum amount they would be willing to pay (WTP) to secure a positive change or minimum compensation they would demand (WTA) for a negative change or loss of access.

The ultimate goal in CV studies is to estimate WTP/WTA measures. In this regard two broad modelling approaches can be pursued in analysing CV survey data: (i) Models relating the Yes/No responses to the monetary stimuli that induced respondents qualitative measures of value; and (ii) model directly relating threshold bid values to estimate the actual WTP/WTA. Models under this category are based on econometric tools developed for the analysis of interval censored data.

Interval –censored data means that a random variable of interest, in this case the specific amount the individual is WTP/WTA, not observed exactly, but is known only to lie within a given interval. Manski and Molinar (2010) point out that intervals are more common in daily communication than we ordinarily think since when a respondent is asked to report a point, they sometimes round it to describe a sentiment that really is an interval. The double bounded CV data can be organized in left-censored, right censored and interval censored dataset format. In the WTA case those who give a 'yes,yes' are left censored, those who give a 'no' no' response are right censored and those with 'no, yes' or 'yes, no' fall within an interval. Using maximum likelihood estimators with interval data, the bids were modelled and the mean WTA/WTP was obtained.

5.4.4.2 Mathematical Representation

The WTA/WTP is modeled mathematically as outlined below:

Let

$y = X\beta + \varepsilon$……………………………………………………………………………..(*6*)

Where:

y represents continuous outcomes underlying latent variable

The model assumes normal distribution of the error term ε. For observations *i €P we observe* y_i (point data); observations *i €L are left censored (*we know only that the unobserved $y_i$is less than y_{Li} i.e a censoring value). Similarly observations *i €R* are right censored (we know only that the unobserved $y_i$is greater than or equal to y_{Ri} i.e a censoring value). Observations *i €I* are interval (we know only that the unobserved $y_i$is in the interval [y_{1i} *and* y_{2i}). The likelihood function is represented in equation 7.

$$\ln L = -\frac{1}{2}\sum_{i\,€P} wi\left\{\left(\frac{yi-\mathrm{X}\beta}{\partial}\right)^2 + \log 2\pi\sigma^2\right\} + \sum_{i\,€L} wi \log\left(\frac{yLi-\mathrm{X}\beta}{\partial}\right) + \sum_{i\,€R}^{wi\log\left\{1-\theta\left(\frac{yRi-\mathrm{X}\beta}{\partial}\right)^2\right\}} + \sum_{i\,€I} wi\ \log\left\{\theta\left(\frac{y2i-\mathrm{X}\beta}{\partial}\right) - \theta\left(\frac{y1i-\mathrm{X}\beta}{\partial}\right)\right\} \ldots..(7)$$

Where ϴ() is the standard cumulative normal and w_i = 1. In this study the analysis of empirical CV data applied the equation above to estimate the mean WTP/WTA.

5.5 Data Specification and Description

For the Conjoint experiment, the respondents ranking (1 through to 5) of the different management scenarios presented are the dependent variable together with the willingness to participate in the scheme, while the explanatory variables are the levels of the six attributes described in section 5.3.2 and the respondents' socio-economic and demographic characteristics gender, age, education, household size, farm size, farm income from, Off farm income, Conservation practices, access to finance, information on trade in Environmental services, awareness of upstream/downstream effects in watershed, and membership of the water Resources Users Association(WRUA). These are listed in Table 5.2. They represent both continuous and categorical variables used in the analysis. The Continuous variables take on numerical values while the categorical variables take on values are defined in the questionnaire.

5.5.1 Variables Used in the Conjoint Model

Table 5.2 shows the explanatory/ independent variables that were used during the survey, selected based on literature review where they were found to be the most likely to affect the ranking (dependent variable) of the management scenarios and the respondents decision to participate in the scheme.

Table 5.2: Description of respondent's characteristics used in CA and their effect on participation and ranking of the management scenarios

Variable name/Label	**Description**	**Hypothes -ized sign**
Gender	Sex of the respondent (household head). [dummy: sex = 1 for male and 2 for female	+ / -
Age	Respondent's age in years	+/ -
Education/ EDUC	Respondent's highest level of education; dummy variable with six categories. The base category for illiterate i.e., respondents having never any schooling takes 1 and 2 for basic literacy in religious or traditional; then 3, 4, 5 and 6 for primary, secondary, technical/vocational and college/university levels schooling respectively.	+
Household size/ HHSIZE	Total household size (head count)	-
Land size owned/ ACERAGE	Total land size owned by the household in acres	+
Agricultural income/ FARMINC	Net household income from agricultural activities (cropping and livestock activities) in Ksh.	-
Total Household Income	Total household income from farm and offfarm activities in Ksh.	+
Accesse to finance/ ACESSFIN	Whether the household got access to financial services; dummy (yes=1; and No=0)	+
Conservation practices/ ENCON	Previous/existing experience in environmental conservation practices; dummy (yes=1; No=0)	+
Prior information in Trade in Environmental Services/ TRADEES	Whether the household got any prior information about market-based provision of environmental services; dummy (yes=1; No=0)	+/-
Awareness of Upstream/downstream effects in a watershed/ AWARE	Whether the household is awaress of the effects of upstream activities on quality and quantity of water received downstream	+
Participation in WRUA/ MKRUA	Whether the household is a member of the water resources user Association (WRUA); dummy (yes=1; No=0)	+

Source: Survey (2013)

AGE is a continuous variable measured in number of years and is expected *a priori* that the hypothesized sign of the coefficient of AGE could be positive or negative. GENDER, a is hypothesized to have a positive or negative sign because whereas male-headed households are likely to have better access to information and services in rural areas in Kenya, many men seek wage employment and farming is hence undertaken by women farmers. The variable EDUCATION is measured in terms of the highest grade the respondent has achieved in formal education and recorded as a categorical variable. It is hypothesized to be positively related to willingness to participate and influence the ranking of management scenarios since it is expected that higher levels of education would mean more exposure to knowledge and information. The HOUSEHOLD SIZE was established by obtaining information on number of people residing in the home. Large family size implies more land required to grow food crops and therefore less willing to participate in scheme that sets aside land for none-food activities and hence the hypothesized sign for HOUSEHOLD SIZE is negative.

LAND SIZE OWNEDbecomes the key factor in influencing households‟ preference to the land management scenarios. During the focus discussion and stakeholders‟ workshop, small land size was identified as one of the major challenges in the study area. Therefore with respondents having small parcels of land, it is expected that they would not favour land management contract schemes that limit their access to the land without adequate compensation. Other things being equal, households owning larger land area are more likely to commit part of their land for proposed PES scheme compared to small holders. The hypothesized sign is positive. FARMINCOME is hypothesized to have a negative relationship in the scheme since the higher the farm income the higher the opportunity cost to the respondent and unless the compensation is sufficiently high this respondent is unlikely to want to participate in the scheme. The opposite is true for OFF-FARM INCOME.

ACCESS TO FINANCIAL SERVICES was identified as an important variable hypothesized to have a positive relationship with preference for management scenarios and participation in the scheme. It is expected that increased access means an enabling environment for financial transactions and therefore increased confidence in the applicability of the scheme. The variables CONSERVATION PRACTICES; those AWARE of the upstream/downstream relationship in watershed and those who are members of the WRUA are identified as among the important factors that influence respondents' preference for a specified land management scenario in a positive way. It is expected that respondents who are already carrying out some conservation activities, have information of trade in ES are aware of the effects of their activities in the watershed and are members of the WRUA are more likely to participate in the scheme than those who do not(Bedru Babulo *et al.*, 2008). For those with prior information on TRADE IN ES,it is not possible to predict the sign in advance since respondents' selection will depend on the success or failure story of any previous scheme.

5.5.2 Variables Used in the Contingent Valuation Analysis

The variables used in the CV models were selected in order to exhibit/proxy the respondents' demographic, attitudinal, economic, behavioural, human capital, and awareness. They include:

Demographic: Respondent's age (in years) and gender (male=1; female=0)

Attitudinal: Respondents' perception on the severity of the problem either in the status of the environment; the water quality; the water quantity; and opinion on beneficiary pays concept.

Economic: This was approximated by several variables including as appropriate: (a) Total household net income from both farm and off farm income; (b) Total farm income; (c) ability to pay current water bill (b) whether water shortage has affected household's income and labour time.

Behavioural: This was approximated as appropriate by the participation in environmental conservation activities; membership to the Water Resources Users Association or any other environmental group; the actual problem the household faces in relation to water shortage.

Human capital: The education level of the respondent was used to reflect the human capital aspect. The six education classes used in the questionnaire include: Never been to school; basic literarcy in religious or traditional settings; primary; secondary; technical/vocational and college/university levels.

Awareness: This was to elicit respondent's knowledge on the relationship between upstream catchment management and water quantity or quality received downstream.

The descriptions of the explanatory variables included in the models are presented in Table 5.3 for WTA and Table 5.4 for WTP.

Table 5.3: Variables included in the contingent valuation survey and their effects on Willingness to Accept Payment (WTA)

Variables	Description	Hypothesized Sign
Age	Respondent's age in years	Positive
Gender	Sex of the respondent (household head). [dummy: sex = 1 for male and 2 for female	+/-
Education	Respondent's highest level of education; dummy variable with six categories. The base category for illiterate i.e., respondents having never any schooling takes 1 and 2 for basic literarcy in religious or traditional; then 3, 4, 5 and 6 for primary, secondary, technical/vocational and college/university levels schooling respectively.	Negative, respondents with higher education level are expected to be aware of the benefits of conservation and willingness to participate in environmental protection with relatively lower compensation
HHsize	Total household size (head count)	Positive because land commitment for conservation schemes costs more with household size
Total income	Total household income from farm and offfarm activities in Ksh.	Untenable to hypothesize the sign *a priori*; depends on the marginal utility of money and perception
Perception of Environmental status	Respondents perception of the status of the environment (1-Very Good to 4-very degraded)	Negative since a respondent who views the environment as good is less likely to accept compensation for extra work or will demand very high compensation

Variables	Description	Hypothesized Sign
Perception of water quality	Respondents perception of the quality of water in river Kuywa (1-Very Good to 4-very Poor)	Negative since a respondent who views the water quality as very good is less likely to accept compensation for extra work or will demand very high compensation
Perception of water quantity	Respondents perception of the quantity of water in river Kuywa (1 – very reliable to 4- very unreliable)	Negative since a respondent who views the water Quantity as very good is less likely to accept compensation for extra work or will demand very high compensation
Aware	Whether the household is awaress of the effects of upstream activities on quality and quantity of water received downstream (yes=1; No=0)	Negative, it is expected that members of the WRUA have high level of environmental awareness and experience to be able to provide environmental services at relatively lower compensation +
ENCON	Previous/existing experience in environmental conservation practices; dummy (yes=1; No=0)	Negative, it is expected that members of the WRUA have high level of environmental awareness and experience to be able to provide environmental services at relatively lower compensation
MKWRUA	Whether the household is a member of the water resources user Association (WRUA); dummy (yes=1; No=0)	Negative, it is expected that members of the WRUA have high level of environmental awareness and experience to be able to provide environmental services at relatively lower compensation
Access to financial services	Whether the household got access to financial services; dummy (yes=1; and No=0)	Positive since access to financial services gives an avenue to receive payment
Tenure	Type of land ownership the respondent has (property rights to land)	Positive since a more secure tenure gives confidence to the owner to utilize as they see fit
Land size	Total land size owned by the household in acres	Negative because the opportunity cost of committing land is less for larger land holders.
Farm income	Net household income from agricultural activities (cropping and livestock activities) in Ksh.	Positive because the opportunity cost is higher.

Source: Field Survey (2013)

Table 5.4: Variables included in the contingent valuation survey and their effects on Willingness to Pay (WTP)

Variables	Description	Hypothesized Sign
Age	Respondent's age in years	Negative but relatively less important
Gender	Sex of the respondent (household head). [dummy: sex = 1 for male and 2 for female	+/-
Education	Respondent's highest level of education; dummy variable with six categories. The base category for illiterate i.e., respondents having never any schooling takes 1 and 2 for basic literacy in religious or traditional; then 3, 4, 5 and 6 for primary, secondary, technical/vocational and college/university levels schooling respectively.	Positive and significant
Household size	Total household size (head count)	Negative
Total income	Total household income from farm and offfarm activities in Ksh.	Positive
Perception of water quality	Respondents perception of the quality of water in river Kuywa (1-Very Good to 4-very Poor)	Negative
Perception of water quantity	Respondents perception of the quantity of water in river Kuywa (1 – very reliable to 4-very unreliable)	Negative
Access to financial services	Whether the household got access to financial services; dummy (yes=1; and No=0)	Positive
Dist to water source in dry season	Distance to the nearest source of water during the Dry season in Km	Positive
Pay for water	Does the respondent pay for the water they are currently using	Positive
Able to pay	Respondents ability to pay current water bill	Positive
Quantity of water used per day	Quantity in litres used by the respondent in one day	Negative
Opinion on beneficiary pays	Respondents opinion on the beneficiary pays concept	Positive

5.6 Sampling Technique

5.6.1 Population

The sample for this study was selected from among two heterogeneous populations. Those living within the watershed of the Kuywa River in the Mt Elgon Ecosystem, with land use rights over one or several resources, form the first population. They were selected because of proximity to the ecosystem that provides water to urban water user, implying that they fall within the sphere of influence on that ecosystem. This population forms the suppliers of the watershed services and therefore from this population the researcher endeavoured to evaluate their willingness to accept compensation for provision of watershed ecosystem services. The second population; the user/beneficiary population comprised those living in the urban areas of Bungoma town, who receive their domestic water supply from the intake on Kuywa River and therefore benefitting from the environment services provided from this watershed. Also included in this population were downstream water users who live within the watershed. They were considered as potential buyers of the watershed services. From this group the researcher examined their willingness to pay (WTP) for improved water quality and quantity.

5.6.2 Sampling Design

The study employed probability sampling that is non-subjective and gives each element of the population an equal non-zero chance of being selected. This also ensured precision and offered the best opportunity to generalize the findings of the sample to the population of interest. The target populations selected best represent the parameters of interest in this study, which are proximity to the ecosystem and river headlands and therefore having influence on the services the ecosystem can provide; and two being a user of the services provided by the Ecosystem without being able to influence the ability of the ecosystem to provide that service. From these populations a sampling frame was generated and using appropriate sampling methods the desired sample size from each population was identified and studied. The results are then used to represent the entire population.

5.6.2.1 Sampling Frame

To generate the sampling frame for the provider population, GIS was used to delineate the watershed area for the Kuywa River and the sampling frame was the list of households living within the delineated watershed based on the Kenya population Census 2009. For the beneficiary population the sampling frame was the list of households living in Bungoma Town which is within the domestic water supply area of the Nzoia Water and Sewerage Corporation, whose water intake in on the Kuywa River and those living downstream within the Kuywa River Watershed.

5.6.2.2 Sampling Methodology

Given the sampling frames generated for each population, a combination of spatial sampling techniques, stratified sampling, and simple random sampling techniques were used to select the study sample. These are detailed in the section below.

5.6.2.2.1 Provider Population:

Using catchment maps provided by the Lake Victoria North Water Resources Management Authority (LVNWRMA), overlaid on a GIS map with administrative boundaries; the researcher listed all sub-locations (smallest Administrative unit) that fell within the watershed. Since the sub-locations vary in size and population, selection of sample households was based on a spatial sampling technique; systematic unaligned pattern (McCoy 2005). Accordingly for each sub-location random sampling points (RSP) were calculated in each cell using ArcGIS tools. This guaranteed a good spatial representation of the sample set. Each RSP represented a survey respondent. For each RSP the GIS coordinates were provided and used to identify the respondents on the ground. Some RSP fell at a spot with no household like churches or market places. To take care of this, some reserve RSP were generated to replace possible ineligible ones.

5.6.2.2.2 Beneficiary Population

With the distribution map of the Nzoia Water and Sewerage Corporation overlaid on a GIS map with administrative boundaries; the researcher listed all sub-locations that fall within the distribution area. There were only two sub-locations in Bungoma Town and the researcher selected both sub-locations. For downstream beneficiary sub-locations the same procedure as in the upstream provider population was used. Since the sub-locations vary in size and population, selection of sample households was based on a spatial sampling technique; systematic unaligned pattern and random sampling point (RSP) were calculated for each sub-location using ArcGIS tools. Each RSP represented a survey respondent and as indicated above, some reserve RSPs were generated to replace possible ineligible ones. Again GIS coordinates for each RSP were provided to identify the household on the ground.

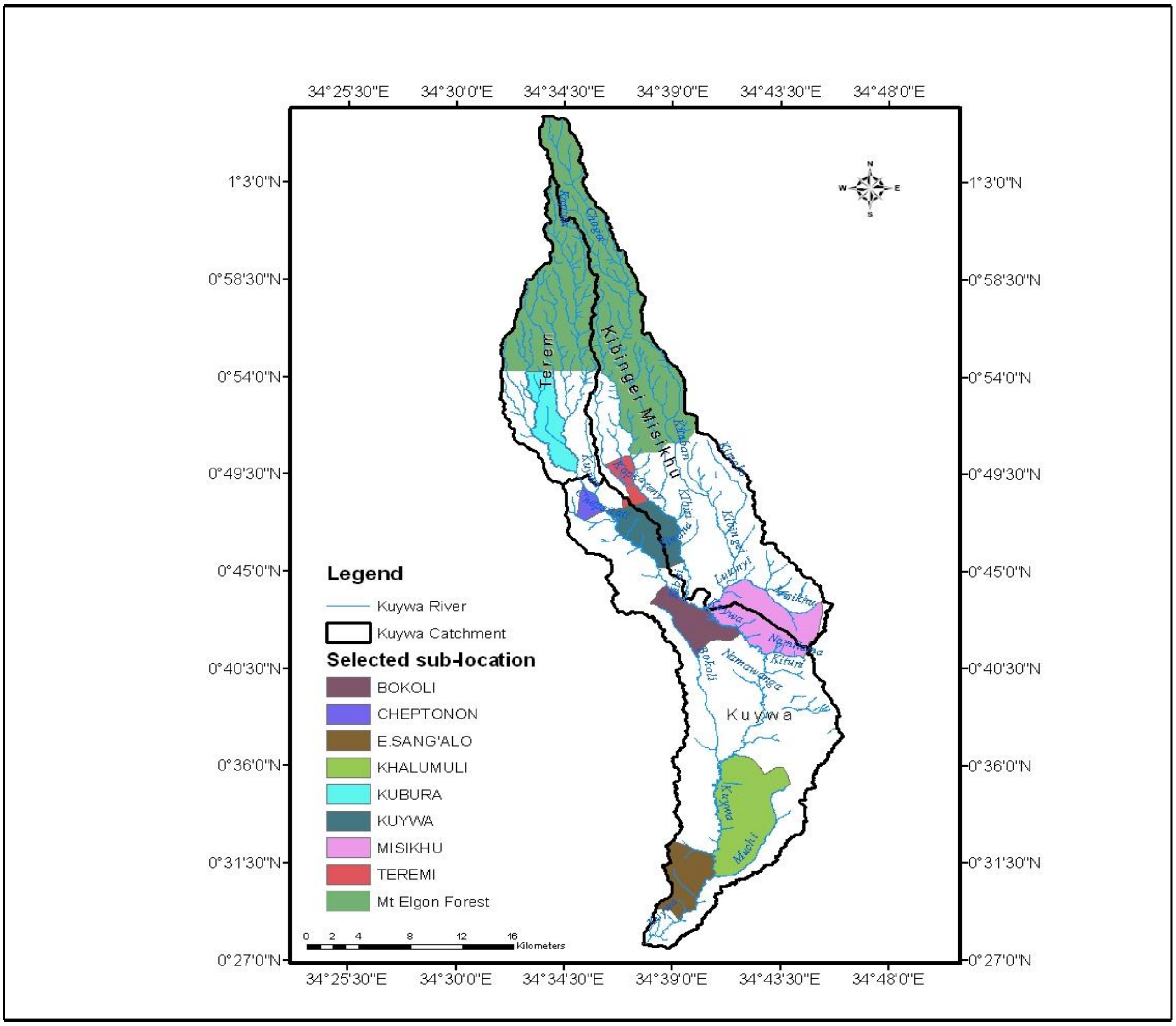


Figure 5.5: Map showing sub-locations within the watershed selected for the study

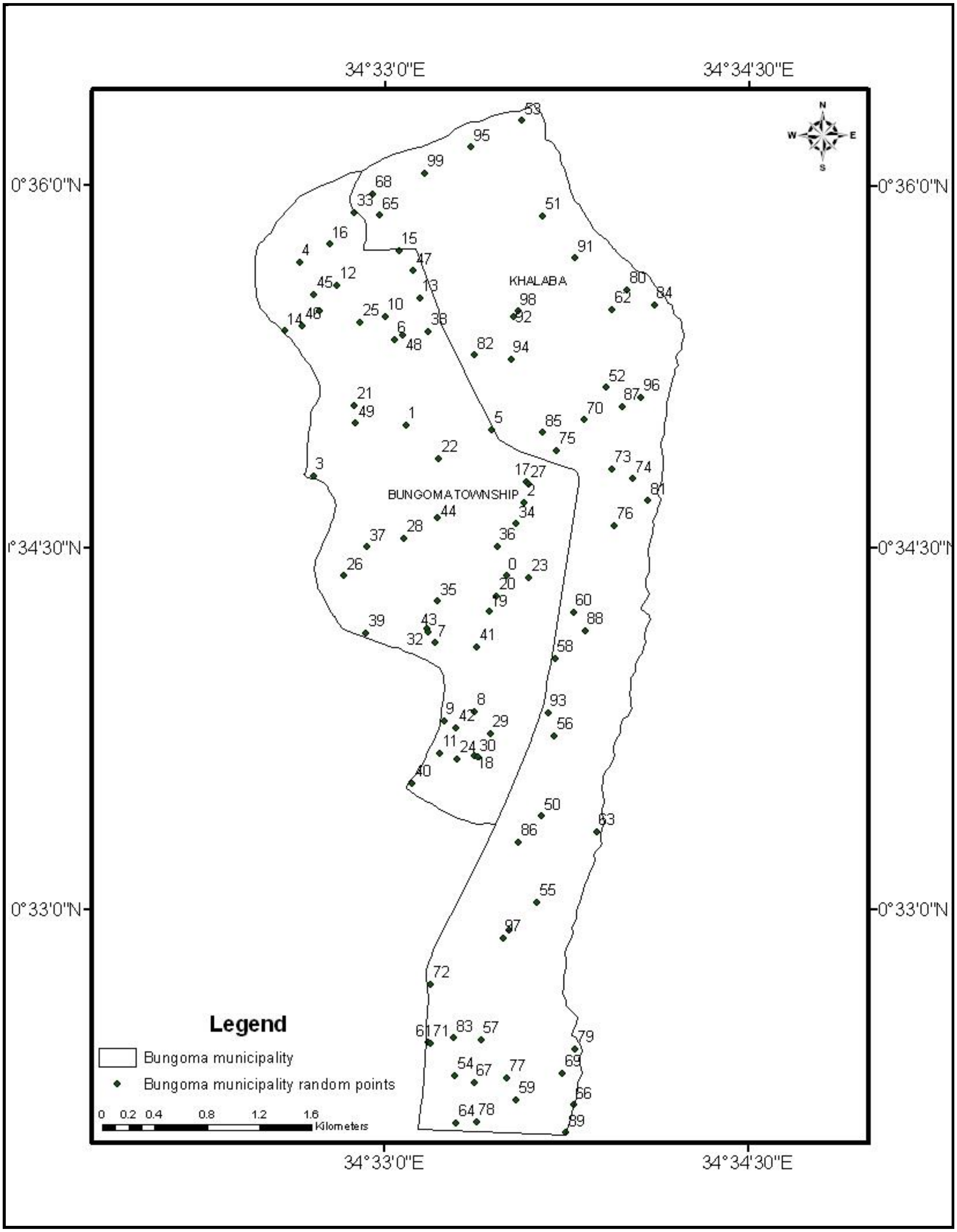


Figure 5.6: Map showing RSP for Bungoma Township the Urban centre receiving water from the Kuywa River

Source, Field Survey (2013)

5.7 Sample size

The required sample size depends on the degree of accuracy required and the extent to which there is variation in the population in regard to the key characteristics of the study. The selected size was therefore a compromise between cost, accuracy and ensuring sufficient numbers for meaningful analysis. The determination of the sample size followed methodology specified by Kothari (2004). The formula for determining the sample size is $n = (z^2pq)/e^2$

Where

n = the desired sample size

z = 1.96, the standard variant at a required confidence level

p = 0.5, the proportion in the target population (potential land owners)

q = 1-p

e= acceptance error of 8.95

Therefore

n = 3.8416 x 0.25 = 0.9604/0.00801025 = 120

From each of the populations a sample size of one hundred and twenty (120) respondents was the minimum number that could be interviewed. The study interviewed a total of 292 respondents: 144 provider population and 148 beneficiary population. For the upstream population the sample size was dictated by the field design of the conjoint experiment as outlined in sub section 5.3.2. For the beneficiary population the sample size was determined using the sampling techniques outlined in sub-section 5.6.2.

5.8 Data Collection Methods

Secondary and primary data was collected for both qualitative and quantitative analysis. Secondary data was obtained from existing relevant literature, while primary data was collected from the field using various data collection instruments. Detailed methodology is discussed below.

5.8.1 Secondary Data Collection

Secondary data was extracted from both published and unpublished literature including books, journals, research reports, District Development Plans and statistical abstracts among others. It complimented primary data sources by providing the theoretical framework for the study and informing interpretation of the study results. Useful information was obtained from various agencies and government Departments. The Forest Department (FD) and the Kenya Wildlife Services (KWS), provided information on policy and management systems used to manage the Mt. Elgon Ecosystem. They also provided information on the current ecological state of the catchment, services it provides and reports citing problems encountered in sustainable management of the ecosystem. The Department of Resource Survey and Remote Sensing (DRSRS) provided maps and statistics on the vegetative quality of the ecosystem and the area of study in general. The World Conservation Union (IUCN) has been working in Mt Elgon for a long time and provided literature from studies done in the area. Several other research institutions and institutions of higher learning were visited to review relevant literature.

5.8.2 Primary Data Collection

The research results will be based on primary data collected using interviews and questionnaire surveys. The tools developed will be administered to the head of household or family member (18 years and older) selected from the target populations for the study.

5.8.2.1 Key Informant Interviews

Key informant interviews were used to collect information from policy implementers on the opportunities available for the sustainable management of the ecosystem and the policy and institutional frameworks in place to support the use of PES. It also informed the selection of management practises and attributes that formed the hypothetical scenario for the survey. The key informants were purposively drawn from various bodies and sectors, including but not limited to the Water Resource Management Authority, Forest Department, KWS, Nzoia water and Sewerage Corporation, local leaders, leaders of water resource user Association and staff of non-governmental organizations working in the area. The Key informant interviews provided in-depth information that may not have been obtained from the questionnaire survey since it provided an opportunity for interaction and genuine conversation. An interview schedule was designed for this purpose to standardize the interview situation and a semi-structured interview technique was employed.

5.8.2.2 Focus Group Discussions

Focus group discussions brought together small homogeneous groups of a maximum of twelve people to discuss specific topics of the study. These discussions used the social dynamics of the group, to stimulate participants to reveal underlying opinions, attitudes, and reasons for their behaviour as they relate to ecosystem services. The discussion was conducted in a relaxed atmosphere to enable participants to express themselves without any inhibitions. This tool was used to gather information from water resource user groups. These groups share a common characteristic as users of the same natural resource.

Using a prepared and pre-tested guide, the researcher sought to find out what ecosystem services are provided, by whom, and who uses the services. The researcher tried to understand the respondents' attitude and perceptions towards payment for ecosystem services and gauged their willingness to participate in such a scheme. The FGD was also used to refine the questionnaire and ensure appropriate language was used. It complemented other data by explaining the respondents' actual thoughts, feelings and beliefs obtained from other data collection tools.

5.8.2.3 Questionnaire Survey

A detailed questionnaire survey of conjoint analysis and contingent valuation methods was developed and used for this study. The questionnaire survey containing detailed enquiry on the major information relevant to the study had four parts covering (i) socio-economic and demographic; (ii) awareness, environmental services, institutions and land use; (iii) conjoint survey (provider) and water supply data (beneficiary); and (iv) contingent valuation. The questionnaire was pre-tested with fifty (50) respondents to get comments and suggestions on instructions, clarity and relevance. The revealed deficiencies in the questionnaire were corrected, before final administration to all respondents. The researcher was assisted by trained enumerators to administer the questionnaires using the most suitable language to ensure effective communication.

5.9 Data Analysis Technique

Both qualitative and quantitative techniques were applied in data analysis. Information gathered from focus groups on perceptions, views, attitudes, opinions and experiences of the local people were summarized qualitatively. The Conjoint analysis was done using the traditional conjoint (Ordinary Least Square); the Binary logistic and ordered logistic regressions as outlined above. The interval data was subjected to an iterative procedure as proposed by Turnbull which estimated the survival function and calculated the mean WTP/WTA. This procedure was implemented using the ***iwtp*** Software run on the statistical computing software R.

5.10 Chapter Summary

The study was carried out in the Kuywa River watershed, which is a tributary of the Nzoia River that Flows from Mt. Elgon to the Lake Victoria. The study area is located Bungoma County in Western Kenya. The Mt Elgon Ecosystem is the headland for this watershed and is one of the five water towers in Kenya. The Kuywa Watershed originates from the Mt. Elgon forest and drains into the Nzoia River system at Khalala, which in turn drains into Lake Victoria. The River Kuywa is one of the major tributaries of the middle Nzoia basin. The entire river system is approx 97km long and traverses Bungoma County. The River Kuywa has a catchment area of 292km^2 serving a mainly rural and agricultural catchment Population is 146,000 people & density of 500 persons/km^2 (WRMA, 2011).

The Kuywa Catchment is chiefly in a rural setting with an economy driven by agricultural activities. Favorable climatic conditions, good soils, and abundant human resources has supported the development activities in the area and has led to the growth of market centers which provide supporting services and market for the agricultural products. The major industrial crop within the catchment is sugar cane with most farms forming part of the Nzoia sugar factory Out-grower scheme.

A total of 292 respondents were interviewed. Different sampling techniques comprising of spatial sampling techniques, stratified sampling and simple random sampling were used. A two part structured questionnaire was used part one of the questionnaire comprised socio-economic and demographic characteristics, section two of the questionnaire dealt with questions to address the conjoint data and section three of the question comprised questions to address the contingent valuation. The data for the conjoint analysis was analyzed using a tradition conjoint model, a binary logit model and an ordinary logit model. The data for the contingent valuation was analyzed using the censored interval regression model.

CHAPTER 6

LAND OWNERS PREFERENCES FOR THE PROVISION AND UTILIZATION OF ENVIRONMENTAL SERVICES

6.1 Introduction

This chapter presents the results of the analysis of survey data collected to address specific objective one of the study which is; to examine respondents' preferences for management options for the provision of environmental services in the River Kuywa Watershed of the Mt. Elgon Ecosystem. Payment for Environmental services (PES) is a relatively new concept in the Kenyan policy context. Although still in its formative years, the interest in PES as a tool for natural resource management is growing. While circumstances differ from country to country, certain threshold requirements exist for all PES transactions to occur. These refer to minimum requirements for example in terms of supply and demand, governance and regulatory aspects and rights in land and ecosystems. The very basic requirement is that there can be no explicit or implied prohibition on PES in any valid law or provision of the constitution. In Kenya this is the case and therefore opening the door for establishment of PES as a management tool.

Markets for watershed environmental services like those provided by the Kuywa watershed, usually involve the financing of upstream land use practicesgenerating benefits and trading commodities such as water quality and quantity. They are generally funded through user fees to finance improved management of the relevant upstream area. This study borrows from this experience and the findings presented in chapter six, cover the state of the environment in the Kuywa watershed including environmental challenges faced and environmental goods and services used by the respondent. The chapter then presents the socio- economic characteristics and land use pattern of the upstream respondents before presenting and discussing the results of the conjoint analysis carried out to establish the respondents, preferences for management options to support a possible PES scheme. Finally the chapter presents the findings of an assessment of the factors that affected the respondents' decision to participate in the hypothetical land management scenarios.

6.2 State of the Environment in the Kuywa Watershed

For PES to be viable there must be a valuable environmental service that is actually being degraded or whose degradation is imminent, and key stakeholders who perceive, or can be made aware of, both the value of the environmental service and the threat. It must also be possible for actions by defined individuals or groups to mitigate these threats or prevent degradation.

6.2.1 Environmental Challenges of the Kuywa Watershed

Due to increased human activities, water catchment areas have been deforested and riverbanks/wetlands encroached resulting in rampant soil erosion. This leads to deterioration of the water quality and quantity. The magnitude of these problems has led to increasing poverty and food insecurity among riparian communities, deteriorating environmental conditions and continued depletion of watershed natural resources. The study examined the state of the environment within the study area and the findings are presented in Table 6.1.

Table 6.1: Respondents' perception of the environmental status within the Kuywa River Watershed

State of the environment	Frequency	Percent
Very good	0	0
Good	14	10.3
Degraded	120	82.8
Very Degraded	10	6.9
Total	**144**	**100**

Source: Field survey (2013)

120 respondents out of the 144upstream respondents (82.8%) perceived the catchment as degraded while another 6.9% thought it was very degraded. Only approximately10%

thought the state of the environment in the catchment was good. To elaborate the state of the environment further the study sought the respondents' opinion on the state of the water in river Kuywa in terms of its quality and quantity. The results are presented in Table 6.2.

Table 6.2: Perception of the respondents on water quality and quantity in the river Kuywa

Status	Water Quality		Water Quantity	
	Frequency	Percent	Frequency	Percent
Very Good/Reliable	0	0	0	0
Good/Reliable	14	9.72	107	74.3
Not good/not reliable	117	81.25	35	24.3
Very poor/ unreliable	13	9.03	2	1.4

Source: Field survey (2013)

In respect to water quality, 81.25% and 9.03% of the respondents reported that the quality was not good and very poor respectively. While 9.72% thought the quality of water was good. On the other hand, 74.3% of the respondents said the quantity of water was reliable against those who felt it was unreliable of 25.7%. To find out which were the most prevalent environmental challenges in the watershed respondents were asked to rank environmental problems according to how severely they affect them, with 1 being the most prevalent problem and 6 the least prevalent. Table 6.3 below shows the mean ranking for each of the problems

Table 6.3: Ranking of environmental problems within the watershed of River Kuywa by respondents

Environmental Problem	Mean Rank	Rank
Deforestation	2.76	2
Poor water quality	1.70	1
Loss of biodiversity	3.84	4
Wetland degradation	3.41	3
Poor agricultural yield	4.14	5
Inadequate water	5.15	6

Source: Field survey (2013)

Respondents felt that poor water quality was their biggest environmental problem, followed by deforestation, wetland degradation, loss of biodiversity, poor agricultural yield and the problem of least concern was inadequate water.

The management of the Mt. Elgon ecosystem offers a daunting challenge not only because of its transboundary nature but also because of its economic potential as a source of finite goods and services that are critical in the livelihood of the local communities and national economies. The population pressure on the ecosystem is high, with an average population of 500 persons per Km^2 (WRMA 2011), the forest products and services are stretched to their limit and in short supply. The River Kuywa watershed, an important watershed in this ecosystem, provides water to both domestic and industrial users. The watershed previously covered by natural indigenous forest is now a settlement area with heavy human activity accounting for the degraded state of the environment which relates to the poverty levels in the study area where 53.9% of the population live below the poverty line (KNBS, 2012).

From discussions the study established that watershed management is socially important to the community because they are very dependent upon having clean water for household use and for livestock. The study results indicate that although the respondents receive more than sufficient water for their use, it was of poor quality. During the wet seasons, the available water is highly turbid and unsuitable for human use. The poor quality of the water has led to persistent waterborne diseases like cholera and typhoid. The poor water quality has been attributed to poor agricultural practices in the study area. The soils in the area are very fertile and have attracted increased agricultural activity which is the main source of income. This coupled with the fact that there are no alternative sources of income in the rural areas and with low awareness on improved land management practices, it is expected that these fertile soils will be lost to erosion in the near future. Farmers use fertilizers and chemicals especially for coffee and sugarcane production which are the main cash crop upstream; and for horticultural crops (vegetables, tomatoes and onions) which are the main short rain crops and usually grown close to the river bank. This is exacerbated by the coffee processing factories in the area which drain their waste water into the river system. These activities affect the water quality, quantity and flow regime downstream. The water in river Kuywa is also polluted by effluent discharge and solid waste from coffee and sugar processing factories, market centres and cattle dips.

Deforestation is mainly blamed on the current high population density of500 persons/km^2 (WRMA, 2011), which continues to increase meaning increased pressure on the resources. In the upper reaches of the Kuywa River Watershed, encroachment into the Mt Elgon Forest reserve is rampant, clearing the forest for settlement, agriculture and wood fuel. The result is increased sedimentation in the river. Though the study was not able to cover this area due to very high sensitivity on issues of land resulting from a just ended conflict, the establishment of PES should include this area otherwise the schemes faces all the challenges associated with leakage.

Activities carried out by farmers upstream affect the water quality, quantity and flow regime downstream. The design and implementation of watershed PES scheme is premised on stakeholders recognizing the relationship between the condition of the ecosystem in a watershed and its capacity to provide watershed services. This establishes a basis for connecting the needs and wellbeing of downstream users of water to the actions of upstream land managers. This knowledge is expected to help influence upstream land use and management practices. The study examined the level of awareness of the respondents and also whether they were already carrying out environmental conservation activities. Table 6.4 reports these findings

Table 6.4: Respondents level of awareness and participation in environmental conservation activities (n=192)

Response	**Awareness (%)**	**Environmental Conservation (%)**	**Aware of trade in Environmental services (%)**
Aware/ Practicing	89.38	55.48	3.4
Not Aware/ Practicing	10.62	44.52	96.6
Total	100	100	100.0

Source: Field Survey (2013)

Majority of the respondents, (89.4%) are aware that the activities farmers carry out on their farms upstream affects the quality and quantity of water received by downstream and urban users. However, only about 56 % are carrying out conservations activities on their farms. Despite the high awareness on environmental conservation within the watershed only 4% of the respondents had heard of trade in environmental services in any of its forms.

Suitable Land use activities like agro-forestry practices, organic agriculture, among others is expected to enhance provision watershed environmental services such as provision of clean water, increased ability of the soil to absorb water, vegetation filtration potential, water flow rates and weather buffering of the wetland and thus the water quality and flow seen as the most valuable of hydrological services. Based on this the study sought to find out what kind of environmental activities the respondents are already carrying out, and if they are not practicing any conservation initiatives why they choose not to. The results are presented in Figure 6.1.

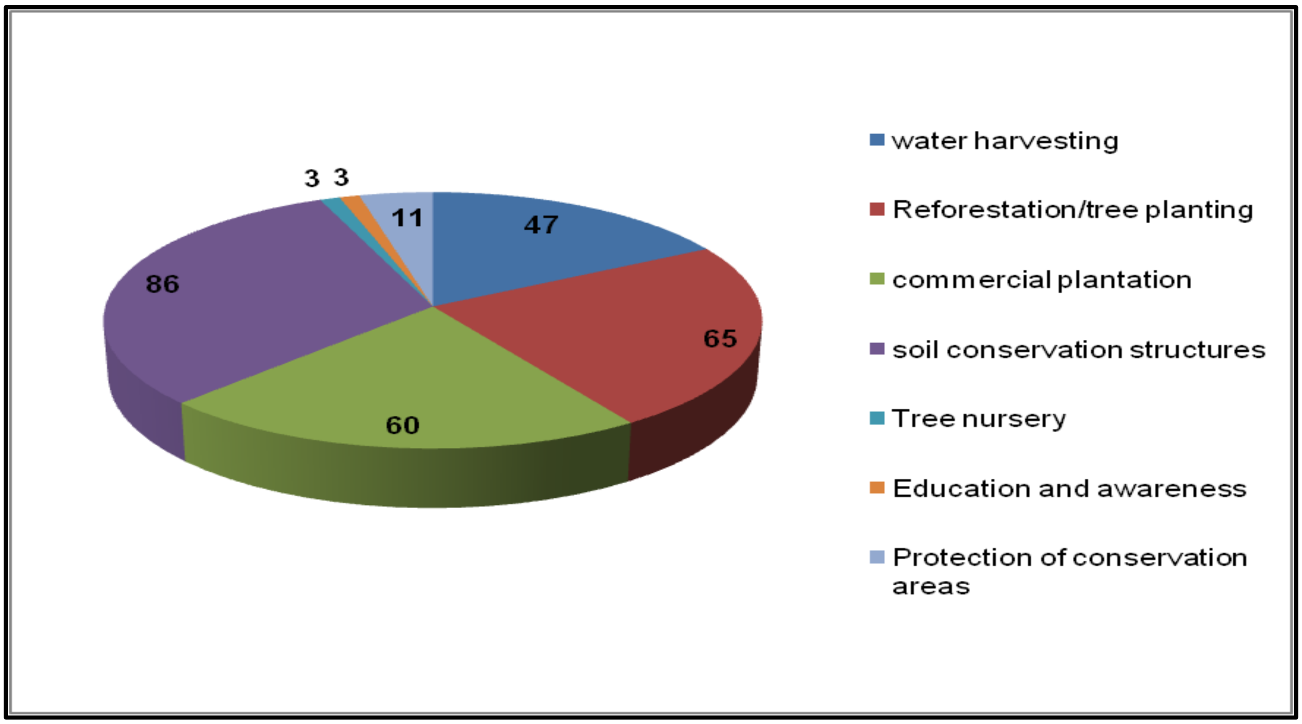


Figure 6.1: Number of respondents carrying out various environmental activities
Source: Field Survey (2013)

The activities the respondents are carrying out will contribute to conserving their land as well as improving the quality of water in the river.

The study results show that the respondents are aware of the interrelatedness of the upstream activities to the downstream. However, this was not matched one-to-one with those who are implementing conservation measures to reduce their impact. The reasons given for not engaging in environmental conservation included a lack of awareness, inadequate labour, lack of money and too little land. During focus group discussions participants indicated that they are aware of the environmental challenges they are facing and their impact. They mentioned that the environmental problems are caused by poor land management by farmers including cutting down of farm trees, farming in riparian areas, use of inorganic fertilizer and lack of or poor done soil conservation structures. They said that despite being aware, they do not have enough knowledge on what would be the best interventions to reverse the problem effectively. They mentioned a poor extension services from Government as the main reason for this. They recommended that the best intervention to reverse the trend on environmental degradation should include training on improved farm management and environmental conservation techniques. This they said would help increase productivity of the small and continually shrinking land sizes and reduce the need to encroachment into ecologically important/fragile areas.

6.2.2 Environmental Goods and Services received from the Kuywa Watershed

Payment for Environmental Services (PES) is a market – oriented instrument, which attempts to use direct economic incentives for ecosystem management that encourages continued provision of environmental services (ES) and alleviates poverty and social conflict which are the main drivers of environmental degradation. In Kenya, there is increased recognition of the contribution of watershed environmental services to water security and the need to invest in the maintenance of watershed services. Bishop and Landell-Mills (2002) determined that in developing a PES scheme, it is important to define, measure and quantify the environmental services that will be generated by the scheme. A background analysis of the study area together with primary data collection was used to determine the situation of existing natural and water resources in the watershed. Figure 6.2 shows the number of different goods each respondent uses.

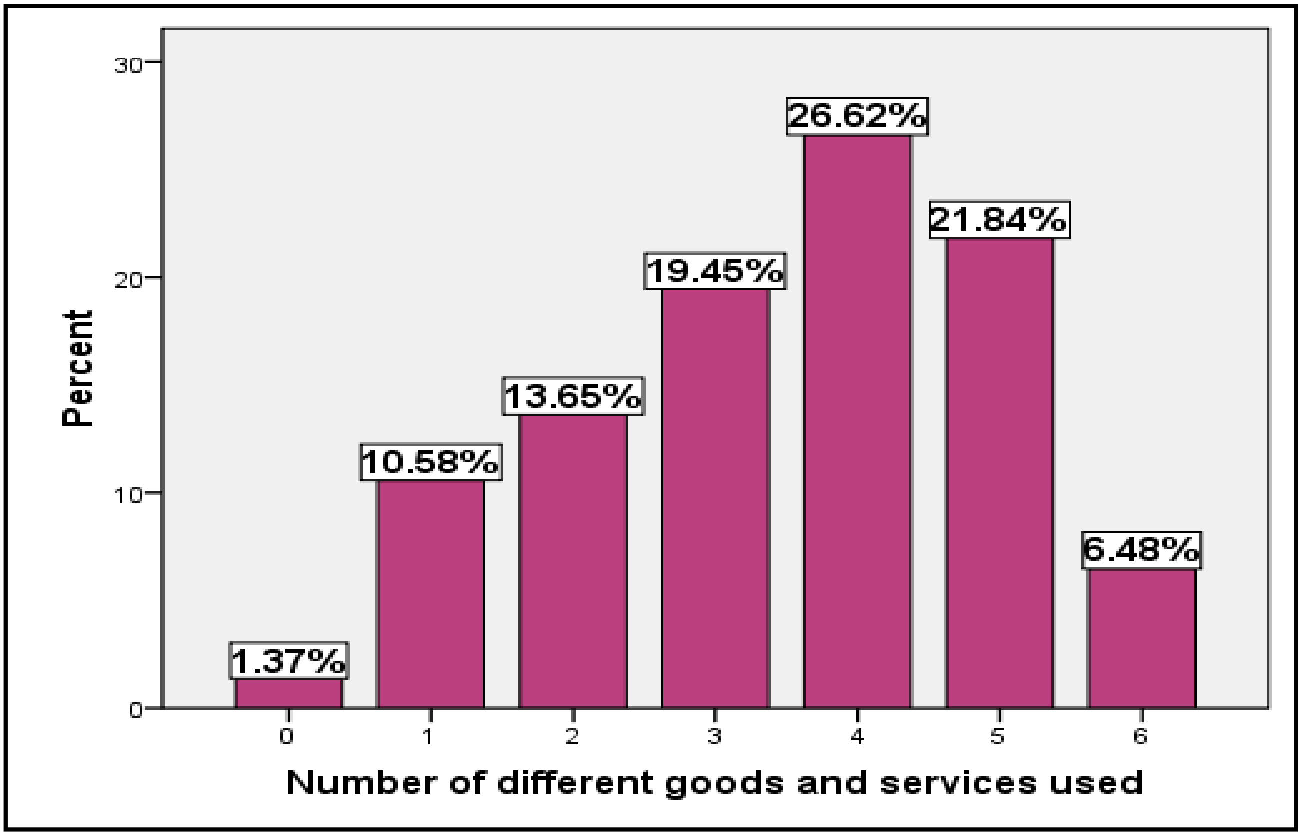


Figure 6.2: Number of different goods and services used by respondents (n=192)
Source: Field survey (2013)

Ninety nine percent of the respondents used environmental goods and services for livelihood support, with most respondents using more than one good or service. Most respondent (26.62%) used four different types of environmental goods and services, followed closely with those who use five different types of environmental goods and services (21.84%). Most of the respondents use between 3-5 different goods and services, with slightly over one percent not using any environmental goods and services. Respondents were asked which goods and services they use and their responses are reported in Figure 6.3.

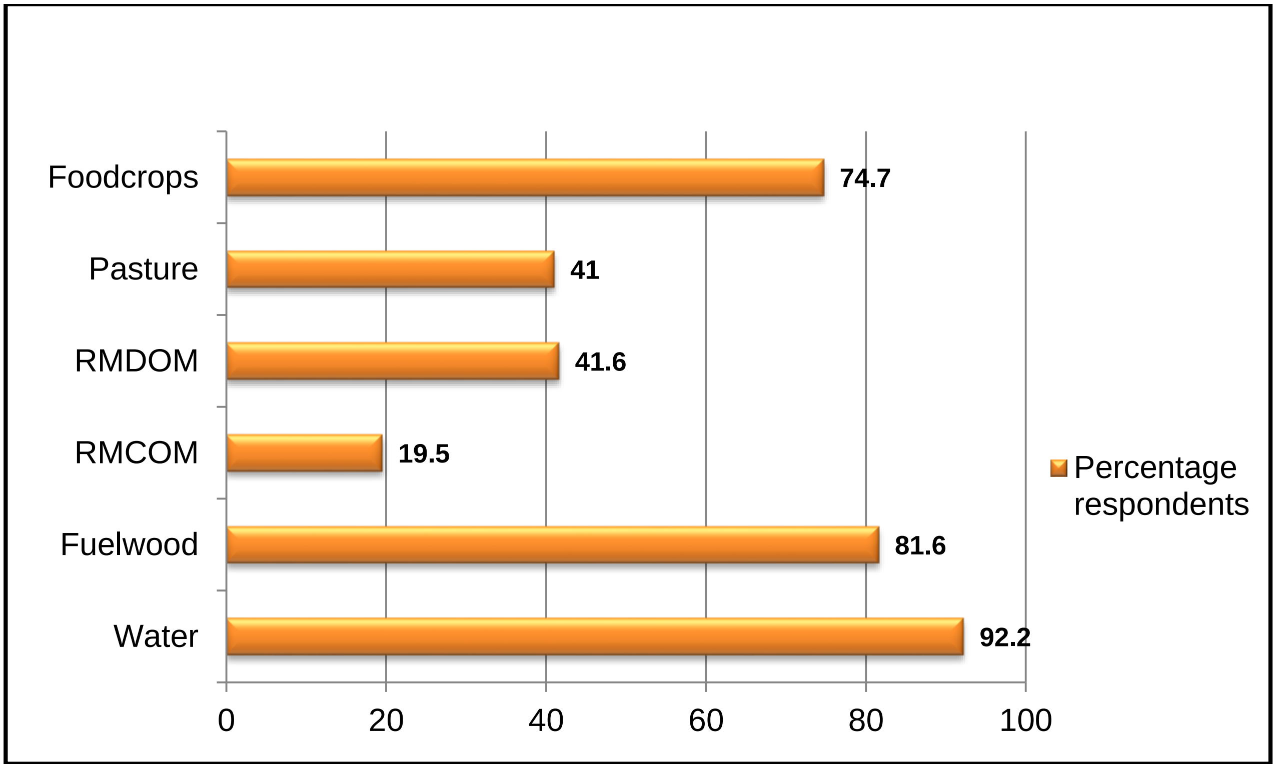


Figure 6.3: Environmental goods and services used by respondents (n=192)
Source: Field Survey (2013)

Among the Natural resources respondents use are Water, fuel wood, pasture, gathering and/or growing food crops and other raw materials including Clay, reeds, timber, and Non-Timber Forest products (NTFP). Ninety two percent of the respondents use water, 81.8% collect fuel wood; 74.7% gather or grow food crops, while 41% use the forests to graze their animals. Of the other raw materials the respondent use, 19.5% use selected raw material for commercial purposes (RMCOM), while 41 % use selected raw material for Domestic purposes (RMDOM). Of the other raw material used timber was the most used, with 16.4% of the respondents using it for commercial purpose and 28.7% using it for domestic purpose. NTFP were mainly used for domestic purposes (14%) and for their medicinal value. About Twelve percent (12.6%) of respondents used reed for domestic purposes against 3.1% for commercial purposes. The reeds are used mainly for thatch and for making baskets and mats.

Thus far it is established that there are environmental challenges in the Kuywa watershed that are affecting the provision of environmental goods and services (Section 6.2.1) and that the respondents are aware of these challenges. Information from the focus group discussions confirmed this and the groups agreed that the magnitude of these challenges has compounded the poverty levels and food insecurity among the community members. This has also led to deteriorating environmental conditions and diminishing natural resources, particularly water, soil and wood products in the watershed. It is also established that there are environmental goods and services in the watershed that are utilized by both the farmers themselves and the communities downstream including urban dwellers using municipal water (section 6.2.2). This sets the basis for the possible establishment of a PES scheme.

Viana *et al.* (2010) stated that objectives of PES schemes range from restoring natural habitats or tree planting as in Piracicaba, Brazil, or can focus on restricting land use by maintaining existing natural habitat and protecting them from destruction like in Ecuador (Echavarria, Vogel *el al.,* 2009); or improving existing land use towards climate smart agricultural practices, and soil conservation. Based on literature review, Key informant interviews and focus group discussions, the most suitable objective of the PES in this watershed would be one that aims at improving land use practices to reduce tillage along river bank, carry out soil conservation interventions, increase farm forestry, and maintain soil fertility. Deforestation was ranked highly as an environmental challenge therefore the need to protect natural habitat through reduced deforestation of the Mt Elgon Forest, would be and additional objective of the PES scheme that would include the Forest reserve and the communities neighbouring it. These interventions upstream are expected to translate into improved water quality and quantity which the beneficiary population downstream and in urban areas would pay for.

6.3 Upstream Respondents Characteristics

The earlier sections have established that there is an environmental service that can be traded. This service is provided by farmers upstream and purchased by user populations downstream and in the urban area of Bungoma Town. The following section presents the characteristics of the upstream/ provider population and evaluates their preferences for a management scenario that would run a proposed PES scheme. In the Kuywa Watershed two main categories of providers were identified. (i) the farmers living within the watershed, whose farming activities affect the water quality and quantity; and (ii) the Government through the Kenya Forest Service (KFS), the department responsible for the management of the Mt. Elgon Forest Reserve. The farmers were willing to participate in the scheme and change their land use practice. The KFS through Key informant Interviews indicated that this was a very good idea and would contribute immensely to their goals for the management of the Mt Elgon ecosystem.

A total of 144 respondents were interviewed upstream distributed into six sub-locations as shown in Table 6.5.

Table 6.5: Distribution of upstream respondents interviewed in sub locations and by gender

Sub - Location	**Male (%)**	**Female(%)**	**% of total respondents**
Cheptonon	28.0	72.0	17.2
Kuywa	30.4	69.6	15.9
Kapkateny	48.0	52.0	17.2
Nomorio	39.1	60.9	15.9
Bokoli	48.0	52.0	17.2
Misikhu	58.3	41.7	16.6
Total	42.1	57.9	100

Source: Field Survey (2013)

Of the number of respondents, 42.1% (61) were male and 57.9% (84) were female. Demographic characteristics of respondents is said to affect their responses. Table 6.6 shows the summary statistics of the respondents' demographic characteristics.

Table 6.6: Summary statistics of upstream respondents' demographic characteristics (n=144)

	Age	Household size
Minimum	18	1
Maximum	86	13
Mean	41.370	6.140
Std. Deviation	15.025	2.681

Source: Field Survey (2013)

The respondents ranged from age 18 years to 86 years, with an average age of 41 years. Respondents upstream had an average household size of 6 persons and ranging from one person per household to 13 people per household. This indicates that in the study area majority of the people are middle aged and they have relatively large families compared to the county average of 5.31 persons per household (KNBS, 2010). Respondents were asked their level of education and the results are reported in Table 6.7.

Table 6.7: Upstream respondents level of education (n=144)

Education level	Frequency	Percentage
No schooling	5	3.4
Religious/Traditional	3	2.1
Primary school	73	51.0
Secondary school	54	37.2
Technical/Vocational	2	1.4
College/University	7	4.8
Total	**144**	**100.0**

Source: Field Survey (2013)

Majority of the respondents had some years of formal education, with those with primary education making up 51% of the respondents and those with secondary education 37.2; technical and university levels 1.4% and 4.8% respectively. Those with no formal schooling made up only 5.5% of the respondents. The main occupation and therefore main source of income for the upstream respondents is farming comprising over 80% of the respondents.

Income level has been predicted to affect farmer's land use choices; Table 6.8 shows the income levels for upstream respondents.

Table 6.8: Income level and sources for upstream respondents (n=144)

Statistic	Farm Income	Off Farm Income	Total household income
Minimum	417	0	417
Maximum	70000	120000	121700
Mean	8724.49	3868.67	12680.74
Std. Deviation	11397.724	12507.348	17393.838

Source: Field Survey (2013)

Farmers upstream have a mean income of approximately Kenya Shillings (KSh.) 12,700/= per month. The average income from farming activities was approximately KSh. 8700/= per month and that from off-farm activities was approximately KSh. 3, 900/= per month. This is consistent with the report that the area suffer high unemployment (KNBS (2010) and the low farm income could indicate poor farming methods and /or poor soils all indicators of land degradation. This also indicates high level of poverty since this figure translate to USD 0.06 per person per day which is far less than a dollar a day.

6.4 Land Use byUpstream Farmers

Land is an important factor of production in rural economies and therefore land size, tenure and other variables affecting land are critical to any scheme. The study examined the land use characteristics of the respondents upstream and the results are reported in Table 6.9.

Table 6.9: Land size and length of stay on the land by upstream respondents (n=144)

Variable	Minimum	Maximum	Mean	Std deviation
Land Size (acres)	.25	24	3.44	4.10
Length of stay on land in (yrs)	1	62	17.37	14.31

Source: Field Survey (2013)

The respondents upstream have an average land size of 3.4 acres ranging from land as small as 0.25 acres to a maximum of 24 acres. The respondents have lived on these farms for periods ranging from 1 year to 62 years with an average length of stay being approximately 17 years. Land tenure is an important factor that has been found to affect the decision to participate in land management schemes (Kosoy, 2007). The prevalent land tenure systems in the study area are shown in Table 6.10.

Table 6.10: Land tenure and land acquisition by upstream respondents (n=144)

Acquisition	**Land Tenure**				
	Individual tenure	Family land (not yet subdivided)	Communal tenure (community)	Squatter	**Total**
inherited from parents	58	45	3	10	**116** (80.6%)
purchased	18	3	2	5	**28** (19.4%)
Total	**76** (52.78%)	**48** (33.33%)	**5** (3.47%)	**15** (10.42%)	**144** (100%)

Source: Field Survey (2013)

Approximately eighty percent (80.6%) of the respondents acquired their land by inheriting it from their parents. Only 19.4% purchased the land. The Land tenure upstream differed among respondents with individual tenure accounting for 52.8%; family land 33.3%; community land 3.5% and squatters accounted for 10.4% of the respondents. These findings indicate that slightly over half of the participants have secure rights to the land they live on. This is expected to affect the decision they make to participate in the hypothetical scheme, since one need to be able to guarantee their ability to provide the environmental service to be able to participate in a PES scheme. The study then assessed what use the respondents put their land to and Figure 6.4shows the average percentage of total land they use for the different land uses.

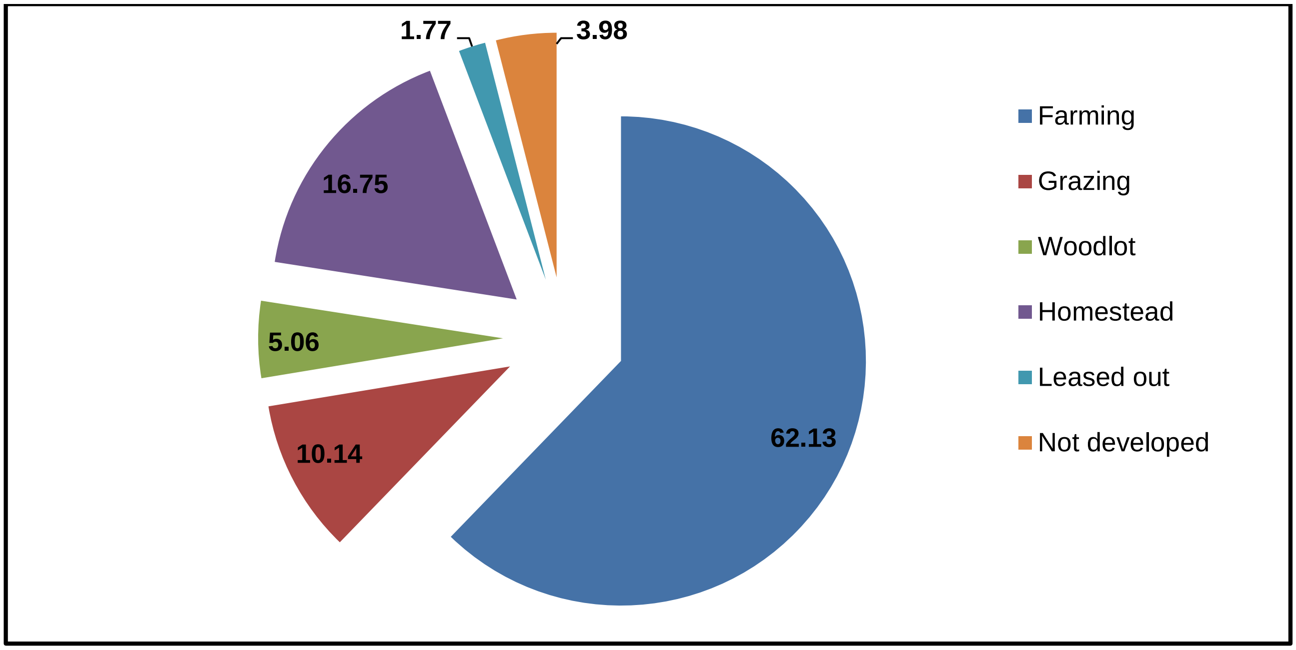


Figure 6.4: Percentage of total land areas allocated to various land use by respondents upstream (n=144)
Source: Field Survey (2013)

Farming takes an average of 62% of the land, 10% is left for grazing livestock; woodlot takes 5%; homestead 17%, leased out 2% while approximately 4% was not developed. Approximately 33% of the respondents indicated that there were sections of their land they could not use for agriculture. The reasons given for this were that the land was in an area that was too steep to farm (40%); or it was waterlogged (25%) or it was rocky (35%). With an average land size of 3.4 acres compared with an average household size of 6 persons, thirty percent (30.3%) of the respondents had access to land outside the one they reside on which they use to grow the extra food (84%) they need for their households. Other uses made of the additional land were for grazing (14%) and for collection of forest and other wild products (2%).

Farmers upstream grow a variety of crops and keep livestock. Farmers were asked to rank the crops according to importance with one (1) being the most important, followed by two, three and so on for all the crops they grew on their farm. This was compared to the income earned from these crops. Table 6.11 presents these results

Table 6.11: Ranking of crops by upstream respondents according to importance (n=144)

Crop	Mean Rank	Rank	Income Per annum
Av income from crops			55955.74
Maize	2.46	1	16496.55
Beans	3.51	2	4888.97
Vegetables	5.81	3	553.97
Groundnuts	6.30	4	328.97
Coffee	6.33	5	3,345.22
Bananas	6.41	6	475.86
Sugarcane	6.46	7	23,071.72
Onions	6.66	8	4,649.66
Sweet potatoes	6.71	9	172.41
Irish potatoes	7.62	10	1,257.93
Tomatoes	7.73	11	714.83

Source: Field Survey (2013)

The farmers ranked Maize as the most important crop followed by Beans and Green vegetables. The farmers ranked growing of tomatoes as least important. The main cash crops in the area coffee and sugarcane were ranked 5th and 7th respectively. The average income from crop farming is KSh. 55,956/=, with sugarcane being the highest paying crop contributing KSh. 23,072/=, followed by maize contributing KSh. 16,497/=. The least paying crop is sweet potatoes which contributed only KSh. 172/=.

Tomatoes are grown during the short rain season and farmers ranked it least because it is labour intensive to cultivate and manage and it is highly susceptible to pests and diseases. Despite sugarcane contributing the largest amount to household income, farmers ranked it low because of delays in payment for the crop by the factory. Coffee was once the most important cash crop in this area, however with falling world market prices and malpractices at the national marketing board, several farmers have abandoned the crop but since the law does not allow them to uproot it, it continues to stay on the farm, poorly managed and therefore low yielding. It is also deduced from these findings that income received from the sell of the crops is not the most important factor affecting the ranking of the crops. Since the highest paying crop is Sugarcane ranked 7th but with an average annual income of Ksh. 23,071/=; followed by Maize with an average annual income of Ksh. 16, 496/=. Although Vegetable is ranked 3rd, it contributes only Ksh. 554/=. The study looked at the livestock enterprise of the respondents and Table 6.12 shows income received from livestock rearing.

Table 6.12: Income received by upstream farmers from livestock rearing (n=144)

Type of Livestock	Maximum	Mean	Std. Deviation
Cows	80000	3913.31	10221.566
Donkeys	24000	250.34	2029.988
Sheep	10000	158.62	1194.175
Goats	6000	71.03	557.140
Chicken	11000	505.86	1356.280
Pigs	2000	15.86	167.778
Total annual income from livestock enterprises	80000	4915.03	11130.524

Source: Field Survey (2013)

Respondents keep Cows, donkeys, sheep, goats, Chicken and pigs. An average Income of KSh. 4915.03 per year was received from Livestock. Cows were the main income generators with an average income of KSh. 3,913 per year. Livestock rearing is not a key farming activity in this area. They mainly keep livestock for social reasons and not for income.

6.5 Results From Conjoint Analysis

This section presents the results from a traditional conjoint analysis, binary logit models and ordered logit models and discusses them. Each of the attributes was compared to the lowest level based on the assumption that the lowest level would be the most preferred and for qualitative variable a base level was selected. These levels are Land area committed 5%; Commitment period 5 years; Harvest permitted; incentive provision of farm tools; administrator water resource users association; and free labour of one day.

6.5.1 Results From Traditional Conjoint Analysis

A chi-square test was run on the attributes to assess whether they significantly affected farmers decisions. Table 6.13 presents the results.

Table 6.13: Analysis of deviance table (Type II tests) – Chi-Square

Attribute	**LR Chisq**	**Df**	**Pr(>Chisq)**
Land Area	6.5225	2	0.038*
Commitment period	11.0729	2	0.004**
Right to harvest	0.8694	2	0.65
Incentive scheme	0.442	3	0.93
Administrator	2.9181	3	0.40
Free Labour contribution	0.244	2	0.89

Significant at 0.005 ** and Significant at 0.05 *

Source: Field Survey (2013)

A chi-square test run on the attributes indicated a significant relationship between Land area and preference for a scenario and between commitment period and preference for a scenario. The other attributes were found not significant.

The results of a traditional conjoint analysis generated by running an ordinary least square regression of ranking on attributes of management scenarios are presented in Table 6.14.

Table 6.14: Results from the traditional conjoint model

Attributes	Estimate (Log Odd)	Std Error	z-value	Pr(>|z|)
Land Area 20%	0.06086	0.48194	0.126	0.89951
Land Area 40%	-1.12871	0.5176	-2.181	0.02921*
Commitment Period 15yrs	-1.49626	0.54964	-2.722	0.00648**
Commitment Period 30yrs	-1.1858	0.46001	-2.578	0.00994**
Harvest partially permitted	0.15138	0.49685	0.305	0.76061
Harvest not permitted	-0.28726	0.47987	-0.599	0.54943
Incentive agricultural extension	0.12664	0.6277	0.202	0.84011
Incentive Microcredit	0.26103	0.52531	0.497	0.61926
Incentive Cash Ksh.5,000	0.37626	0.62975	0.597	0.5502
Administrator local NGO	0.26554	0.56322	0.471	0.63731
Administrator WRMA	-0.30462	0.51507	-0.591	0.55424
Admin. rural water supply Co.	-0.73582	0.58481	-1.258	0.20831
Free labour 2 days/mth	0.19458	0.48707	0.399	0.68954
Free labour 3 days/mth	-0.02423	0.50013	-0.048	0.96136

Significant at 0.005 ** ; Significant at 0.05 * ;

Source: Field Survey (2013)

The commitment period (15 years and 30years) is highly significant at p<0.005 and is negatively related to the respondents ranking. This means management scenarios with longer commitment periods were rated lower. Land area to be committed becomes significant at p<0.05 after the area exceeds 40% of the total farmers land area and is also negatively related to respondents ranking. Therefore farmers' ranking is indifferent to land area below 40%; however after land area committed approaches 40% any further increase will lower the ranking for that scenario. Land area of 20% is not statistically significant and neither is the right to harvest, incentive schemes, administrator and free labour contribution.

Although right to harvest is not statistically significant as expected there is a negative relationship with preference when harvesting is not permitted. Similarly a negative relationship exists with free labour of 3 days and with Water resources management authority as administrator and the rural water supply company. It appears that the respondents did not clearly indicate their preferences against the incentive since the estimated coefficient to incentive scheme variable did not change signs from one scheme to the other.

6.5.2 Results from a Binary Logit Model

The probability that farmers would definitely undertake any of the management scenarios was estimated as outlined in chapter 5, with the dependent variable, ranking assuming a value of 1 for management scenarios which received a conjoint ranking of 5 and 0 otherwise. Results of A chi-Square test to the study variables is presented in Table 6.15

Table 6.15: Analysis of Deviance Table (Type II tests) – Chi-Square

Attributes	LR Chisq	Df	Pr(>Chisq)
Land Area	16.8023	2	0.0002246***
Commitment period	9.5748	2	0.008334**
Right to harvest	1.1095	2	0.5742241
Incentive scheme	1.1422	3	0.7668869
Administrating Agency	0.7146	3	0.8697547
Free labour Contribution	1.4045	2	0.495473

Significant at 0.0005 *** ; Significant at 0.005 **;

Source: Field Survey (2013)

The results indicate that land area and commitment period are highly significant and therefore will influence the respondents' decision. A binary logit model was run using program attributes defined in Table 5.1 (Attribute table) as explanatory variables for the ranking of management scenarios. The table6.16reports these results showing both the estimated coefficient (Log odds ratio) and the transformed coefficient (Odds ratio), the marginal effects and change in probability.

Table 6.16: Results from a binary logit model

Attributes	**Estimate Log odds**	**Std.Error**	**z value**	**Pr(>|z|)**	**Odds**	**Marginal effects**	**Change, ∆p**
Land area 20%	0.196212	0.488487	0.402	0.68792	1.21678484	0.032367596	0.163844404
Land area 40%	-2.059044	0.642112	-3.207	0.00134	0.12757587	-0.339663922	-1.719380078
Commitment period 15yrs	-1.325915	0.575121	-2.305	0.02114	0.26555986	-0.218725561	-1.107189439
Commitment Period 30Yrs	-1.334285	0.503473	-2.65	0.00805	0.2633464	-0.220106289	-1.114178711
Harvest partially permitted	0.211117	0.52995	0.398	0.69036	1.23505685	0.034826279	0.176290721
Harvest not permitted	-0.325202	0.524277	-0.62	0.53507	0.72238142	-0.05364589	-0.27155611
Incentive agric. extension	-0.100508	0.703597	-0.143	0.88641	0.90437788	-0.016580031	-0.083927969
Incentive Microcredit	0.438409	0.547211	0.801	0.42303	1.55023883	0.072320854	0.366088146
Incentive Cash Ksh.5,000	0.354765	0.684004	0.519	0.604	1.42584554	0.058522725	0.296242275
Administrator local NGO	-0.178646	0.622331	-0.287	0.77407	0.83640193	-0.029469768	-0.149176232
Administrator WRMA	-0.037931	0.555054	-0.068	0.94552	0.96277937	-0.006257147	-0.031673853
Admin. rural water supply	-0.474635	0.619273	-0.766	0.44341	0.62211209	-0.078296736	-0.396338264
Free labour 2 days/mth	0.564952	0.527913	1.07	0.28455	1.75936333	0.09319565	0.47175635
Free labour 3 days/mth	0.05355	0.547282	0.098	0.92205	1.05500974	0.008833694	0.044716306

Source: Field Survey (2013)

Again commitment period and land area over 40% were the only statistically significant factors with slight changes being noted in the level of significance. Again the three attributes had a negative relationship with the ranking meaning that with longer commitment period and larger land area the ranking was lower. The relationship between the independent variable and the right to harvest was again negative for the binary logit as in the traditional logit showing indifference to the partial permission to harvest. Another difference in the direction of the relationship was seen for the incentive extension services which here show a negative relationship to ranking meaning that with extension services as an incentive the ranking of the scheme was lower. In this case unlike in the previous one, the sign did not change with change in incentives and number of days of free labour indicating probable indifference to these attributes.

Looking at the last column showing direction and magnitude of change from the base line attributes the chances of selection increases by 16% as land area moves from 10% to 20% and decreases greatly as land area moves to 40% by over 100%. This means that a scenario requiring land area of 40% was unlikely to be selected. For commitment period the likelihood selection compared to the baseline of 5years reduces by over 100% for both periods of 15years and 30years. These could be attributed to insecurity on land ownership within this area. There has been persistent conflict and people do not feel they will own the land for long periods even though they have a title deed for it. Although the right to harvest is not statistically significant, when partial harvesting is allowed, the probability selection increases by 17%; but when harvesting is not permitted the probability selection drops by 27%. This could be because the community lives next to a protected area and understand that for conservation areas only partial harvesting can be allowed and hence the bias towards that attribute.

6.5.3 Results From an Ordered Logit Model

The response variable used here is the respondents rating for the alternative management scenario and explanatory variables are the attributes. Table 6.17 presents the results of the ordered logit.

Table 6.17: Results from an ordered logit model

Attributes	Estimate (Log Odds)	Std. Error	z value	Pr(>|z|)	Odds	Marginal effects	Change, ∆p
Land area 20%	0.061	0.482	0.126	0.899	1.063	0.011	0.049
Land area 40%	-1.129	0.518	-2.181	0.029	0.323	-0.212	-0.916
Commitment period 15yrs	-1.496	0.550	-2.722	0.006	0.224	-0.282	-0.963
Commitment Period 30Yrs	-1.186	0.460	-2.578	0.0099	0.306	-0.223	-1.215
Harvest partially permitted	0.151	0.497	0.305	0.761	1.163	0.028	0.123
Harvest not permitted	-0.287	0.479	-0.599	0.549	0.750	-0.054	-0.233
Incentive agric. extension	0.127	0.628	0.202	0.840	1.135	0.024	0.103
Incentive Microcredit	0.261	0.525	0.497	0.619	1.298	0.049	0.212
Incentive Cash Ksh.5,000	0.376	0.630	0.597	0.550	1.457	0.071	0.305
Administrator local NGO	0.266	0.563	0.471	0.637	1.304	0.050	0.216
Administrator WRMA	-0.305	0.515	-0.591	0.554	0.737	-0.057	-0.247
Admin. rural water supply	-0.736	0.585	-1.258	0.208	0.479	-0.138	-0.597
Free labour 2 days/mth	0.195	0.487	0.399	0.689	1.215	0.037	0.158
Free labour 3 days/mth	-0.024	0.500	-0.048	0.961	0.976	-0.005	-0.0197

Source: Field Survey (2013)

The results of the ordered logit and those of the traditional conjoint were found to be the same and only slight differences were noted between the two and the Binary logit. The ordered logit also indicated that commitment period was the most significant factor affecting the respondents' decision to select a management scenario. It also found that land area of 40% was also statistically significant. The rest of the factors do not significantly affect the preference of farmers for a given management scenario.

6.5.4 The Preferred Management Scenario

The change in P (Δ**p**) parameter shows the marginal effect of a change from the baseline case situation. Going through all the attribute levels and comparing them to the baseline the study was able to rank the attributes as shown in Table 6.18.

Table 6.18: Ranking of attribute levels based on likelihood to be selected

Attributes	Change, ∆p Ordered	Preference
Land area 20%	0.049	1
Land area 10%	0	2
Land area 40%	-0.916	3
Commitment Period 5years	0	1
Commitment period 15yrs	-0.963	2
Commitment Period 30Yrs	-1.215	3
Harvest partially permitted	0.123	2
Harvest Permitted	0	1
Harvest not permitted	-0.233	3
Incentive Cash Ksh.5,000	0.305	1
Incentive Microcredit	0.212	2
Incentive agric. extension	0.103	3
Incentive farming tools	0	4
Administrator local NGO	0.216	1
Administrator WRUA	0	2
Administrator WRMA	-0.247	3
Admin. rural water supply	-0.597	4
Free labour 2 days/mth	0.158	1
Free labour 1 day/mth	0	2
Free labour 3 days/mth	-0.019	3

Source: Field Survey (2013)

Based on the ordered logit analysis, everything else being equal, increasing the land area committed to 20 per cent is a preferred option to that of 10% by nearly 5%. This changes drastically when land area committed increases to 40% then the likelihood to be selected decreases by 90%. From the analysis above based on the probability to be selected, it can be deduced that a management scenario that includes commitment of 20% of land area for a period of 5 years would have the highest likelihood of being selected. This can be combined with other likely first choices which include harvesting partially permitted, a cash incentive of KSh. 5,000 per acre per annum; administered by a local NGO and requiring contribution of free labour for two days.

6.6 Factors Affecting Farmers' Decision to Participate in the Land Management Scheme

The socio-Economic and demographic characteristics of the respondents were entered as dependent variables and the decision to participate or not in a land management scheme, similar to the one described to them in the conjoint experiment was the independent variable. Table 6.19 shows these results.

Table 6.19: Factors affecting decision to participate in the land management scheme

Socio-Econ Characteristic	Estimate (Log Odd)	Std. Error	Z value	Pr(>|z|)
(Intercept)	2.446e+01	3.306e+03	0.007	0.99
GENDER	2.804e+00	1.199e+00	2.338	0.019*
AGE	1.203e-01	4.581e-02	2.626	0.0086**
EDUC	4.696e-01	6.223e-01	0.755	0.45
HHSIZE	-7.758e-01	2.104e-01	-3.688	0.0002***
AWARE	6.130e+00	2.213e+00	2.77	0.0056**
ENCON	7.123e+00	1.647e+00	4.324	1.53e-05***
MKWRUA	-1.690e+01	2.597e+03	-0.007	0.99
ACESSFIN	-2.195e+01	2.046e+03	-0.011	0.99
TENURE	6.004e+00	1.843e+00	3.258	0.001**
ACERAGE	-2.539e-01	1.981e-01	-1.282	0.199
FarmIncome	1.798e-05	1.231e-05	1.46	0.144
Annual Income Ksh.	-1.066e-05	2.229e-06	-4.783	1.72e-06***

Signif. codes: 0 '' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1***
Source: Field Survey (2013)

Twelve socio-economic and demographic characteristics were run and table 6.19shows that Gender, age, household size, awareness of upstream effect on downstream benefits; carrying out environmental conservation on farm, land tenure and annual income are statistically significant, and therefore the factors that influence the decision to participate in a land management scheme similar to the one described in the conjoint experiment. Gender and Age have a positive relationship with the decision to participate as has land tenure meaning that females are more likely to participate in the scheme than male respondents while as age increases and as tenure becomes more secure it is more likely that they will participate in the management scheme. Further as expected respondents with awareness, knowledge and prior experience in environmental conservation are also more likely to participate in the management scheme.

Household size has a negative relationship indicating that as household size increases the farmers are less likely to participate. Since the scheme will require the commitment of a portion of the land, it is likely that a person with a large family feels they are not able to forego use of any piece of their land for fear of being unable to provide food for their family using the remaining piece. The culture here is for children to inherit land from their parents so this could also mean that farmers knowing they are keeping land in trust for their children may not want to make any decisions that will affect land use for a long period of time.Total annual income is statistically significant and has a negative relationship with the decision to participate meaning as income increases it is unlikely that the person will participate. This is expected since the total income comprises farm and non-farm income. It is expected that non-farm income will increase by larger proportions than the farm income therefore it may be correct to assume that increase in non-farm income is the cause of the negative sign. And increase in non-farm income is usually associated with stay away from home since most jobs are in urban areas.

The study found that level of education, being a member of the water resources users association, access to financial services, land size and farm income are not statistically significant and are therefore unlikely to affect the decision to participate in the management scheme. The insignificance of level of education is an unexpected result since previous studies show that education plays a significant role in environmental management programs in developing countries (Bedru Babulo *et al.,*2008). This contrary finding could mean that the respondent have sufficient environmental awareness, knowledge and hands on experience. Another unexpected result was the insignificant and negative relationship of land size and the decision to participate. It had been anticipated that given the value attached to land and the generally small land size (average land size of 3.4 acres), the decision to participate would be related positively to land size. This find could mean that with other appropriate measure in place, land size is not a major constraint in implementing improved land management practices.

Membership in the Water Resource Users Association, the local level watershed management body, was found not significant in the decision however; there is a negative relationship with the decision to participate, which sadly means membership reduces the likelihood to participate. This is probably a show of lack of confidence in this institution. This is also confirmed by the choices of administering agencies for the management scheme discussed in the previous section, where it ranked lower than a non-governmental organization.

6.7 Chapter Summary

The study found that the environment in the Kuywa watershed is degraded as a result of increased human activity in the watershed. Though there respondents receive sufficient water the quality of the water ispoor with high sedimentation and chemical and solid waste pollution from farms, industries and market centers. The communities are aware of these challenges and are willing to do something to reverse the trend.

The upstream/provider population are middle aged having an average age of 41 yrs. The household sizes are large (6person per households) with some being as many as 13 persons per household. The respondents have some formal education mainly primary level (51%) and Secondary level (37%). Poverty is high in the study area with average incomes of KSh. 12, 700 per annum. This translates to USD 0.06 per person per day which is below the dollar a day threshold. Maize is the preferred crop here but it is not the most highly paying. Sugarcane is the most highly paying contributing over KSh.23,000/= . However, farmers complained that delayed payments make growing the crop not worth their while.

A conjoint analysis done using three models produced similar results from each of the models indicating a degree of accuracy in the results. The study found that the length of time the management intervention will commit the farmers land affected their selection of the management scenarios presented. Further land size to be committed also affected the selection of the management scenario. With land size smaller area were insignificant in informing the decision, however for areas of 40% and above of the total land area then it significantly affects the selection of the management scenario. This is an indication that farmers are willing to set aside a portion of their land for the conservation intervention. The results of the conjoint analysis lead us to draw the conclusion that a management scenario that includes commitment of 20% of land area for a period of 5years, a cash incentive of

KSh. 5,000 per acre per annum; administered by a local NGO and requiring contribution of free labour for two days would have the highest likelihood of being selected.

Further based on the findings reported in this chapter, Gender, age, household size, Awareness of upstream effect on downstream benefits; carrying out environmental conservation on farm, land tenure and annual income are the main factors that affected the decision of the farmer to participate in the scheme.

CHAPTER 7

WILLINGNESS TO PAY AND WILLINGNESS TO ACCEPT PAYMENT FOR ENVIRONMENTAL SERVICES

7.1 Introduction

This chapter presents the results of the contingent valuation analysis to assess the willingness to pay (WTP) and willingness to accept (WTA) payment for the provision and utilization of environmental services in response to specific objective two of the study. In this chapter the study will evaluate how much upstream farmers are willing to be paid to supply the environmental service. This will be followed by a description of the characteristics of the beneficiary population downstream and in Bungoma Town, whose willingness to pay for the environmental service being supplied will be evaluated. Establishing a WTA and WTP for environmental services confirms that the service being offered has a value to both parties and therefore can be exchanged in a PES scheme.

7.2 Willingness to Accept Payment

After describing in detail the PES concept to the respondent, all 144 respondents were asked if they would be willing to participate in the scheme. Of this number, only 67% (97 respondents) agreed to participate. Their reasons for selecting to participate included: (i) monetary benefit to them (57.6%); (ii) Conservation is important (60.4%); (iii) have land they cannot use for any other purpose (2.8%); (iv) to ensure environmental services for themselves (1.4%); and (v) to provide environmental services to downstream users (2.1%). The thirty three percent (33% = 47 respondent) who declined to participate and gave various reasons including:- (i) Land shortage (13.9%); (ii) schemes will not benefit them (16.7%); and intervention will have no effect on the water in river Kuywa (1.4%). The study looked at the factors and perceptions that affect the decision to participate in a PES scheme, similar to the one described to them, and Table 7.1 shows these results.

Table 7.1: Factors that affect upstream respondents, decision to participate in a PES scheme

Observations:	Total	Left-censored	Uncensored	Right-censored
	144	47	0	97

Variables	Coefficients Estimates	Std.Error	Z-value	Pr(>|z|)
Age	-2.267e-02	2.739e-02	-0.828	0.40786
Gender	2.480e-01	4.754e-01	-0.522	0.60182
Education	3.470e+00	1.704e-00	2.036	0.04176*
HHsize	1.616e-01	1.087e-01	1.487	0.13711
Total income	-9.658-07	1.494e-05	-0.065	0.94847
Perception of environmental status	5.517e-01	6.733e-01	0.819	0.41259
Perception of water quality	-2.884e-02	5.767e-01	-0.050	0.96011
Perception of water quantity	-1.204e+00	4.557e-01	-2.642	0.00824**
Aware	-3.897e-01	9.323e-01	-0.418	0.67598
ENCON	-2.647e-02	5.745e-01	-0.046	0.96324
MKWRUA	5.279e-05	8.743e-04	0.060	0.95186
Access to financial services	-1.066e+00	7.315e-01	-1.457	0.14504
Length of stay	2.716e-02	2.715e-02	1.000	0.31718
Tenure	-1.427e-01	2.122e-01	-0.672	0.50127
Land size	3.045e-01	1.120e-01	2.718	0.00658**
Farm income	-6.202e-06	3.061e-06	-2.026	0.04277*
Signif. codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1				

Source: Field Survey (2013)

These results show that education level, perception of water quantity, land size and farm income were statistically significant. As the level of education increases the likelihood to participate in the scheme also increases. This is attributed to the fact that with education comes the ability to understand the scheme and its benefits better and so increases the likelihood to participate. For water quality the perception of it as poor, increases the likelihood to participate since the respondent has identified it as a problem that requires action to resolve. The land size has a positive relationship with the decision to participate, as the area of the land holding gets bigger it is expected that the farmer would be more willing to commit some to the scheme. The negative relation between farm income and participation in the scheme indicates the high ranking of economic consideration over social and environmental consideration in the farmers’ decision making process. Therefore farmers making a higher income from their farming activities are less likely to want to participate in the scheme.

The 97 upstream respondents who accepted to participate were then invited to participate in the contingent valuation bidding exercise. From the contingent valuation bids, a summary of the responses based on the initial bid only since the second bid depends on the first are displayed in table 7.2a (with one follow up bid) and 7.2b (with two follow up bids).

Table 7.2a: Number of responses by initial offer amount using only first two responses

Initial bid	YY	YN	NY	NN	TOTAL
650	0	0	0	2	**2**
720	0	0	0	3	**3**
1600	6	1	0	11	**18**
3000	8	5	5	23	**41**
5000	3	0	0	30	**33**
TOTAL	**17**	**6**	**5**	**69**	**97**
Percentage	**17.5**	**6.2**	**5.2**	**71.1**	

Source: Field survey (2013)

Table 7.2b: Number of responses by initial offer amount and two follow up bids

Initial bid	YYY	YYN	YNN	NYY	NNY	NNN	TOTAL
650	0	0	0	0	1	1	2
720	0	0	0	0	0	3	3
1600	4	2	1	0	3	8	18
3000	6	2	5	5	10	13	41
5000	2	1	0	0	14	16	33
Total	12	5	6	5	28	41	97
percentage	12.3	5.2	6.2	5.2	28.9	42.2	

Source: Field survey (2013)

The respondents who provided two positive responses make up 17.5% of the population, while those who provided two negative responses make up 71.1%, while 6.2% and 5.2% fell in the 'yes no' and 'no yes' response categories. Of these 71.1% left censored responses, those who answered yes to the third and higher bid were 40.6% (28/69 respondents). The remaining 59.4% (41 respondents) answered No to the higher follow up bid, and that 16.5 % of all the respondent said no to the highest bid amount offered and therefore had higher WTA values than the highest one offered of KSh. 8,000/=. On the other hand in the right censored category 4.1% of all the respondents accepted the lowest bid offered of Ksh. 650 per acre per year. This indicates that there is a large variation in WTA within each category. To give a visual idea of the distribution of censored observations below are Figure 7.1a and Figure 7.1b which are histograms of left censored and right-censored observations respectively.

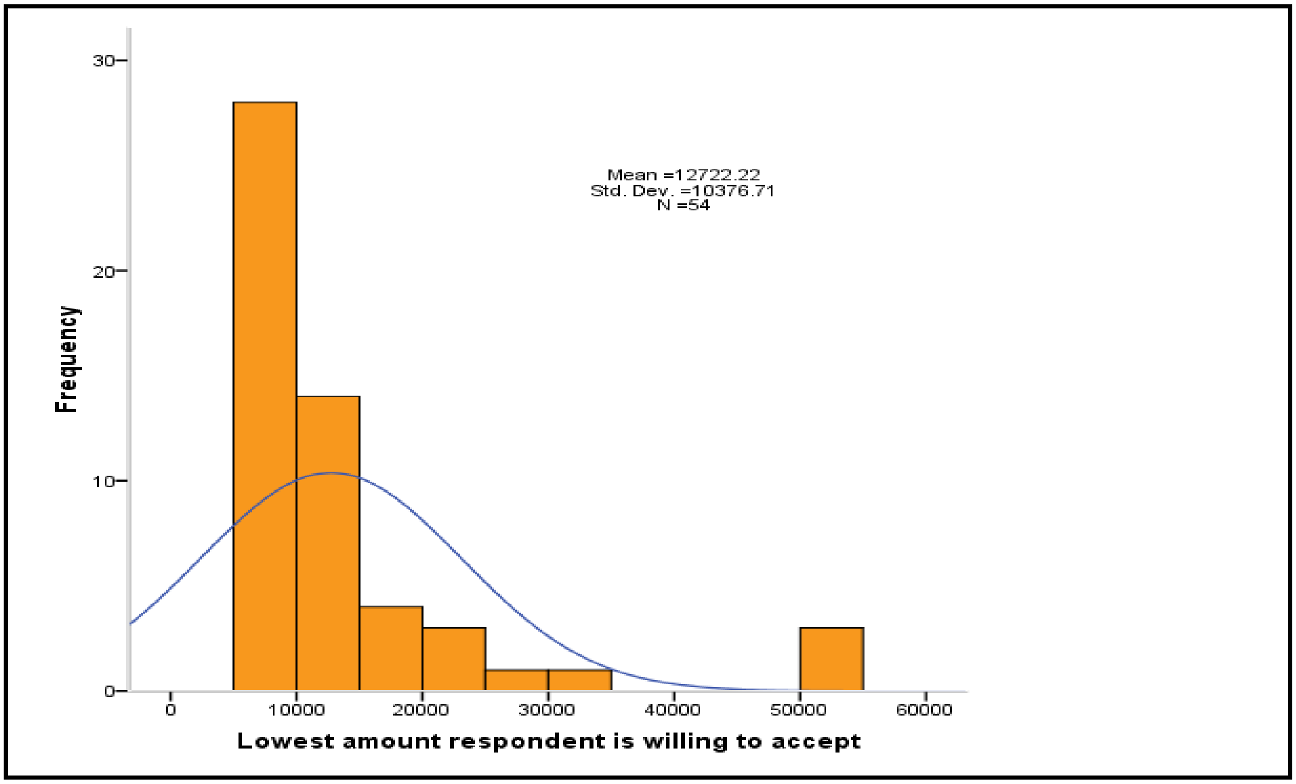


Figure 7-1a Left –censored Observations (No, No responses)
Source: Field survey (2013)

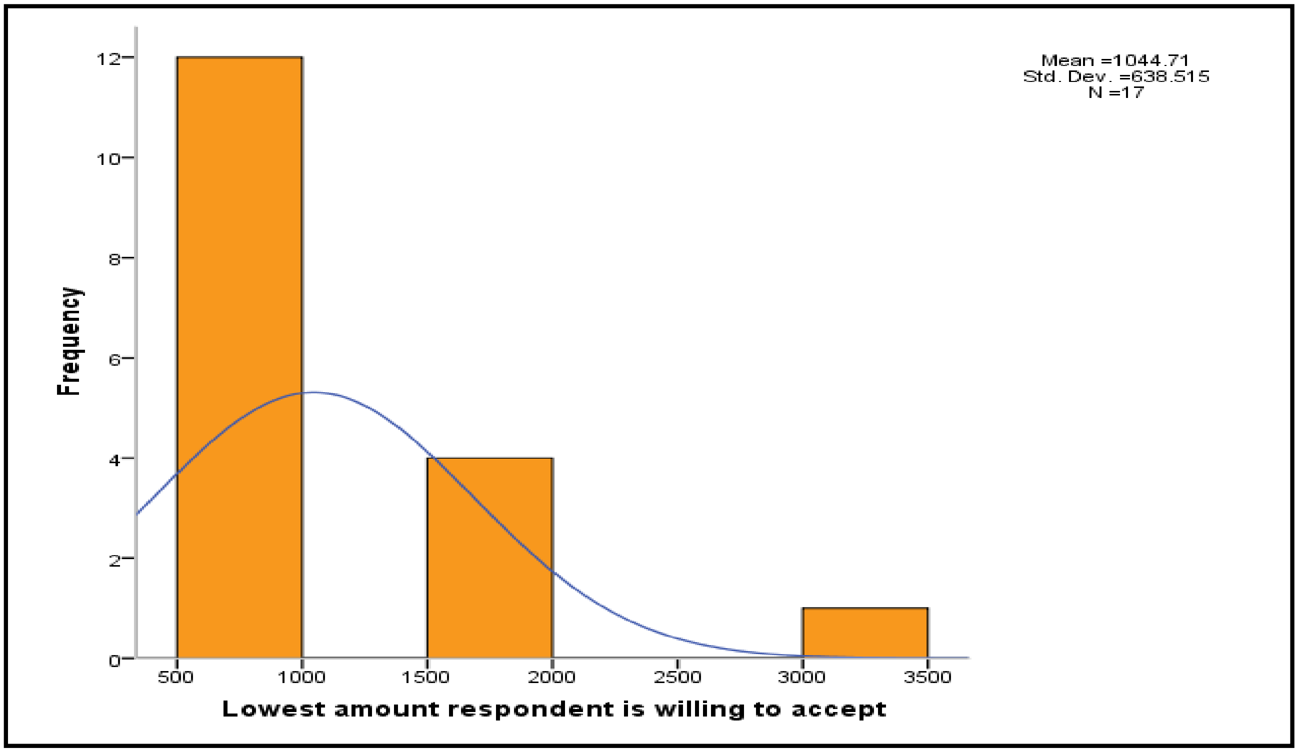


Figure 7.1b Right-censored observations (Yes; Yes responses)
Source: Field survey (2013)

The study calculated descriptive statistics for each of the response categories and these are presented in Table 7.3.

Table 7.3: Summary statistics for each response category

Category	Number	Min	Max	Mean	Std. Deviation
Right Censored (YY)	17	650	3,000	1,044.71	638.515
Left Censored (NN)	54	5,000	50,000	12,722.22	10,376.710
Middle (NY; YN)	11	1,600	6,500	3,918.18	1,446.940
Total	82	650	50,000	9,120	9838.96

Source: Field survey (2013)

These results support the earlier ones since they also show the wide variation within the category and also across categories. This may be an indication that other extraneous factors influence the amount each respondent is willing to accept.

Applying the models discussed in the study methodology (Chapter 5) to calculate the mean willingness to accept, the study obtained a likelihood function by generating intervals from the collected data based on the lower and upper amounts selected by each respondent given that the WTA points are inside the division's intervals. The study then estimates nonparametric WTA – survival functions based on the Weibull and the mixed weibull/exponential parametric families of distributions. This can be viewed as an extension of the Survival analysis Turnbull's estimator (Turnbull, 1976)

Based on the options provided during the CV bidding process the following 6 intervals were used: (650, 720); (720, 1600); (1600, 3000); (3000, 5000); (5000, 6500); (6500, 8000). Based on proposals made by respondents several other intervals were included in the model to bring the total to 25 (see box below). Within these intervals only 68 of the 97 responses were deemed valid by the iwtp model and therefore used to estimate the mean WTA. Using the weibull survival function the calculated WTA was KSh. 7,080.05 per acre of land committed per year. The survival function mixing weibull and exponential (Wemix) calculated a mean WTA of KSh. 7,019.5per acre of land committed per year. The other non-parametric estimates gave a mean WTA of KSh. 10,555 and 6,934 for the Turnbull. These figures are close and the study will use a WTA of KSh. 7,080.05 per year. This converts to USD 83.3 per annum. This figure is also close to the annual lease rate for land in the area which ranges from between Ksh. 5000/= to Ksh. 7,000/= per year. The figure is also comparable to the average farm income of households amounting to KSh. 8,724/= per year. This could mean that the farmers WTA value is based on opportunity cost of his land if he were to lease it or use it to grow crops.

WEIBULL
Respondent no.: 68
Self-selected interval no.: 25
Division intervals: 14 in total
(650, 720], (720, 1600], (1600, 3000], (3000, 5000], (5000, 6500],
(6500, 8000], (8000, 10000], (10000, 12000], (12000, 13000], (13000, 15000],
(15000, 20000], (20000, 25000], (25000, 30000], (30000, 50000]

Survival function: Weibull
Behavior model: BM5
Parameter estimates:
Scale (a): 7972.290966
Shape (b): 1.856955
Coefficient c: 17.988753
Maximum llik: -200.832948
Mean WTA: 7080.048334

- Nonparametric estimate of the mean value of the empirical survival function(based on the right-end values of self-selected intervals): **10555**
- Nonparametric estimate of the mean value based on Turnbull estimator[see Turnbull, 1976]: **6934.472**
- Estimated Mean WTA based on parametric Weibull model (taken self-selectedintervals as Turnbull intervals [see Turnbull, 1976]): **6243.803**

WEMIX
Respondent no.: 68
Self-selected interval no.: 25
Division intervals: 14 in total:- (650, 720], (720, 1600], (1600, 3000], (3000, 5000], (5000, 6500], (6500, 8000], (8000, 10000], (10000, 12000], (12000, 13000], (13000, 15000], (15000, 20000], (20000, 25000], (25000, 30000], (30000, 50000]

Survival function: the mixture of Weibull/exponential
Bahavior model: BM5
Parameter estimates:
mixing parameter p: 0.990000
scale parameter a: 7985.607502
shape parameter b: 1.889941
parameter m: 300.000000
Coefficient c: 16.612189
Maximum llik: -201.200362
Mean WTA: 7019.494044

- Nonparametric estimate of the mean value of the empirical survival function(based on the right-end values of self-selected intervals): **10555**
- Nonparametric estimate of the mean value based on Turnbull estimator[see Turnbull, 1976]: **6934.472**
- Estimated Mean WTP based on parametric Weibull model (taken self-selectedintervals as Turnbull intervals [see Turnbull, 1976]): **6243.803**

7.3 Beneficiaries of Watershed Environmental Services

Demand for Environmental services is generated from the needs of downstream water users in a watershed, and from users who do not live in the watershed but use water abstracted from the river. The willingness of this category of stakeholders to pay for environmental services forms a central part of any PES scheme. Watershed environmental services can be directly consumed or used indirectly through the household production function or as a factor of production (Lele, 2006). In the Kuywa Watershed several categories of potential buyers were identified. They included

1. The community living within the watershed but downstream. They have no control over what kind of water they receive since the composition of the water is determined by practices upstream. The study interviewed 50 respondents from this category and determined that they were aware of the upstream – downstream relationship and 97% were willing to participate in a PES schemes to ensure they received clean water.
2. Urban population of Bungoma town receiving piped water from the Nzoia Water Services Company Ltd. The study interviewed 100 respondents from this category and 97% were willing to pay for improved water quality.
3. The Nzoia Water Services Company Ltd is the major abstractor of water from the Kuywa river. They are the company set up to manage water supply to urban areas within Bungoma County. They were willing to participate in the scheme. They are targeted as possible intermediaries since they receive the payment from water users in urban centres.
4. Industry – mainly coffee factories and the Nzoia Sugar Factory are the main industrial abstractors. An interview with these industries also found that all of them are willing to pay a little more for water to ensure reduced sedimentation since it cost them a lot to treat the water for their use. They were willing to pay between Ksh. 5 and KSh. 20 more per litre of water used.
5. Other abstractors including large scale farms, schools, hospitals and other institutions. This group of beneficiaries was also willing to pay extra for clean water

since it would reduce the cost of water treatment. They were willing to pay between KSh. 1 and KSh. 10 more per litre of water used.

7.4 Socio-Economic Characteristics of Downstream and Urban Respondents

One hundred and forty eight (148) respondents were interviewed downstream. The respondents were divided into two groups those living downstream within the Kuywa watershed (48) and those living in the urban centre, Bungoma Town and were therefore expected to be using water from the Kuywa river (100).The watershed respondents were selected from two sub locations namely Khalumuli and East Sang'alo. Similarly the urban area, has only two sub-locations – Township and Khalaba- and respondents were selected equally from both of them. Of these respondents 28.4% (42) were male and 71.6% (106) were female. This skew could be attributed to the fact that the interviews were carried out during the day when most men are at work. Table 7.4 shows the averages of key socio-economic and demographic variables for each of the sub-locations.

Table 7.4: Key socio-economic variable of beneficiary respondents by sub-location (n=148)

S/loc	Township	Khalaba	East Sang'alo	Khalumuli	Downstream
Av Age (yrs)	37.5	37.4	44.7	40.4	39.1
Av Household size (no)	5	5	7	7	6
Av Household income (KSh.)	22,950	21,430	7,622	13,620	18,478

Source: Field Survey (2013)

The respondents ranged from age 18 years to 73 years, with an average age of 39 years. The household size ranged from 1 to 18 members per household with an average of 6 persons per household. The respondents' income per month ranged from KSh. 1,500 to KSh. 120,000 per month averaging at KSh. 18,478/= per month. The two urban sub-locations have a relatively smaller household size and a larger income when compared to the sub-locations within the catchment which is a rural area. Khalumuli shows a higher average income than East Sang'alo mainly because they have larger farms and grow sugarcane which is the dominant cash crop. The study looked at the sources of income for the respondents and Table 7.5 shows these results.

Table 7.5 Main sources of income for the beneficiary respondents by sub-location (n=148)

Source of income	Sub-locations (number)				
	Township	Khalaba	East Sang'alo	Khalumuli	downstream
Farming	8	13	22	22	65
Wage employment	1	5	1	0	7
Artisan	4	4	0	1	9
Salaried	13	10	0	1	24
Trading	22	15	0	1	38
Rental income	1	3	0	0	4
remittance	1	0	0	0	1
Total	50	50	23	25	148

Source: Field survey (2013)

The main source of income for the respondents was farming mainly in the rural sub-locations (East Sang'alo; Khalumuli) and in Khalaba which is a sub-urban area. Conversely trading is also an important source of income but mainly in the Urban sub-locations same to salaried employment which is non-existent in the rural sub-locations. The study looked at the level of education of the respondents and Figure 7.2 shows this result.

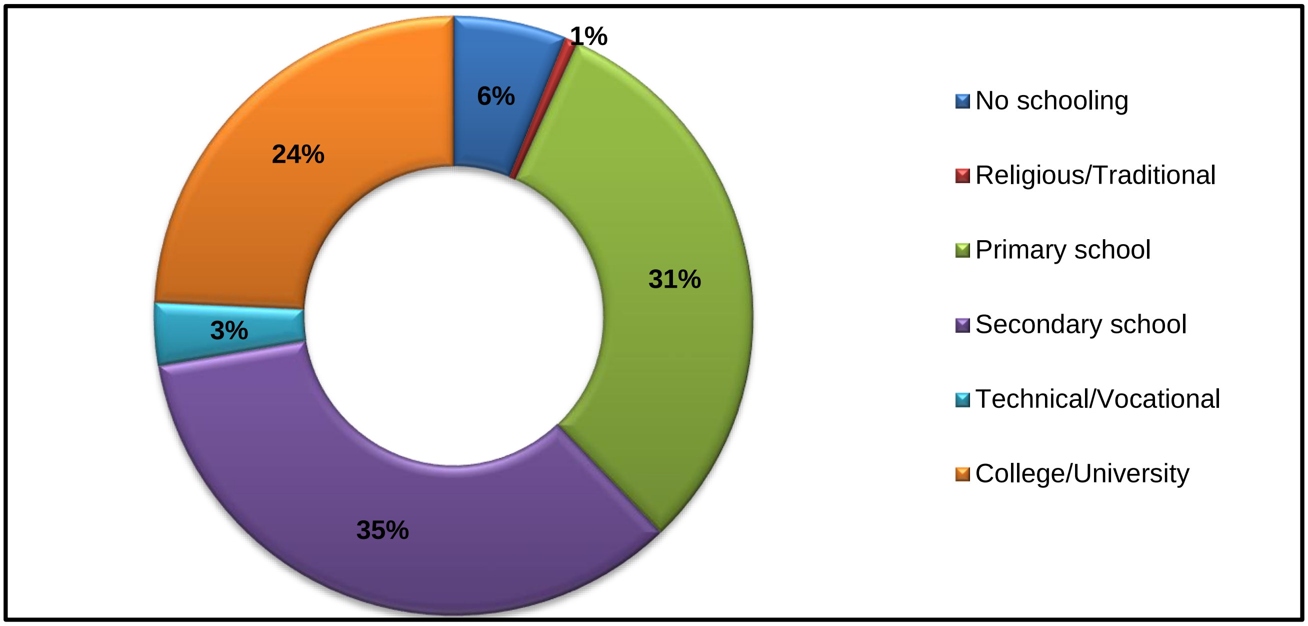


Figure 7.2: Level of schooling of beneficiary respondents (n=148)
Source: Field Survey (2013)

Majority of the respondents had some years of formal education, with those with secondary school education making up 34.5% of the respondents and those with primary school education 31.1%; university education 24.3% and technical/vocational education 3.4%. Those with no formal schooling made up only 6.8% of the respondents.

7.5 Water Supply and Quality Characteristics

7.5.1 Sources, Quantity and Quality of Water

Downstream populations especially those leaving in urban area are expected to pay for the provision of good quality water by upstream participants. Since water is the service being traded, it is important to know the current water situation faced by the downstream population. The study examined the sources of water for the respondents in the wet and dry seasons and Table 7.6 presents the results.

Table 7.6: Percentage of beneficiary respondents drawing water from various sources during the wet and dry seasons (n=148)

	WATER SOURCE	PCWET	PCDRY	PPWET	PPDRY
1	Protected Spring	12.8	14.9	14.9	15.5
2	Hand dug well	41.2	36.5	38.5	37.2
3	Borehole (drilled)	6.1	6.1	6.8	6.8
4	Piped water	24.3	25.0	19.6	19.6
5	Water Kiosk	6.8	8.1	8.8	8.8
6	Unprotected Spring	4.7	4.7	4.7	4.7
7	River	4.1	4.7	4.1	4.7

Key: PC – Current source in wet and dry season;
PP – previous source (three yrs ago) in wet and dry season
DC – Distance to current source in wet and dry season
DP – Distance to water source three years ago in wet and dry seasons
Source: Field Survey (2013)

The main source of water for respondents was hand dug wells. 41.2% of respondents used this source during the wet season with only a slight decrease during the dry season to 36.5% and it was still the main source of water for respondents three years ago. This is an indication that water is available and in most cases for free from wells dug by household. 24.3% of the respondents have access to piped water in their houses and this decrease to 25.0% during the dry season; and to 19.6% three years ago. This shows that piped water is not readily available and only one quarter of the population have access; however, respondents indicated that they would like to have access. Also noteworthy is the fact that there is little difference between sources of water in the dry and in the wet season. The study also looked at the distance to the source of water and Table 7.7 shows this result.

Table 7.7: Distance covered by beneficiary respondents to water source

	DISTANCE	DCWET	DCDRY	DPWET	DPDRY
1	Within compound	58.8	56.8	54.7	53.4
2	Less than 1km	32.4	33.1	35.1	35.1
3	1km to 3km	6.8	8.1	8.1	9.5
4	>3km – 5km	2.0	2.0	2.0	2.0

Source: Field Survey (2013)

Over 50% of respondents had water available within the compound during both the wet and the dry season and also have had access within the compound for over three years. Another over 30% has access to water within a distance of less than 1km for all seasons. Approximately 8% have access further than 1km in the wet season; increasing to 10% in the dry season. Respondents were asked about the reliability of the water supply and 66.9% and 6.1% said the quantity of water available was reliable and very reliable respectively making a total of 73%. The amount of water used per day per household ranged from 20liters (ltr.) to 300ltr and averaging at about 90ltrs and about 97% of the respondents said that they received enough water to meet this need.

The study also looked at water shortage trends in the area and the results are presented in Table 7.8.

Table 7.8: Water shortage trend by sub-location

	TOWNSHIP	KHALABA	E.SANGALO	KHALUMULI	TOTAL
Is water shortage a problem in your area? (%)					
Strongly agree	22	8	8.7	16	14
Agree	5.8	78	48	64	64
Disagree	8	12	39	12	15
Strongly disagree	12	2	4.3	8	7
Trend in shortage over last three years (%)					
Significantly Increased	0	2	8	8	3.4
Increased	26	16	22	36	23.6
Decreased	56	80	70	52	66
Significantly decreased	18	2	0	4	7

Source: Field Survey (2013)

This was contrasted by the 78% of respondents who said that water shortage was a problem in the area. They clarified this by indicating that this was mainly for piped water, and to meet their need most households had a hand dug well to cover up for the shortage. However, 65.5% of respondents felt the problem of water shortage has decreased, but not significantly, over the last three years while another 23.6% said the problem had increased slightly over the last three years. The main reason given for the shortage was dry spell which occurred late in the fourth quarter of the year(Late Nov and Dec) and continued into the first quarter of the year (January, February and March) with long rains expected to start late March or early April. Respondents agreed that water shortage affects the household allocation of income and time.

The respondents were divided on their perceptions of the quality of the water in River Kuywa, with 49.3% indicating it was good and 50.7% indicating it was poor. When asked if they felt the water was safe to drink, 61.5% said it was unsafe and they treated it before use. Respondents made proposals of how water quality and quantity can be improved. And the main suggestions included: (i) water harvesting (55%); (ii) Maintenance of the water intake (48%); (iii) Improved catchment management (45%); (iv) pressure on water service providers to give good service (42.6%); and share in the cost of catchment improvement and management (37.8%)

7.5.2 Payment for Water

To allow the study to examine the means by which water is supplied to the household and therefore a potential avenue for collection of the funds for the scheme, respondents were asked who their suppliers were and the results are presented in Figure 7.3.

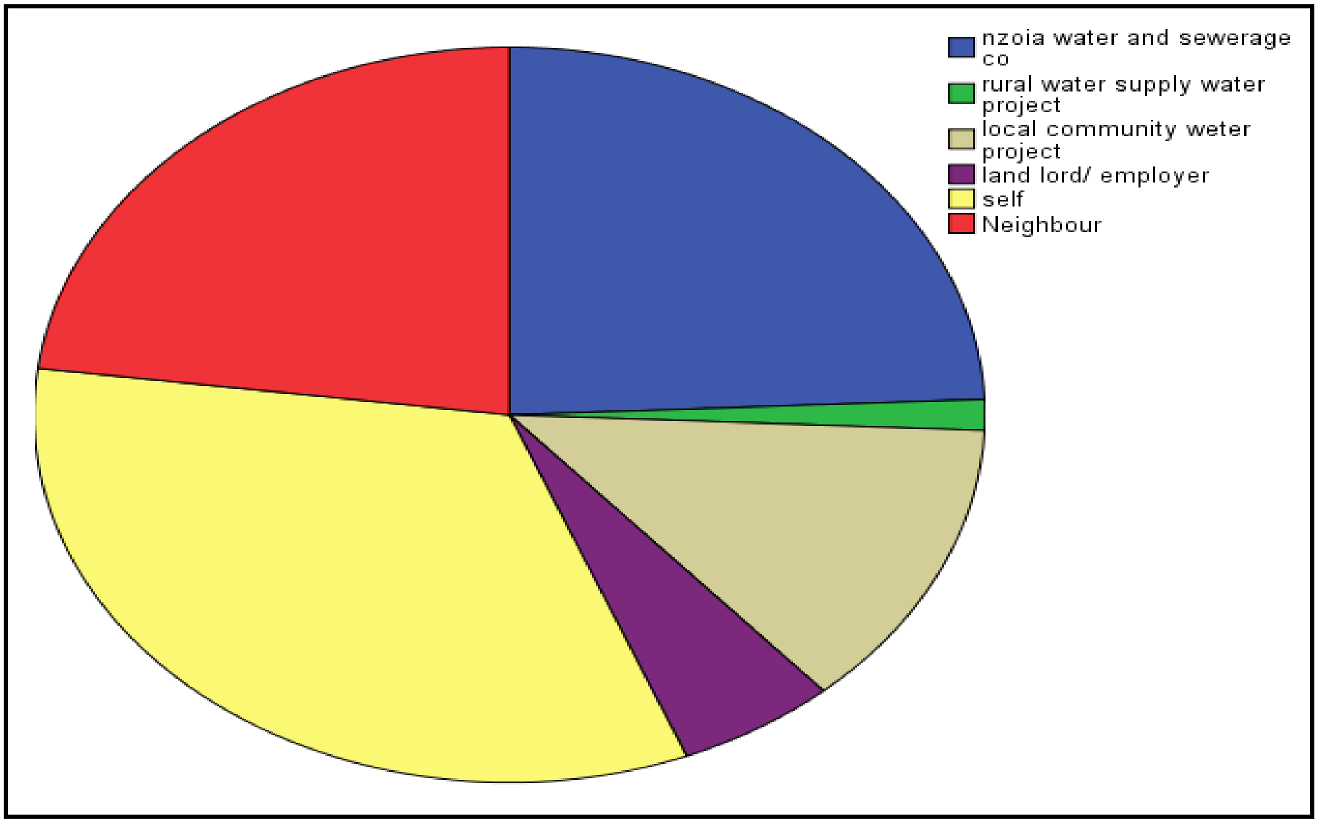


Figure 7.3 Water suppliers to the downstream respondents
Source: Field Survey (2013)

In the study area there are different suppliers of water to the households. Only 24.3% have piped water in their residents provided by the Nzoia Water and Sewerage Corporation. Self means they go to the river or spring to fetch water. Approximately fifty seven percent (56.8%) of the respondents do not pay for the water they use. Of those who pay (43.2%), the amount paid per month ranges from KSh.100/= to KSh.4,000/= with a mean amount of KSh.503.59/=. Removing the extreme values, the realistic mean becomes KSh. 423/= per month per household and ranging from KSh.100/= to KSh.1000/=. Using all respondents including those who do not pay since there is an indication that they would be willing to pay then the amount paid ranges from KSh.1 to KSh.4,000/= with a mean of KSh.218/=. Since the study aims at assessing willingness to pay extra for water, it looked at the ability of respondents to pay their current bill with a view to gauge ability to pay more. Table 7.9 shows the result.

Table 7.9 Respondents ability to pay for water

Ability	Frequency	Percentage
Easily pay	22	36.7
Can pay	26	43.3
Struggle to pay	12	20
total	**60**	**100**

Source: Field Survey (2013)

Eighty percent (80%) of the respondents are able to pay for the water, with 36.7% paying very easily. This indicates ability to handle an additional charge to their water bills. This was confirmed by the fact that only 35% of the respondents have had their water disconnected for non-payment and most of this category claimed it was due to problems with the billing system by the supplier with bills arriving after their due date or not getting to the user at all.

7.6 Willingness to Pay for Environmental Services

Of the 148 downstream respondents 5 (3.4%) were not willing to participate in the PES scheme and 143 (96.6%) agreed to participate. The previous section on payment for water showed that over 50% of the respondents are currently not paying for water and yet here there is an indication that they would be willing to pay to get good quality water. The reasons respondents gave for wanting to participate in the scheme were: (i) Had monetary benefit to them – 39.2%; (ii) Conservation is important to them – 33.8%; (iii) will reduce hospital Bills – 2%; and (iv) it will increase water supply to them – 62.2%. The study investigated factors and perceptions that affect the decision to participate in a PES scheme similar to the one described to them by the study. Table 7.10 shows these results.

Table 7.10: Factors that affect beneficiary respondents decision to participate in a PES scheme

Observations:	Total	Left-censored	Uncensored	Right-censored
	148	143	0	5

Variables	**Coefficients Estimates**	**Std. Error**	**Z-value**	**Pr(>|z|)**
Age	1.142e-03	9.667e-04	1.181	0.2395
Gender	3.888e-02	3.179e-02	1.223	0.2234
Education	1.805e-02	1.193e-02	1.514	0.1325
Household size	-2.302e-03	6.091e-03	-0.378	0.706118
Total income	1.704e-06	9.120e-07	1.869	0.0639.
Perception of water quality	-5.251e-02	2.347e-02	2.237	0.0269*
Perception of water quantity	-1.485e-02	3.155e-02	-0.471	0.6386
Access to financial services	8.741e-02	3.984e-02	2.194	0.0300*
Source of water in dry season	8.277e-03	6.151e-03	1.346	0.1807
Dist to water source in dry season	1.832e-02	2.154e-02	1.850	0.3966
Pay for water	4.429e-02	8.549e-02	0.518	0.6053
Able to pay?	3.996e-05	8.878e-05	0.450	0.6534
Quantity of water used per day	-3.368e-04	2.871e-04	-1.173	0.2429
Opinion on beneficiary pays	2.705e-01	6.371e-02	4.245	4.09e-05***
Signif. codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1				

Source: Field survey (2013)

Income, perception of water quality, access to financial services and perception of beneficiary participation in improving water quality were significant. Since the downstream population will be paying for the services it is accurate to conclude that the rise in income level would increase the likelihood to participate in this scheme. Further those who felt the water quality was very poor are also more likely to participate in the scheme since they are experiencing a genuine problem they require a solution to. Access to financial service could also influence the decision to participate since the respondent would have to be making payments towards the scheme and a convenient pay point would encourage participation. The understanding of the upstream – downstream watershed interaction and acknowledging that interventions upstream could result in changes in the services received downstream also positively affects the decision to participate, since knowledge, awareness and information on the basis of the scheme are key factors in participation in PES schemes the world over.

The contingent valuation bidding questions were asked to the 143 (96.6%) respondents who were willing to participate. Table 7.11a (one follow up bid) and Table 7.11b (two follow up bids) summarize the responses based on the initial bid.

Table 7.11a: Number of responses by initial offer amount and one follow up bid

Initial bid	**YY**	**YN**	**NY**	**NN**	**TOTAL**
30	0	2	0	0	2
45	8	2	8	58	76
50	23	11	6	25	65
Totals	**31**	**15**	**14**	**83**	**143**
Percentages	21.68	10.49	9.79	58.04	

Source: Field Survey (2013)

Table 7.11b: Number of responses by initial offer amount and two follow up bids

Initial bid	YYY	YYN	YNN	NYY	NNN	NNY	TOTAL
30	0	0	2	0	0	0	2
45	5	3	2	8	22	36	76
50	14	9	11	6	11	14	65
Total	19	12	15	14	33	50	143
Percentage	13.29	8.39	10.49	9.79	23.08	34.96	

Source: field Survey (2013)

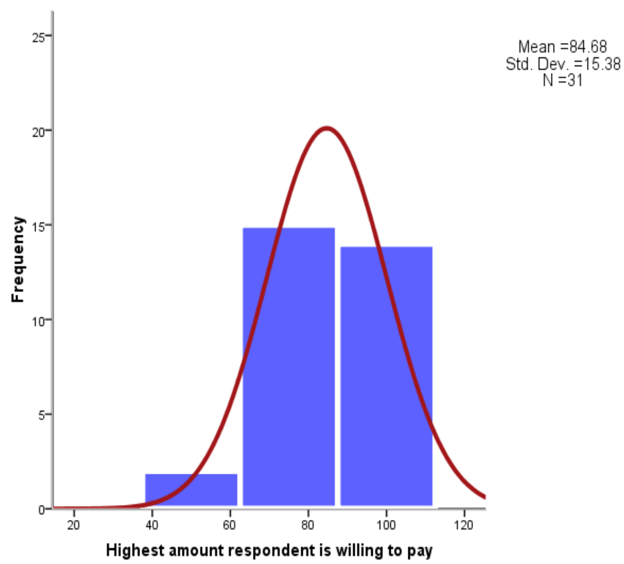
Tables 7.11 a & b show that 21.7% of the respondents gave two positive responses, 58% gave two negative responses, while 10.5% and 9.8% fell in the “yes no” and “no yes” response categories. Following the “No No”, left censored category, 23% of the respondents rejected the second follow up bid, specifically 15.4% said no to the lowest bid offered of KSh.25. Meaning respondents were not willing to pay even KSh.25 per month on top of what they were already paying for water. Conversely following the “Yes Yes” right censored category 13.3% of the respondents were willing to pay more than the maximum amount offered of Ksh.100 per month on top of what they were already paying for water. Table 7.12 presents the summary descriptive statistics for each response category. As was the case with the WTA, there is a wide variation within and among the response categories.

Table 7.12 Summary statistics of CV bids for different response categories

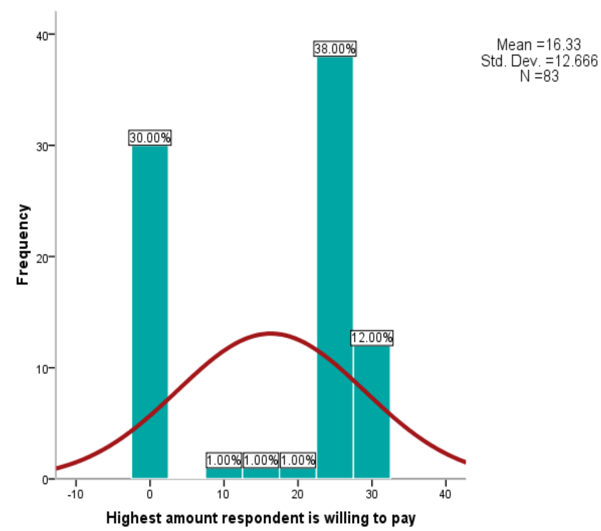
Category	Number	Min	Max	Mean	Std. Deviation
Right Censored (YY)	31	50	100	84.68	15.380
Left Censored (NN)	83	0	30	16.33	12.666
Middle (NY; YN)	29	30	50	42.07	8.610
Total	143	0	100	36.36	30.136

Source: Field Survey (2013)

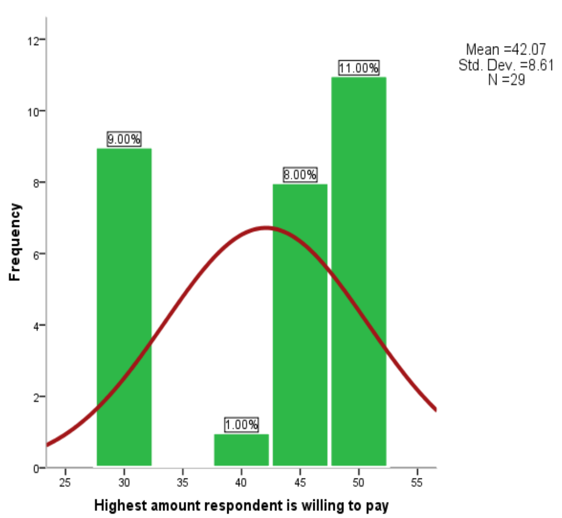
For right censored responses the mean WTA value is KSh.85/=, for the left it is KSh. 16/=, while for the centered data it is about KSh.42/=. Therefore the true willingness to pay can range anywhere between KSh. 16 and KSh.85/=.To get an idea of the distribution of censored observations four histograms are presented in Figure7.4 that show the frequency distribution of right censored, left-censored, middle and all observations.



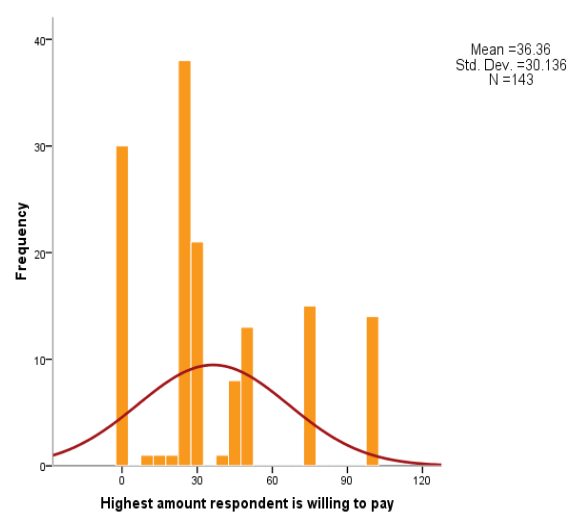
RIGHT CENSORED



LEFT CENSORED



MIDDLE CENSORED



ALL OBSERVATIONS

Figure 7.4: Frequency distribution of data by category
Source: Field survey (2013)

To calculate the mean willingness to pay, the study obtained a likelihood function by generating intervals from the collected data based on the lower and upper amounts selected by each respondent given that the WTP points are inside the division's intervals. The study then estimates nonparametric WTP – survival functions based on the Weibull and the mixed weibull/exponential parametric families of distributions. This can be viewed as an extension of the Survival analysis Turnbull's estimator (turnbull. 1976). Based on the options provided during the CV bidding process the following 5 intervals were used: (25,30); (30, 45); (45, 50); (50, 75); (75, 100). Within these intervals 91 of the 143 responses were deemed valid by the iwtp model and therefore used to estimate the mean WTP. Using the Weibull survival function the calculated WTP was approximately KSh.43/= above current water bill charges. The survival function mixing weibull and exponential (Weimex) calculated a mean WTP ofapproximately Ksh.44/= above current water bill charges. Other non parametric estimates gave mean WTP of approximately KSh.50/=. Figure 7.5 is a graphic representation of the two function weibull and weimix

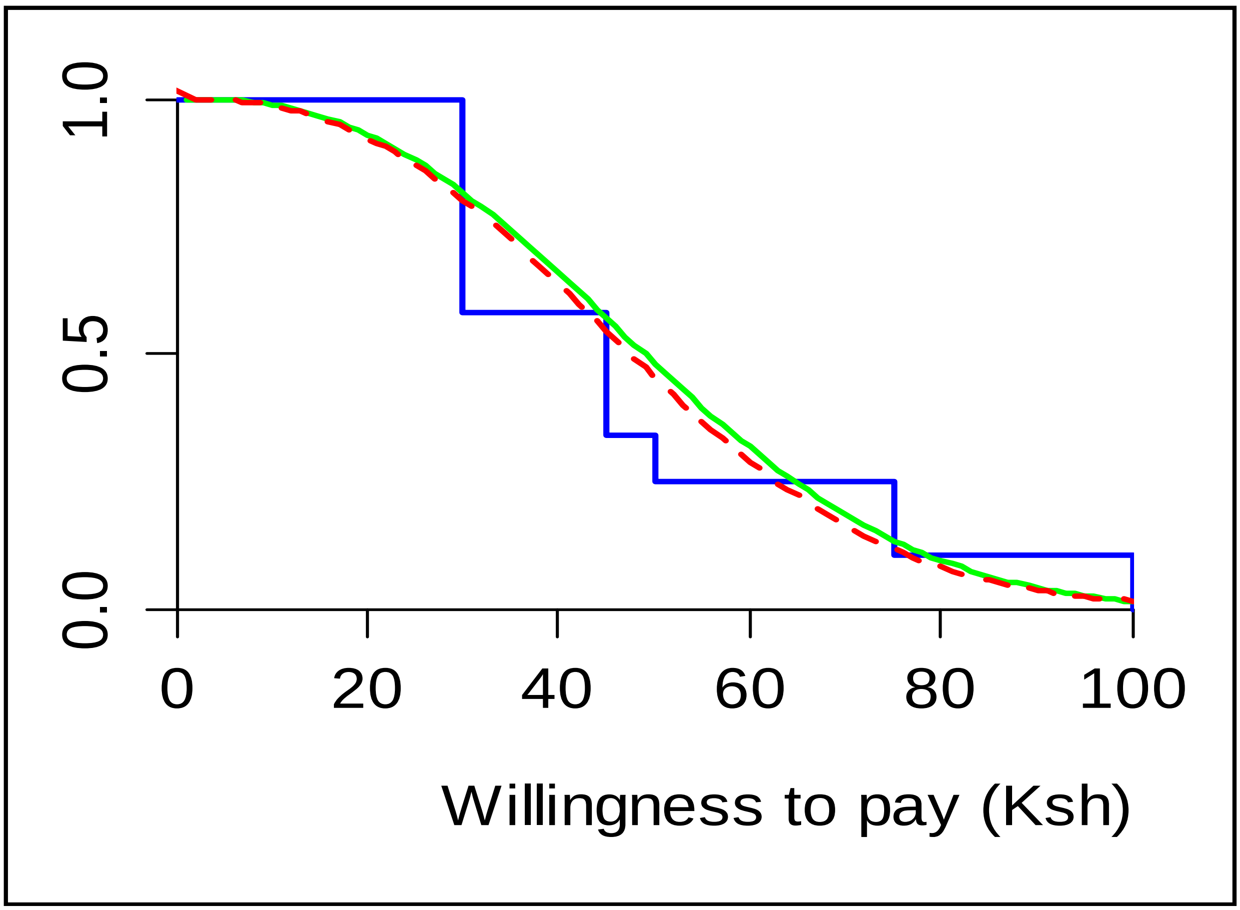


Figure 7.5: The estimated Weibull (green) and the mixed Weibull (red) survival functions

WEIBULL
Respondent no.: 91
Self-selected interval no.: 5
Division intervals: 5 in total
(25, 30], (30, 45], (45, 50], (50, 75], (75, 100]

Survival function: Weibull
Behavior model: BM5
Parameter estimates:
Scale (a): 48.039666
Shape (b): 2.444248
Coefficient c: 0.100000
Maximum llik: -184.348817
Mean WTP: 42.601805

Nonparametric estimate of the mean value of the empirical survival function (based on the right-end values of self-selected intervals): 49.50549
Nonparametric estimate of the mean value based on Turnbull estimator [see Turnbull, 1976]: 49.50549
Estimated Mean WTP based on parametric Weibull model (taken self-selected intervals as Turnbull intervals [see Turnbull, 1976]): 42.6018

WEMIX
Respondent no.: 91
Self-selected interval no.: 5
Division intervals: 5 in total
(25, 30], (30, 45], (45, 50], (50, 75], (75, 100]

Survival function: the mixture of Weibull/exponential
Bahavior model: BM5
Parameter estimates:
mixing parameter p: 0.990000
scale parameter a: 47.952866
shape parameter b: 2.448311
parameter m: 200.000000
Coefficient c: 0.100000
Maximum llik: -184.895976
Mean WTP: 44.101080

Nonparametric estimate of the mean value of the empirical survival function (based on the right-end values of self-selected intervals): 49.50549
Nonparametric estimate of the mean value based on Turnbull estimator [see Turnbull, 1976]: 49.50549
Estimated Mean WTP based on parametric Weibull model (taken self-selected intervals as Turnbull intervals [see Turnbull, 1976]): 42.6018

7.7 Chapter Summary

This chapter examined the two sides of the trading/transfer process for the environmental services, the WTA for upstream providers and the WTP of downstream beneficiaries.

Upstream, 67% of the respondents agreed to participate. Reasons for declining to participate were given as low level of understanding of the concept, and small land sizes. Looked at in relation to the land tenure situation, it can also be concluded that with only 51% of the respondents having a secure tenure, chance are around the same number would be willing to participate since they can guarantee the provision of services with ownership. The study found that he decision to participate was affected positively by the level of education which is consistent with the hypothesis that education means the ability to understand the scheme and its benefits better and so increases the likelihood to participate. The study also found that farmers making a higher income from their farming activities were less likely to want to participate in the scheme. This could be attributed to the notion that the amounts being offered are lower than the farmers' opportunity cost. The study also found wide variation within the categories of responses to the Contingent Valuation bidding exercise, in both the WTP and WTA.

The study estimated a mean WTA of KSh.7,080 which is approximately USD 83.3[6]. The accuracy of this result was confirmed by the other models which gave comparable mean WTA values. This estimate was found to be close to the opportunity cost the farmers would face based on lease rate per annum that range from KSh.5,000 – KSh.7,000 per year and also the estimated annual farm income that was approximately KSh. 8,000.

Downstream faced with a good supply of water that is of a poor quality, 97 percent of the respondents were willing to participate in the scheme. The respondents are also able to pay their current water bills and so show capacity to pay the additional amount. Factors affecting their decision to participate included Income, perception of water quality, access to financial services and perception of beneficiary participation in improving water quality were significant. Similar to the upstream population, the understanding of the upstream –

[6] Exchange rate applied is KSh.85 to USD 1.

downstream watershed interaction and acknowledging that interventions upstream could result in changes in the services received downstream also positively affects the decision to participate, since knowledge, awareness and information on the basis of the scheme are key factors in participation in PES schemes. The study calculated a mean WTP of KSh. 43 per month over and above their current water bill. Therefore Ceteris Paribus, each household downstream is willing to pay KSh. 516 per year towards upstream conservation efforts. This is approximately USD 6 per year.

Comparing the WTA and WTP amounts, we require nearly 14 buyers to cover the amount requested by the providers. This is possible since the urban population is larger than the rural one and therefore more people can pay the amount requested by one farmer upstream. Also the industrial and institutional buyers have not been considered here. Since they have shown willingness to pay they could also cover any shortfall. However, it is prudent to note here that the amount paid to the provider is subject to the provision of a service which must be measured and the compensation commensurate.

CHAPTER 8
INSTITUTIONAL AND REGULATORY FRAMEWORK FOR PES

8.1 Introduction

The frameworks for examining supportive institutional and regulatory environment including community level arrangements were based on thorough desk analysis, literature review, key informant interviews and focus group discussions. To enable the study comprehensively respond to specific objective three, there was need to look at the operating environment for the proposed PES scheme with a view to assess its ability to support the scheme. This chapter presents the finds of the study, beginning with a detailed presentation of the institutional setup in the water sector and other sectors that have a stake in the watershed including the Environment sector and the agricultural sector. The study uses its findings to propose an institutional arrangement for a proposed PES scheme for the watershed. It then presents the Regulatory framework elaborating the policies, laws and associated regulations that could be used to provide legal backing to a PES scheme.

8.2 Institutional Framework to Support PES

In Kenya, the Governance structure for natural resource management in Kenya oscillates from command-and-control to more decentralized participatory approaches. These structures impact the institutional and regulatory environment in which PES will operate since it shapes the capability of institutions to support PES. The adoption of the Integrated water Resources management (IWRM) in the management and regulation of the nation’s water resources aims at promoting a change to sustainable water resource management, thereby widening the analytic framework and the involvement of stakeholders to participate in water management. PES schemes need to be developed to fit this particular context.

Like for any other investment, good governance plays a major role in facilitating stable PES schemes and attracting necessary funding. It is critical therefore, to ensure minimum governance factors are in place to support PES. These include: (i) Public participation; (ii)

Transparency; (iii) Access to information; (iv) Accountability; and (v) Rule of law. Further, since PES transactions are highly dependent on contracts, which outline the parties' rights and responsibilities, access to courts and enforcement of contracts are particularly important aspects of PES preparedness. Without minimum levels of governance in place, PES investments will be perceived as too risky, crippling demand for PES. In assessing the viability of a PES scheme for the Kuywa Watershed and the Mt Elgon Ecosystem, the stakeholder analysis aims at giving an interrelated institutional feasibility outline. It will incorporate components of existing frameworks, guidelines and criteria being used by already established PES schemes and emerging schemes from around the World to describe and prioritize factors relevant to PES establishment.

8.2.1 Institutional Framework for Water Resources Management

The institutional framework for water management in Kenya is governed by the water Act (2002) and the national water policy (2012). The Water Act, (2002) introduced comprehensive changes to the Institutional framework for the management of the water sector in Kenya. It provides for the inclusion of all stakeholders groups and relevant sectors in the management of water including those responsible for hydrological services, water supply, irrigation development, water research, environmental protection, forestry, minerals, customary authorities, NGOs, Private sector and communities. In Kenya, this would include on the Government arm the Ministry of Environment, Water and Natural Resources and several other Ministries that are involved and/or affect water use e.g. Ministry of Agriculture, Lands and Energy.

The water sector organization is based on the principle of separation of roles: planning, regulation, monitoring and water service provision. The 'separation of policy and regulatory responsibilities and the devolution of responsibilities for water resource management and water services provision to local level functions has been the principal mechanism for improving accountability and transparency in the water and sanitation sector' (Hajikami Trust, 2008). The separation of regulatory mandate from implementation functions in order to avoid impaired accountability resulting from self-regulation also created conditions for higher level of performance and service quality and fostered transparency and accountability (GoK, 2012). The performance management system is also to be underlined as a factor for efficiency of the water sector The Institutions set up by the water Act (2002) are briefly discussed below.

8.2.1.1 Directorate of Water, Ministry of Environment, Water and Natural Resources

At the National level, the Ministry of Environment, Water and Natural Resources, Directorate of water is in charge of the water sector and is therefore responsible for the overall management of water resources and general government policy on the water sector in the country. The goal of the Directorate is conserving, managing and protecting water resources for socio-economic development. Under the water sector reforms, the separation of policy making from day-today administration and regulation, the Ministry and specifically the Directorate of Water, remains in charge of developing legislation, policies and national strategies on water and sanitation. It is also responsible for ensuring that all the water sector institutions work in coordination with each other and monitoring performance of the water sector. In addition the Ministry is also responsible for ensuring that funds are mobilized and properly allocated country wide. PES being a policy instrument for the management in this case of water resources, will need to be anchored in this Ministry.

8.2.1.2 Water Resource Management Authority (WRMA)

Section 7 of the Water Act establishes an autonomous public entity, the Water Resources Management Authority (WRMA) to protect and conserve water resources. Water resources for purposes of the Water Act include lakes, ponds, swamps, streams, marshes, watercourses or any body of flowing or standing water both below and above the ground. The Authority is responsible for (i) planning, management, protection and conservation of water resources; (ii) monitoring and assessment of water resources; (iii) regulation and protection of water sources for quality and quantity; (iv) determining allocation of water resources through a permit system; (v) monitor compliance; and (vi) formulate management strategies. WRMA is expected to implement policies and strategies relating to the management of water resources; these include the National Water Resources Management Strategy and the Principles of Integrated Water Resources Management.

They are expected to develop management strategies for water catchment areas that mirror these national policies and strategies to guide the management of Catchment areas. As policy implementers, the overall coordination of the implementation of the watershed PES scheme would be entrusted to them.

Currently the Water Resources Management Authority (WRMA) has six regional offices in Kenya these are Athi catchment area in Machakos, Tana catchment area in Embu, Rift Valley catchment area in Nakuru,Lake Victoria South catchment area in Kisumu, Lake Victoria North catchment area in Kakamega and Ewaso Nyiro North catchment area in Nanyuki. The Study area falls within the Lake Victoria North Catchment Area. To support the work of WRMA in each region, the Act provides for public participation in establishing institutions to work with the Water Resources Management Authority and their functions are: (i) to advise the WRMA on conservation of water resources; (ii) to advise on use and apportionment of water resources; (iii) to advise on the grant, adjustment, cancellation or variation of any water use permit. Two such institutions are the Catchment Areas Advisory Committees (CAACs) and the Water Resources Users Association

The water Act defines catchments as areas from which rainwater flows into a watercourse. WRMA is given authority by the Act to designate catchment areas and for each one develops a catchment area management strategy that is consistent with the national water resources management strategy. The WRMA is mandated to appoint a committee of up to 15 members in respect of each catchment area, the Catchment Area Advisory Committees (CAAC), to advise its staff at the appropriate regional office on matters concerning water resources conservation and management, including the grant and revocation of permits. The Catchment Area Advisory Committees may include representatives of communitygroups such as farmers and pastoralists and NGOs within catchment areas. The members are normally persons chosen to represent the different community groups around the catchment area.

Figure 8.1 presents a schematic representation of the institutional set up for the water sector in Kenya as it relates to the Kuywa Watershed, including other support sectors that have a stake in the management of the watershed.

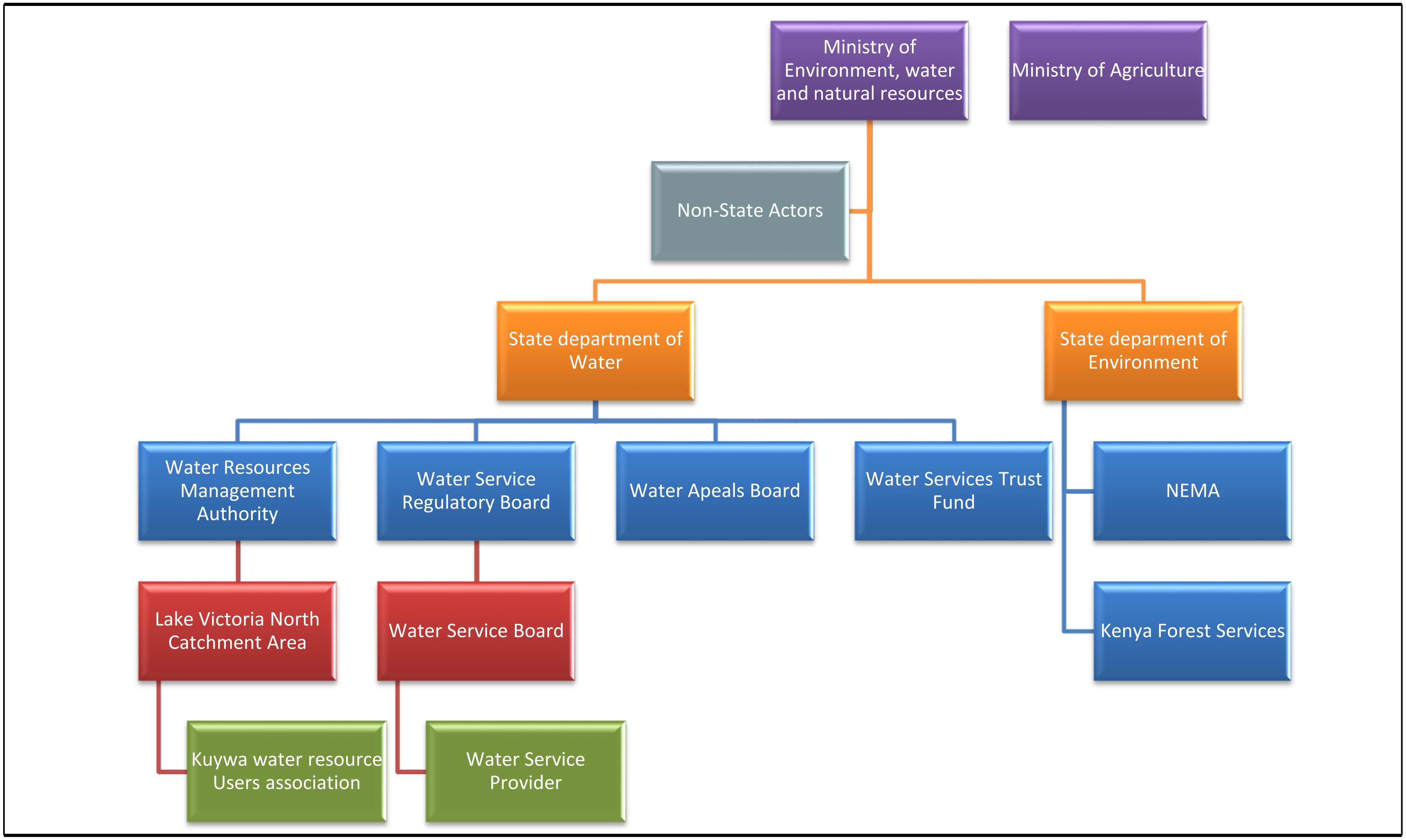


Figure 8.1: Representation of the institutional structure for management of water affairs relevant to the Kuywa watershed, in Kenya

8.2.1.3 Local Level Community Institutions

Most significant however, the Act provides a role for community groups, and relies on voluntary membership associations rather than on other institutional mechanisms such as local authorities. The reason for this is the belief that, being voluntary in nature, these associations can draw on the commitment of the members as social capital, as opposed to attempting to rely on more formal statutory structures, which might not necessarily be able to call on that social capital. The study sought to establish the organization of the respondents in groups and the results are shown in Table 8.1.

Table 8.1: Respondents membership to groups in their area (n=192)

		D/STREAM	**URBAN**	**UPSTREAM**	**TOTAL**
YES	COUNT	23	24	135	182
	%within membership	12.6%	13.1%	74.3%	100.0%
	%within location	47.9%	24.0%	93.8%	62.5%
NO	COUNT	25	76	9	110
	%within membership	22.7%	69.1%	8.2%	100.0%
	%within location	52.1%	76.0%	6.2%	37.5%
TOTAL	COUNT	48	100	144	292
	%within membership	16.4%	34.1%	49.5%	100.0%
	%within location	100.0%	100.0%	100.0%	100.0%

Source: Field Survey (2013)

Of the 292 respondents, 183 (62.5%) are members of at least one group while 110 (37.5%) do not belong to any group. Group membership is important since it is through these groups that extension services/public awareness exercises are provided as opposed to individual home visits. Also experience with working in groups makes it easier to form WRUAs since the concept is the same. As shown on Table 8.1, most of the respondents who are members of a group live within the Kuywa catchment either upstream or downstream; 74.3% and 12.6% respectively. Only 13.1% of those who belong to a group live in the urban area.

For purposes of water resource management, the Water Act provides for the establishment of community level organization, the Water Resources User Associations (WRUAs),to support the Government in the Management of Water catchments. WRUAs are formed by community members and groups in cooperation with Catchment Area Advisory Committees (CAAC). The Water Resource User Association (WRUA) represents community-based organizations that come together around specified water resources for cooperative management and conflict resolution. The emergence of WRUAs in Kenya can be qualified as a success story. They are a vehicle for community participation in Water Resources Management based on the assessment that the people using and impacting the water resources are the ones mostly affected by the scarcity of water, pollution and degraded catchments. The users are also directly responsible for the people living downstream, sharing the resource. A WRUA is an association of water users, riparian land owners, or other stakeholders who have formally and voluntarily associated for the purposes of cooperatively sharing, managing and conserving a common water resource. It membership is voluntary and it is empowered through the participation of its membership. Eligibility for membership derives from one's relationship to a common water resource, either as a water user (Abstractor members); or as a riparian land owner (Riparian Members); or as a non-consumptive member; or as an observer member.

In the Kuywa Watershed, two WRUAs exist; the Terem WRUA in the uppermost part of the watershed and the Kuywa WRUA. The Terem WRUA is not yet well established and was not included in the study. The study explored the membership to the WRUA by the respondents and the results are presented in Table 8.2.

Table 8.2: Respondents membership to the Kuywa Water Resource Users Association (KWRUA)

response		D/STREAM	URBAN	UPSTREAM	TOTAL
Not Selected	COUNT	6	14	10	30
	%within WRUA	20.0%	46.7%	33.3%	100.0%
	%within location	12.5%	14.0%	6.9%	10.2%
Selected	COUNT	17	10	126	153
	%within WRUA	11.1%	6.5%	82.4%	100.0%
	%within location	35.4%	10.0%	86.9%	52.2%
N/A	COUNT	25	76	9	110
	%within WRUA	22.7%	69.1%	8.2%	100.0%
	%within location	52.1%	76.0%	6.2%	37.5%
TOTAL	COUNT	48	100	145	293
	%within WRUA	16.4%	34.1%	49.5%	100.0%
	%within location	100.0%	100.0%	100.0%	100.0%

Source: Field Survey (2013)

The Kuywa WRUA has been established and of the respondents interviewed 153 (52.2%) belong to the WRUA distributed among the sub-locations as: 82.4% Upstream; 11.1% downstream and 6.5% Urban. Those who do not belong to the KWRUA are mainly those living in urban areas that are not eligible for membership since they do not live within the catchment. The ten respondents in the urban area, who are members of the KWRUA, possibly have a rural home within the catchment. Of the 153 respondents who are members of the KWRUA, 96% are registered as farmer users with the other 4% distributed among fisher folks (0.7%), herders (2%),and tree nursery (1.3%) user groups.

The WRUA is the institution that ensures that water users are integrally involved in the management of the water resources, since their livelihood is at stake, the water resource users can be mobilized to undertake water resource management activities that serve their best interests (e.g. surveillance on illegal or harmful activities and other WRM. It is also more efficient (with respect to the WRMA) for the WRUA to mobilize the water users to solve problems at the grassroots level. The objectives of the WRUA are to : (i) Promote controlled and legal water use activities; (ii) Promote good management practices to make efficient and sustainable use of the water resource; (iii) Promote water conservation practices to ensure sufficient water reserves that meet the demands of the environment, the wildlife, the livestock and all the communities who rely on the water resource; (iv) To work towards reducing conflict in use of the water resource and participate in solving those that arise; and (v) Promote catchment conservation measures to improve water quantities and quality.

The Kuywa WRUA is a legal entity registered under the Societies Act as an association and caries out activities including but not limited to (i) Exchange of information and ideas on the water resource use; (ii) Discuss potential projects and developments that may affect water usage with a view to obtain the consent of other WRUA members and the public; (iii) Resolve conflicts on water use; (iv) Monitor water availability and use; and (v) Lobby for resources to improve availability, reliability, quality or other aspects of the water resources. Ideally one WRUA should cover a sub-basin of about 200km^2 so as to remain reachable for all members. However, this ideal has not been reached, but the Kuywa WRUA has divided itself into Sub-Basins named A, B and C in an attempt to closely mirror this requirement. To establish the WRUA the potential membership of the WRUA go through a series of steps as outlined in the diagram below. The Kuywa WRUA has accomplished all these steps and has a catchment Management Plan in Place against which they are mobilizing resources.

8.2.1.4 Water Supply and Sanitation

The Act vests the regulatory functions over the provision of water and sewerage services in the Water Services Regulatory Board (the Regulatory Board), which is created in Section 46. Overall supervision of water services is carried out by the Water Services Regulatory Board (WSRB), an organ in charge of regulating the services supplied by the regional Boards and their providers. It also shapes an institutional framework that gives responsibility for providing decentralized services to seven regional Water Service Boards (WSB). These Boards manage water services assets and ensure that they remain in the public realm. The regulatory board is mandated to license all providers of water and sewerage services that supply water services to more than 20 households.

8.2.1.5 Water Services Regulatory Board (WASREB)

The Water Services Regulatory Board is established under the Water Act and was operationalized in March 2003. The functions of the WASREB include the issuance of licenses to Water Service Boards and to approve service provision agreements concluded between Water Service Boards and Water Service Providers. The Water Service Providers are the agencies that directly provide water and sanitation services to consumers. The WASREB is responsible for ensuring that water services and supply are efficient and meet expectations of consumers through regulation and monitoring of Water Service Boards and Water Service Providers. To standardize service provision, the Board has the responsibility of developing among others, tariff guidelines.

The Board is therefore supposed to oversee the implementation of policies and strategies relating to provision of water and sanitation services, these policies include the National Water Services Strategy (2007 -2015), Pro-Poor Implementation Plan for Water Supply and Sanitation. The specific functions of the WASREB include: (i) Providing information about water and sanitation services; (ii) Regulating the provision of water and sanitation services; this is done through such methods as setting standards for the provision of water services, monitor compliance of facilities for water supply with the set standards, Licensing Water Service Boards and other regional water service boards and approving their appointed Water Service Providers through service provision agreements; (iii) Setting the rules, establishing standards guidelines and monitoring the performance of Water Service Boards and Water Service Providers and enforcing regulations; (iv) Establishing technical, water quality and effluent disposal standards.

8.2.1.6 Water Appeals Board

The Water Appeals Board is established under the Water Act to adjudicate disputes within the water sector. The Appeals Board is made up of three persons, one appointed by the President on advice of the Chief Justice and two others appointed by the Minister for

Water and Irrigation. The Water Appeals Board can hear and determine appeals arising from the decision of the Minster in charge of Water, the WASREB and the Water Resources Management Authority (WRMA) with respect to the issuance of permits or licensees under the Water Act. The Act provides that the appeals board is meant to hear and determine matters where a person's rights to property have been affected by the decision of the Minster in charge of Water, the WRMA or the WASREB, or where a person who is a licensee of the Water Service Boards has been affected in the terms of the agreement by the decisions of any persons mentioned above. Any matter must therefore fall within the above specified category for it to be considered by the Water Appeals Board.

8.2.1.7 Water Services Boards (WSB)

Water Service Boards (WSBs) are constituted under the Water Act 2002. The WSBs are responsible for the provision of water and sewerage services within their areas of coverage and are licensed by the WASREB. The WSBs are also responsible for contracting Water Services Providers (WSPs) for the provision of water services. WSB and WSP enter into service provision agreements that include but not limited to the supply area, development, rehabilitation and maintenance of water and sewerage facilities of the WSBs. The WSBs are responsible for the review of the water services tariffs proposals from WSP before submission to WASREB for consideration. There are currently eight established WSBs through Gazette Notice No. 1717 of 12th March 2004, namely, Athi Water Services Board, Tana Water Services Board, Coast Water Services Board, Lake Victoria South Water Services Board, Lake Victoria North Water Services Board, Northern Water Services Board, Rift Valley Water Services Board and Tanathi Water Services Board.

This study falls under the jurisdiction of the Lake Victoria North Water Services Board (LVNWSB). The Board operates under a license issued by Water Services Regulatory Board (WASREB). The current license is for 10 years and runs from 11th May 2007 to 11th May 2017. Lake Victoria North Water Services Board covers the entire Western Province (i.e counties of Bungoma, Busia, Kakamega and Vihiga) and parts of the North Rift region of the counties Trans-Nzoia, Uasin Gishu and parts of Nandi and Elgeyo -

Markwet counties. The direct provision of water services to end users is entrusted to Water Services Providers (WSPs) who are contracted agents of the Board.

The mandate of the Board is to contract, monitor and enforce agreements between the Board and water service providers in accordance with regulations set by the Water Services Regulatory Board; ensure effective and economical provision of water services within its area of jurisdiction; monitor and acquire assets; plan, manage and develop water and sewerage services; and take custody of water services provision assets. Like other water service Boards, the LVNWSB has the mandate of ensuring efficient and economical provision of water and sewerage services within its area of jurisdiction. Direct provision of water and sewerage services is undertaken by Water Service Providers (WSPs) who are the Board's agents. However, in the event that for either economic or social reasons it is not possible to establish a WSP, the Board is mandated to undertake service provision.

The functions of WSBs include among others:- (i) efficient and economical provision of water services as authorized by license; Maintaining and acquiring assets, planning, development and management and expanding the coverage with strong focus on improving access to water services; (ii) Appoint viable and well managed Water Service Providers and ensure they have appropriate systems by undertaking the following: Enforce water quality monitoring; Ensure they have maintenance systems and procedures to minimize interruptions to water supplies; Ensure they have accurate and efficient billing system; Ensure they are customer focused in all their activities; and (iii) build capacities of Water Service providers to embrace efficiency, accountability and responsibility in service delivery.

8.2.1.8 Water Service Providers

The Board has the mandate of provision of water and sanitation services in its area of jurisdiction, through a license from the Water Services Regulatory Board (WASREB). The board however contracts service provision to other agents as provided for in the Water Act 2002. The Water Service Providers act as agents of the Water Service Boards. Under the Water Act, Water Service Providers are defined to include companies, NGOs, other persons or bodies. The Interpretation and General Provisions Act, Chapter 2 of the Laws of Kenya defines “person” asa legal or natural person. The implications are that community groups to qualify as Water Service Providers must be formally registered under the Societies Act, Chapter 108 of the Laws of Kenya to gain legal personality. The functions of Water Service Providers (WSPs) include the direct provision of water and sanitation services and the development, rehabilitation and maintenance of water and sewerage facilities of the WSB. Currently the Lake Victoria North Water Services Board (LVNWSB) has contracted five main urban Water Services Providers for actual provision of water and sewerage services within its coverage region. These are: (i) Nzoia Water Services Company Ltd; (ii) Kakamega Busia Water Supply; (iii) Amatsi Water Services Company Ltd; (iv) Eldoret Water and Sanitation Company Ltd; (v) Kapsabet Nandi Water and Sanitation Company

The LVNWSB has appointed and contracted Nzoia Water Services Company Ltd. as the legal agent for water services provision in Webuye, Bungoma, Kimilili, and Kitale Municipalities. The study area falls within its jurisdiction. The Nzoia Water Services Company Ltd is registered under the companies act cap 486 as a ‘private company’ though using public assets with respective local authorities/ counties as shareholders.
Formation of the urban Water Service Providers (the Water and Sewerage Companies) is also guided by WASREB regulations on Corporate Governance. The guidelines have elaborate criteria of recruiting directors from diverse stakeholder groups and disciplines, through a rigorous process involving advertisements, applications, interviews conducted by a selection committee representative of the stakeholder groups. The guidelines also states that one third gender rule has to be observed, persons with business relations with the company and those holding elective political posts are not eligible for consideration as a Board member. However, there is a provision for the county government to be represented in the Board by a professional

The LVNWSB has also focused on developing and promoting community run water supplies through funding from the ministry, UNICEF, Water Services Trust Fund, SIDA, DANIDA and other development partners. To ensure sustainability in the operations of the completed projects, the Board in collaboration with WASREB is registering the projects as rural water service providers.

8.2.1.9 Non- State Actors

The Water Act, 2002 involves non-governmental entities and individuals in the management of water resources, as well as in the provision of water services. The Act envisages the appointment of private individuals to the boards of both the Authority and the Regulatory Board. Rule 2 of the First Schedule to the Act, which deals with the qualification of members for appointment to the boards of the two public bodies, states that, in making appointments, regard shall be had to, among other factors, the degree to which water users are represented on the board. More specifically, subsection 3 of section 16 states that the members of the catchment advisory committee shall be chosen from among, inter alia, representatives of farmers, pastoralists, the business community, nongovernmental organizations as well as other competent persons. Similarly, membership on the board of the WSBs may include private persons.

Respondents were also asked if they were members of groups other than the WRUA. Of the 183 respondents who were members of groups, only 17.1% belong to Cooperatives; 13.7% belong to Self-Help Groups, and 6.8% belong to community based organization. Majority (85%) of the respondents did not know any group or institution working in the areas on matters of environmental conservation. The remaining 15 percent listed the following groups as working in the area:-

1. One Acre Fund – Empowering farmers to improve farm production
2. Life Straw – Deals with provision of equipment to purify drinking water
3. Action Aid – Poverty reduction
4. Green Belt Movement – Environmental conservation
5. Kopsiro Environmental Group (Vi Agroforestry) – Promoting agroforestry and other organic farming methods
6. Mazingira Women group – environmental conservation
7. Credis Youth Group – environmental conservation
8. Mulikhu Environmental Association – environmental conservation

In watershed PES schemes, the presences of watershed institutions can facilitate the setting up of PES. Government institutions have a significant role but civil society and the market often drive PES. Based on experiences from developed countries Gouyon (2003) reported that market-based mechanisms, combined with civil society institutions, are best able to deliver the highest combined levels of efficiency and equity. NGOs and CBOs play an important role in mediation with Markets (Rosa, Barry et. Al. 2004) and in channelling and implementing functions. From earlier analysis on farmers' preferences for management scenarios, this study found that farmers selected a local NGO as the most preferred administrator for the Scheme. During discussions, there were varied views on which of the NGOs present in the area would be best suited for this role. However, two strong contenders emerged:- (i) the Vi Agroforestry; and (ii) the One Acre Fund.

These local level institutions, working in partnership with the community groups and sector players could play the vital roles to influence policies, remove barriers and promote access to potable water, sanitation and improved hygiene for poor and vulnerable groups. This would help to improve decisions from both economic and environmental perspective and also create a sense of community ownership and management, and so contribute to the establishment and maintenance of improved water supply systems through PES. The direct contact with farmers would assist them monitor intermediaries, support farmers in drafting management plans and prepare applications and obtain contracts for payments. They could also assist in establishing structures for effective communication and negotiation among various actors, act as brokers between buyers and sellers to improve the process of negotiation, they fill institutional gaps and facilitate financial transactions.

8.2.2 Other Supportive Institutional Frameworks

The Laws governing environmental management in Kenya are many. Other than that described above for management of water resources, other frameworks exist for Coordination of environmental management (EMCA, 1999); Forest Act; Land management Act. These three are selected since they also provide an institutional framework that is supportive of the creation of PES schemes and affect the Kuywa watershed that starts in the Mt Elgon forest reserve managed under the Forest Act; passes through individual farmers land managed by the Land Act and the water act.

8.2.2.1 Institutional Setup by Environmental Management and Coordination Act (EMCA)

The current framework for environmental management came into existence with the Environmental Management and Coordination Act of 1999, which at the same time created the National Environmental Management Authority (NEMA) an institution with responsibility for coordinating environmental interventions in Kenya. EMCA does not repeal the sectoral legislation but seeks to coordinate the activities of the various institutions tasked to regulate the various sectors. These institutions are referred to as Lead Agencies in EMCA. Lead Agencies are defined in Section 2 as any Government ministry, department, Parastatal, and State Corporation or local authority in which any law vests functions of control or management of any element of the environment or natural resource.

The Environmental Management and Coordination Act, establishes various institutions for the proper management of the environment:

1. The National Environment Council (NEC) is responsible for policy formulation, setting national goals and objectives, setting priorities for environmental protection and promoting cooperation among public and private organizations engaged in environmental protection programs.
2. NEMA to exercise general supervision and coordination over all matters relating to the environment and to be the principle instrument of the government in the implementation of all policies relating to the environment. NEMA is also mandated to promote the integration of environmental considerations into development policies, plans, programs and projects.
3. District and Provincial Environment Committees responsible for the proper management of the environment within the District and the Province in respect of which they are appointed.
4. The Public Complaints Committee (PCC) with powers to investigate “any allegations or complaints against any person or against the Authority (NEMA) in relation to the

condition of the environment in Kenya" (EMCA 1999). Further, PCC has the powers to investigate suspected cases of environmental degradation.

5. National Environment Action Plan Committee (NEAPC) whose task is to prepare national environment actions plans every five years for the consideration and adoption by Parliament.
6. The National Environment Tribunal (NET) whose main responsibility is to review the administrative decisions of NEMA. For instance, NET has powers to review NEMA's environmental restoration orders.
7. The Standards and Enforcement Review Committee (SERC) to advise NEMA with respect to the establishment and regulation of environmental quality standards.
8. The National Environment Trust Fund (NETFUND) to facilitate research intended to further the requirements of environmental management, capacity building, environmental awards, environmental publications, scholarships and grants.
9. The National Environment Restoration Fund whose object is to act as "supplementary insurance for the mitigation of environmental degradation where the perpetrator is not identifiable or where exceptional circumstances require the Authority (NEMA) to intervene towards the control or mitigation of environmental degradation. This therefore provides for the remediation of environmental damage in order to avoid delays hence further degradation.

Section 9(1) of EMCA establishes the National Environment Management Authority (NEMA) to exercise general supervision and co-ordination over all matters relating to the environment and to be the principal instrument of Government in the implementation of all policies relating to the environment. Among the key functions of NEMA relevant to PES as spelled out in subsection (2) are:

a) Coordination of various environmental management activities being undertaken by the lead agencies and promote the integration of environmental considerations into development policies, plans, programmes and projects
b) Establish and review in consultation with the relevant lead agencies, land use guidelines;
c) Examine land use patterns to determine their impact on the quality and quantity of natural resources;

d) advise the Government on legislative and other measures for the management of the environment or the implementation of relevant international conventions, treaties and agreements in the field of environment;
e) publish and disseminate manuals, codes or guidelines relating to environmental management and prevention or abatement of environmental degradation;
f) render advice and technical support, where possible, to entities engaged in natural resources management and environmental protection so as to enable them to carry out their responsibilities satisfactorily;

8.2.2.2 Institutional Setup of the Forest Act 2005

Apart from the institutions established by EMCA, the Forest Act 2005 establishes an institutional framework for the management of forests. Section 3 of the Act establishes the Kenya Forest Service to be in charge of protection, conservation and sustainable use of all types' forest resources. The KFS builds capacity in the forest sector, provides policies and guidelines regarding management, conservation and utilization of forests, stakeholder collaboration and community participation, provide extension services, and enforce the law and regulations on forestry. In regard to watershed management, KFS is mandated to manage forests on water catchment areas primarily for purposes of water and soil conservation, carbon sequestration and other environmental services; and enforce forestry and land use rules and regulations made pursuant to any other written law.

Section 12(1) of the Forest Act establishes forest conservancy areas which are divided into forest divisions. A forest conservation committee is established in respect of each conservancy area. Among the functions of the Committee are to inform the Board on the ideas, desires and opinions of the people within the forest conservancy areas in all matters relating to the conservation and utilization of forests; regulate the management of forests at the local level, including the setting of charges and retention of income; assist local communities to benefit from royalties and other rights derived from flora or fauna traditionally used or newly discovered by such communities; and identify areas of un-alienated Government land or trust land to be set aside for the creation of forests. The Act under section 24 (1) provides for registration of Private forests. It entitles the owner of a private forest to receive from KFS technical advice regarding appropriate forestry practices and conservation; and subject to availability of funds, loans from the Fund for the development of the forest. Farmers involved in PES schemes can therefore access technical and financial support from KFS.

The Act promotes community participation in the management of forests through formation of Community Forests Associations (CFAs).The CFAs are registered under the Society's Act. Once registered the CFA may apply to the Director for Permission to participate in the conservation and management of a state forest or local authority forest on the basis of a management plan. With the approval of the Board, CFA may enter into partnerships with other persons for the purposes of ensuring the efficient and sustainable conservation and management of forests. These partnerships may be with consumers of watershed services e.g. water companies.

Even though PES is not specifically mentioned as an option for benefits to the CFAs, a strict interpretation of the Act can ensure that the CFAs can benefit from the PES schemes especially if they are providing critical ecosystem services which could otherwise not be optimally provided.

8.2.2.3 Institutional Framework for Land Resources Management

Article 67 (1) of the Land Act, establishes the National Land Commission to manage public land on behalf of the national and County governments. The commission also has functions in research on land use and other natural resources, assessment of tax on land, and to monitor and have oversight responsibilities over land use planning throughout the country. Section 11. (1) mandates the National Land Commission to take appropriate action to maintain public land that has endangered or endemic species of flora and fauna, critical habitats or protected areas. The Commission has obligation to ensure that any public land that has been identified for allocation does not fall within any of the following categories—

(*a*) public land that is subject to erosion, floods, earth slips or water logging;

(*b*) public land that falls within forest and wild life reserves, mangroves, and wetlands or fall within the buffer zones of such reserves or within environmentally sensitive areas;

(*c*) public land that is along watersheds, river and stream catchments, public water reservoirs, lakes, beaches, fish landing areas riparian and the territorial sea as may be prescribed;

Under section 19 (1) The Commission shall make rules and regulations for the sustainable conservation of land based natural resources. The rules and regulations may contain:

(*a*) Measures to protect critical ecosystems and habitats;

(*b*) Incentives for communities and individuals to invest in income generating natural resource conservation programmes;

(*c*) Measures to facilitate the access, use and co- management of forests, water and other resources by communities who have customary rights to these recourses;

(*e*) Procedures on the involvement of stakeholders in the management and utilization of land- based natural resources; and

(*f*) Measures to ensure benefit sharing to the affected communities.

8.3 Proposed Institutional Set Up for the Kuywa Watershed PES

The establishment of a Payment for Environmental Services (PES) scheme requires the removal of all institutional barriers and mechanisms put in place to ensure clear modalities for negotiation and involvement of stakeholders (Peprah-Asante, 2009). This will foster an environment of trust and commitment by all stakeholders. With the results from the Literature review, respondents, interviews, key informant interviews and focus group discussions presented, the study proposes an institutional structure that could support the establishment and implementation of PES in the Kuywa Watershed in Kenya. Figure 8.2 is a representation of this structure.

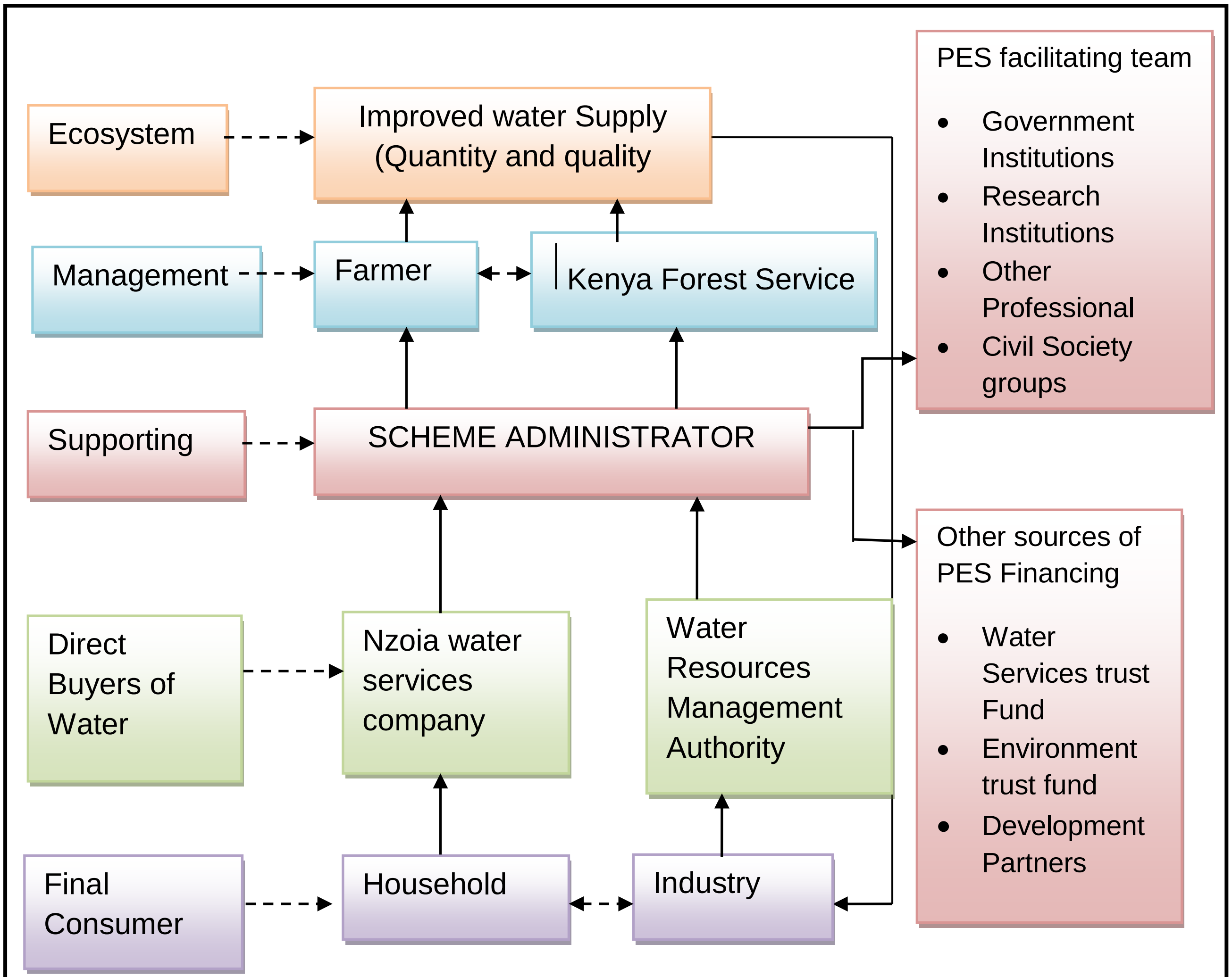


Figure 8.2: Proposed institutional setup for PES in Kuywa catchment
Source: field Survey (2013)

The study identified the buyers/ final consumers of the service as households receiving piped water from the Nzoia water services company (NZWASCO) and industrial and institutional players who have abstraction permits. The households make payments to the NZWASCO, while the industry and institutions top up their abstraction fees and pay to the Lake Victoria North Catchment Area under Water Resources Management Authority (WRMA) who forward the payment to the scheme administrator. The respondents selected to have a local based NGO as the scheme administrator; however for sustainability this study recommends that the Kuywa Water Resource Users Association (KWRUA) is strengthened to carry out this role. The administrator task is to organize the distribution of funds to the farmers and maybe to the Kenya Forest Service. Otherwise the Kenya Forest Service should receive funds directly from the Water Services Board or the WRMA for use of water sources originating from the Forest. This is provided for by law in Kenya. The farmers and the KFS will use the funds to improve the environment and ensure increased provision of water quality and quantity to the final consumers.

The scheme administrator will also have other responsibilities to coordinate the provision of support services to the players in the scheme from other stakeholders whom the study refers to as PES facilitating teams. They can include Government Departments identified in the previous section as being able to provide technical, policy and regulatory support to the scheme. Other facilitators include research institutions to provide information to support decision making, professional e.g. lawyers to provide technical support to the scheme and civil society groups who may have a comparative advantage in areas of awareness creation or technology dissemination. The other role the administrator will play is resource mobilization from development partners and from local sources like the water services trust fund and the environment trust fund among others.

8.4 Regulatory Regime for PES

The introduction of PES schemes requires appropriate analysis of the current legal system to ensure the scheme can operate within the current national legislation. An appropriate legal framework of a country can enable the successful implementation of PES schemes.

8.4.1 The Constitution of Kenya

The Kenyan Constitution defines the basic authority of state and rules governing their functioning. The Kenya Constitution, 2010 has been hailed as a green Constitution because of its elaborate provisions with considerable implications for sustainable development. These range from environmental principles and implications of multilateral environmental agreements (MEAs) to the right to clean and healthy environment enshrined in the Bill of Rights. From the perspective of PES there are two articles in the bill of rights and a chapter on land and environment that are relevant.

The Bill of rights guarantees protection of right to property, in article 40, stating that everyone has a right to own property and such property is protected against arbitrary deprivation and limit or restriction of enjoyment of property, interest in or right over the same. However, the same property should not be abused to the detriment of the rights of others and of the general interest and its use may not cause harm to human health and the environment. In Article 42 the constitution states that every person has the right to a clean and healthy environment, including right to have the environment protected for the benefit of present and future generations and to have obligations relating to environmental fulfillment.

The constitution has dedicated chapter five to land and environment. Part one of this chapter covers issues related to land and in Article 60 states that land in Kenya shall be held, used and managed in a manner that is equitable, efficient, productive and sustainable. It goes further to state that the same right shall be in accordance with the principles of (a) equitable access to land; (b) security of land rights; (c) sustainable and productive management of land resources (d) transparent and cost effective administration of land (e) sound conservation and protection of ecologically sensitive areas; (f) elimination of gender discrimination; (g) encouraging use of local dispute resolution mechanisms. Chapter five part one then goes on to establish the land Commission, and set out the forms of Land tenure that shall be applicable to include public, private and communal Land. Article 66 leaves room for the state to regulate land use in the interest of defense, public safety, order, morality, health and land use planning.

Part two of Chapter five of the constitution of Kenya deals with matters of the Environment and Natural resources. Article 69 outlines obligations in respect of the environment in which the state commits to among others (i) ensure sustainable exploitation, utilization, management and conservation of environment and natural resources and ensure the equitable sharing of the accruing benefits; and (ii) encourage public participation in management, protection and conservation of the environment. Conversely every person has a duty to cooperate with state organs and other persons to protect and conserve the environment and ensure ecologically sustainable development and use of natural resources. This provides a firm basis and principles upon which PES can thrive, if followed up with appropriate legislative, policy and institutional reforms.

8.4.2 Eco-system Related Legislation to Support PES

8.4.2.1 Environmental Management and Coordination

The framework legislation for environmental management in Kenya is the Environmental Management and Coordination Act (EMCA) of1999. Prior to the enactment of EMCA, the legal framework for environmental management was scattered in over 77 sectoral laws. These statutes either dealt with natural resources (e.g. fisheries, water, forestry and wildlife etc.) or functions (e.g. Public Health, Agriculture, Factories, Mining or shipping) (Migae2006). This posed serious coordination challenges, and institutional overlaps and grey areas.

The Environmental Management and Coordination Act (EMCA) was enacted to remedy the above weaknesses. It provides for the establishment of an appropriate legal and institutional framework for the management of the environmental in Kenya. it should be noted that EMCA does not repeal the existing sectoral legislation but merely seeks to improve coordination of all sectors and actors. The Act is founded on the same constitutional principles of sustainable development- the right to a clean and healthy environment, polluter pays principle, public participation, precautionary principles, and equity principles. The Environmental Management and Coordination Act provides for environmental action planning for rational management of the environment and natural resources in sections 38-40. An Environmental Action Plan (EAP) has to be prepared every five years for consideration and adoption by the National Assembly. Among other things, the EAP can recommend appropriate legal and fiscal incentives to encourage the business community to incorporate environmental requirements into their planning and operational processes;

EMCA provides a framework for command and control approach to the management of environment, water and land resources through subsidiary legislation (regulations). These regulations are observed more in breach than compliance. To achieve the intended purpose, these will need to be supplemented by economic instruments such as PES.Among the regulations and guidelines include:

a) Regulations, procedures, guidelines and measures for the sustainable use of hill sides, hill tops, mountain areas and forests so as to protect water catchment areas, prevent soil erosion and regulate human settlement. The guidelines to – appropriate farming methods; carrying capacity of the areas described in subsection in relation to animal husbandry; measures to curb soil erosion; protection of the areas from human settlements, and the protection of water catchment areas. To date these have not been developed.
b) Water Quality Regulations, 2006 that sets standards for drinking water, water for industrial purposes, water for agricultural purposes, water for recreational purposes, and water for fisheries and wildlife;

The National Environment Council may recommend to the Minister responsible for Finance tax and other fiscal incentives, disincentives or fees to induce or promote the proper management of the environment and natural resources or the prevention or abatement of environmental degradation.The tax and fiscal incentives, disincentives or fees may include user fees to ensure that those who use environmental resources pay proper value for the utilization of such resources.

A PES-like mechanism provided in EMCA is the easement or an environmental conservation order. Section 112(1) of EMCA gives powers to a court of law to grant on application, an environmental easement or an environmental conservation order to facilitate the conservation and enhancement of the benefited environment, through the imposition of one or more obligations in respect of the use of land (burdened land). Section 116 (1) entitles a person who has a legal interest in the land which is the subject of an environmental easement, to compensation commensurate with the lost value of the use of the land. However, the court may, if satisfied that the environmental easement sought is of national importance, order that the Government compensates the person with legal interest.

Among the reasons an environmental conservation order may be imposed on burdened land is to preserve the quality and flow of water in a dam, lake, river or aquifer; preserve the natural contours and features of the burdened land; and prevent or restrict the scope of any agricultural activity on the burdened land. Section 115 provides for the registration of an environmental easement under a particular system of land registration, or if the land is not registered under any registration system, the District Environment Committee of the area in which that land is situated shall register the environmental easement on a register maintained for that purpose.

8.4.2.2 The Water Sector

The Kenyan constitution in Article 43 (1) guarantees every person the right to clean and safe water in adequate quantities. This right is to be realized progressively through legal and administrative interventions. The government of Kenya is currently implementing wide ranging reforms in the water sector in accordance with the Water Act 2002. The broad objective of the reforms is to equitably improve access to sustainable safe water and sanitation services and resource management at affordable cost. The Water Act 2002, provide for the management, conservation, use and control of water resources and for the acquisition and regulation of rights to use water; and the regulation and management of water supply and sewerage services. The principles of the Act include: (a) The Act clearly differentiates the roles of various actors in the water sector i.e government, public, private sector, water resources management and water services and supply; (b) the Act has entrenched public participation and involvement in the water services and water resources management; (c) the Act intended to define water rights and legislated ways in which resources could be utilized; (d) the Act introduced new water management institutions to govern water and sanitation services; (d) the Act has strong pro-poor focus.

These principles are supportive of PES as they clearly separate producers of water resources and buyers, and strengthen community participation and grassroots institutions involved in water resources management. The Water Act, 2002, mandates the Water Resources Management Authority (WRMA) to designate a defined area from which rainwater flows into a watercourse to be a catchment area (section 14). Following public consultation, the Authority shall formulate a catchment management strategy for the management, use, development, conservation, protection and control of water resource within each catchment area. A catchment management strategy shall among other things prescribe the principles, objectives, procedures and institutional arrangements of the Authority for the management, use, development, conservation and control of water resources within each catchment area; and provide mechanisms and facilities for enabling the public and communities to participate in managing the water resources within each catchment area.

8.4.2.3 Legislation in the Agricultural Sector

Kenya has enacted three new pieces of legislation to govern the Agricultural sector. They are The Agriculture, Livestock, Fisheries and Food Authority Act 2031, The Kenya Agricultural and Livestock Research Act 2013, and the Crops Act 2013. The aim was to transform farming into a professional, well-paying, internationally competitive and attractive to the youth if the agricultural sector is to drive Vision 2030.

The Crops Act 2013contains various statutes relating to crops; to provide for the growth and development of agricultural crops. The objective of this Act is to accelerate the growth and development of agriculture in general, enhance productivity and incomes of farmers and the rural population, improve investment climate and efficiency of agribusiness and develop agricultural crops as export crops that will augment the foreign exchange earnings of the country, through promotion of the production, processing, marketing, and distribution of crops in suitable areas of the country. This will affect the selection of land use practices that can be implemented in a Watershed management PES.

The Agriculture, Fisheries and Food Authority Act (2013) is an ACT of Parliament to provide for the consolidation of the laws on the regulation and promotion of agriculture generally, to provide for the establishment of the Agriculture, Fisheries and Food Authority, to make provision for the respective roles of the national and county governments in agriculture excluding livestock and related matters in furtherance of the relevant provisions of the Fourth Schedule to the Constitution. The Act establishes an authority to look at all matters relating to agriculture. Part five of the Act will have the greatest effect on establishment of PES as they relate to policy guidelines on land development and preservation and utilization of agricultural land.

8.4.2.4 The Forest Sector Legislation

The Forest Act 2005 promotes the conservation and sustainable utilization of forest resources. An example of support for PES under the Act is provided in section 35 (1) which gives the Director of Kenya Forest Service (KFS) powers to enter into an agreement with any person for the joint management of any forests. The agreement may enjoin such person to use or refrain from using such forest or any part thereof in a particular manner in order to ensure the conservation of biodiversity. Provided that where an agreement enjoins such person to use or refrain from using the forest in any particular manner, it shall contain modalities of payment of compensation to such person for any loss incurred thereby.

8.4.2.5 Legislation Relating to Land

The national Land policy underpins these principles of land management outlined in Article 60 of the Constitution. The Land Act, 2012 gives effect to Article 68 of the Kenya Constitution by revising, consolidating, and rationalizing land laws to provide for the sustainable administration and management of land and land based resources. The Act applies to public, private and community land. The Act recognizes four types of tenure systems with equal recognition and enforceability: freehold, leasehold, partial interest e.g. easements, and customary land rights. The Act's guiding principles of land management and administration as given in Section 4, are based on the constitutional provisions of the Act. Relevant to PES schemes are the principles of: equitable access to land; security of land rights; sustainable and productive management of land resources; transparent and cost effective administration of land; and conservation and protection of ecologically sensitive areas. The Land Act, 2012 also provides for the creation of easements, while, the Land Registration Act 2012, provides for their registration. An easement benefits the "dominant" land and burdens "the servient land". Easements can be used as a form of PES where the owner of the burdened or servient land is compensated for doing or not doing something in order to benefit another land.

8.5 Chapter Summary

This chapter has presented the institutional and regulatory environment in which any proposed Payment for Environmental Services Scheme (PES) for the Kuywa Watershed would operate in. The Water Sector in Kenya has an elaborate structure that goes all the way to the community level for both water resources management and for Water Services provision. This provides a mix of the Government facilitation through the parastatal WRMA and the privatized Water Service providers. Other than the water sector, other Government sectors also have a role to play in the establishment and implementation of a PES scheme. They include the National Environment Management Authority (NEMA) which has an environmental coordination role, The Kenya Forest Service which is a co-manager of the natural resources in the area and the Ministry of Agriculture which is best placed to provide technical support to the farmers. Based on the findings of the study a proposal is made for a suitable institutional structure for PES in the watershed. To support the regulatory arm of the scheme, other useful sectors include the Judiciary and the lands ministry (to support land tenure issues). The chapter has also outlined the regulatory regime that will support the PES scheme arrangement which will depend heavily on contracts and sound legal backing.

CHAPTER 9

SUMMARY, CONCLUSION AND RECOMMENDATION

9.1 Summary

Natural resources are common pool resources that have a public good characteristic and the concern for their management originated around the time of Hardin's writing the Tragedy of the commons that brought to light the dire consequences of the human patterns of consumption highlighting that as the population increases the demand for the resource outstrips supply and every additional unit consumed by each individual consumer, denies others the benefits. He proposed that privatization was the only plausible solution. This theory has been applied to environmental management discourse on management of commons and stood in the wake of governments centralization of resource management and use of protectionist and command and control management techniques. However critics like Ostrum disputed Hardin's thesis and demonstrated that common property regimes have a history of success, especially in local and/or traditional resource management contexts. Ostrum's premise that each type of "commons" called for its own set of governance regimens, which would vary according to the social and ecological context forms the basis of her approach to managing the commons. She argued that individuals using an existing commons could organize as commons users (a user-group) to manage collectively held properties or govern the use of common-pool resources. To date protecting common-pool resources still poses great challenges at both the local and the global scale. This is further exacerbated by the fact that in many developing countries economic, institutional and policy failures prevail increasing the pressure on ecosystems and result in imperfect service delivery.

The debate on sustainable development has prompted policy-makers to formulate new strategies for achieving a balanced economic and technological pathway that would safeguard the environment, not only here and now, but also elsewhere in the future. This has guided environmental decision making towards a more inclusive management regime. The resilience thinking is increasingly used as an approach for understanding the dynamics of social–ecological systems as one system. The resilience approach emphasizes non-linear dynamics, thresholds, uncertainty and surprise, how periods of gradual change interplay with periods of rapid change and how such dynamics interact across temporal and spatial scales. The combination of sustainable development discussions and resilience perspective brings to fore the ecological and economic perspectives of natural resource management. The increasing recognition of the interdependence of human and the natural environment led to the concept of environmental goods and services as benefits derived by human kind from the environment. This caused a shift in management technique to focus efforts of conservation on the benefits derived by society. This is closely related to the increasing body of knowledge on economic valuation which is expected to raise the profile of the environmental goods and services in the policy making process.

Environmental governance approaches have continued to evolve over the year moving in tandem with the theoretical development and discussion. The Hardin;s era came with protectionist and nationalization approaches. These were changes with the findings of Ostrum and others that communities could contribute to environmental management. This led to the proliferation of decentralized approaches to management that were more participatory like the community based natural resource management approaches. The sustainable development thinking highlighted the economic angle of the problem of environmental management and made interdependence central to the policy formulation process. This led to governance approaches that incorporate economic consideration into environmental management. Work therefore increased to making environmental goods and services marketable, through valuation and using this information to inform policy making. It is from this that the Concept of Payment for Environmental services grew.

Environmental degradation and the associated decrease in provision of environmental services to mankind continue to be issues of global concern. Sustainable approaches to Environmental management have been proposed as solutions to this challenge. This calls for an integrated approach that will ensure a combination of environmental, economic, policy and institutional concerns are addressed. PES is a tools used for sustainable management of natural resources and can work effectively and efficiently with good governance in place which comprises effective institutional and legislative systems. That there is no single recipe to the development of PES schemes is demonstrated by the benefits and challenges to PES. PES is therefore an entire toolbox with a variety of tools/ instruments for different situations. It is apparent then, that thorough research is required when developing PES schemes to support the selection of the most suitable conservation tool. This should be done keeping in mind the contextual factors that may influence design and implementation of the PES scheme. Carroll & Jenkins, (2009) stated that to achieve the sustainable management of environmental services, PES schemes must be designed and implemented carefully, intelligently, and adaptively. Motivated by this, this research was designed to investigate the various aspects of PES and assess their suitability for the management of the Natural Resources in the Mt. Elgon ecosystem.

The key issues in designing and implementing a payment for environmental services scheme, include and understanding of among other things, (a) farmers' preferences over various scheme management options that would facilitate the provision of watershed services, (b) farmers' willingness to accept (WTA) payment for the provision of required watershed services (supply side), and (c) the potential buyers of environmental services and the willingness to pay (WTP) of beneficiaries (the demand side). Implementing PES in the context of weak institutions is challenging. It is therefore important to ensure existence of sustainable institutions that will support PES. This will be enabled if (i) there are clearly defined boundaries for the resource system and associated households; (ii) Costs and benefits are in equivalence; (iii) rules based on collective choice and easy to monitor are in place; (iv) Accountable officials and monitors; (v) A sanction system; (vi) a conflict resolution mechanism; and (vii) recognized user rights are in place. In an enabling environment, it is imperative that the right actors are involved at all stages of the establishment and during implementation of the Scheme. Lopa (2010) said there are three main actor groups; the ES stewards; the potential buyers; and an intermediary institutional structure to facilitate the transfers. The study looked at prevailing institutional setup from experiences across the world and concludes that a suitable institutional environment needs to be constructed from a variety of institutions with different mandates and administrative level. This could ensure all round support to the PES in terms of scientific research, resource mobilization, information collection and dissemination, capacity building, conflict resolution, monitoring and enforcement. Above all the institutional structure must reflect the reality in which it operates taking into account national and local circumstances and governance structures.

Studies analyzing the legal frameworks for PES tend to be vague because defining tangible rules for PES systems that are applicable all around the world is a great challenge, given the differences in legal and institutional frameworks of countries. Laws and policy determine the powers and responsibility of institutions, their legal status, and their integration and collaboration within a framework of transparency, public participation, equity and legal certainty. PES schemes can be promoted through different legal instruments at different levels including the Constitution, specific PES laws, sectoral environmental legislation and indirectly relevant laws. An enabling legal environment for PES should therefore ensure linkage with all relevant laws, provide guidelines to support financial transaction, provide grounding for the institutional structure, and legislation that supports implementation and sustainability of a PES scheme.

The study was carried out in the Kuywa River watershed, which is a tributary of the Nzoia River that Flows from Mt. Elgon to the Lake Victoria. The study area is located in Bungoma County, Western Kenya. The Mt Elgon ecosystem is the headland for this watershed and is one of the five water towers in Kenya. The Kuywa Watershed originates from the Mt. Elgon forest and drains into the Nzoia River system at Khalala, which in turn drains into Lake Victoria. The River Kuywa is one of the major tributaries of the middle Nzoia basin. The entire river system is approx 97km long and traverses Bungoma County. The River Kuywa has a catchment area of 292km^2 serving a mainly rural and agricultural catchment Population is 146,000 people & density of 500 persons/km^2 (WRMA, 2011). The Kuywa Catchment is chiefly in a rural setting with an economy driven by agricultural activities. Favorable climatic conditions, good soils, and abundant human resources has supported the development activities in the area and has led to the growth of market centers which provide supporting services and market for the agricultural products. The major industrial crop within the catchment is sugar cane with most farms forming part of the Nzoia sugar factory Out-grower scheme.

A total of 292 respondents were interviewed. A two part structured questionnaire was used part one for socio-econ and demographic characteristics, part two for the conjoint data and part three for the contingent valuation. The data for the conjoint analysis was analyzed using a tradition conjoint model, a binary logit model and an ordinary logit model. The data for the contingent valuation was analyzed using the censored interval regression model. The study found that the environment in the Kuywa watershed is degraded as a result of increased human activity in the watershed. Though respondents receive sufficient water the quality of the water is poor with high sedimentation, chemical and solid waste pollution from farms, industries and market centers. The communities are aware of these challenges and are willing to do something to reverse the trend.

The upstream/provider population are middle aged having an average age of 41 yrs. The household sizes are large (6person per households) with some being as many as 13 persons per household. The respondents have some formal education mainly primary level (51%) and Secondary level (37%). Poverty is high in the study area with average incomes of KSh. 12, 700 per annum. This translates to USD 0.06 per person per day which is below the dollar a day threshold. Maize is the preferred crop here but it is not the most highly paying. Sugarcane is the most highly paying contributing over KSh.23,000/= . However, farmers complained that delayed payments make growing the crop not worth their while.

A conjoint analysis done using three models produced similar results from each of the models indicating a degree of accuracy in the results. The study found that the length of time the management intervention will commit the farmers land affected their selection of the management scenarios presented. Further land size to be committed also affected the selection of the management scenario. With land size smaller area were insignificant in informing the decision, however for areas of 40% and above of the total land area then it significantly affects the selection of the management scenario. This is an indication that farmers are willing to set aside a portion of their land for the conservation intervention. The results of the conjoint analysis lead us to draw the conclusion that a management scenario that includes commitment of 20% of land area for a period of 5years, a cash incentive of KSh. 5,000 per acre per annum; administered by a local NGO and requiring contribution of free labour for two days would have the highest likelihood of being selected. The study found that Gender, age, household size, Awareness of upstream effect on downstream benefits; carrying out environmental conservation on farm, land tenure and annual income are the main factors that affected the decision of the farmer to participate in the scheme.

The study examined the two sides of the trading/transfer process for the environmental services, the WTA for upstream providers and the WTP of downstream beneficiaries. Upstream, 67% of the respondents agreed to participate. Reasons for declining to participate were given as low level of understanding of the concept, and small land sizes. Looked at in relation to the land tenure situation, it can also be concluded that with only 51% of the respondents having a secure tenure, chance are around the same number would be willing to participate since they can guarantee the provision of services with ownership. The study found that he decision to participate was affected positively by the level of education which is consistent with the hypothesis that education means the ability to understand the scheme and its benefits better and so increases the likelihood to participate. The study also found that farmers making a higher income from their farming activities were less likely to want to participate in the scheme. This could be attributed to the notion that the amounts being offered are lower than the farmers' opportunity cost. The study also found wide variation within the categories of responses to the Contingent Valuation bidding exercise, in both the WTP and WTA.

The study estimated a mean WTA of KSh.7,080 which is approximately USD 83.3[7]. The accuracy of this result was confirmed by the other models which gave comparable mean WTA values. This estimate was found to be close to the opportunity cost the farmers would face based on lease rate per annum that range from KSh.5,000 – KSh.7,000 per year and also the estimated annual farm income that was approximately KSh. 8,000.

Downstream faced with a good supply of water that is of a poor quality, 97 percent of the respondents were willing to participate in the scheme. The respondents are also able to pay their current water bills and so show capacity to pay the additional amount. Factors affecting their decision to participate included Income, perception of water quality, access

[7] Exchange rate applied is KSh.85 to USD 1.

to financial services and perception of beneficiary participation in improving water quality were significant. Similar to the upstream population, the understanding of the upstream – downstream watershed interaction and acknowledging that interventions upstream could result in changes in the services received downstream also positively affects the decision to participate, since knowledge, awareness and information on the basis of the scheme are key factors in participation in PES schemes. The study calculated a mean WTP of KSh. 43 per month over and above their current water bill. Therefore *Ceteris Paribus,* each household downstream is willing to pay KSh. 516 per year towards upstream conservation efforts. This is approximately USD 6 per year.

Comparing the WTA and WTP amounts, we require nearly 14 buyers to cover the amount requested by the providers. This is possible since the urban population is larger than the rural one and therefore more people can pay the amount requested by one farmer upstream. Also the industrial and institutional buyers have not been considered here. Since they have shown willingness to pay they could also cover any shortfall. However, it is prudent to note here that the amount paid to the provider is subject to the
Provision of a service which must be measured and the compensation be commensurate.

The study found that the Water Sector in Kenya has an elaborate structure that goes all the way to the community level for both water resources management and for Water Services provision. This provides a mix of the Government facilitation through the parastatal WRMA and the privatized Water Service providers. Other than the water sector, other Government sectors also have a role to play in the establishment and implementation of a PES scheme. They include the National Environment Management Authority (NEMA) which has an environmental coordination role, The Kenya Forest Service which is a co-manager of the natural resources in the area and the Ministry of Agriculture which is best placed to provide technical support to the farmers. Based on the findings of the study a proposal is made for a suitable institutional structure for PES in the watershed. To support the regulatory arm of the scheme, other useful sectors include the Judiciary and the lands ministry (to support land tenure issues). Further, the regulatory regime that will support the PES scheme arrangement will depend heavily on contracts and sound legal backing.

9.2 Conclusion

Environmental services provided by Watersheds are scarce due to destruction and unsustainable use of watershed resources. Degradation of watersheds, poor water quality and the associated stress on human populations continues to be a major challenge to policy makers as demand for water increases and the human population continues its exponential growth path. Increasingly it has been documented that ecosystem-based management approaches are the answer for effective protection of global water resources. In harmony with this idea is the possibility of achieving greater results with the involvement of the affected communities within a watershed context, where the relationship between land-use practices and the condition of water quality are better understood. This is because major contributing factor that affect the provision of watershed services in developing countries include land –use decisions and agricultural management practices. Farmers' activities upstream affect water quantity and quality available to beneficiaries downstream, but they have no or little incentives to take these impacts into account in their decision making processes.

The main source of water for the urban residents of Bungoma town is at the Matisi water abstraction and treatment plant on the Kuywa River. This plant was found to be operating below its capacity resulting in several unreached urban residents and unreliable supply of piped water to those who have access. This has resulted in residents providing alternative and often unsafe alternative sources of water for themselves like the hand dug wells in several homesteads. Further those who receive piped water usually treat it further to make it safe for drinking meaning the water provided is not of a good enough quality for human consumption. In the Kuywa watershed, increased human activity and the resultant destruction of natural resources, is translated into the poor quality of water received downstream and by urban users in Bungoma town. This is an indication that economic and social considerations have outweighed environmental considerations in informing the land use decisions making of upstream farmers in the Kuywa watershed. Literature reveals that this can be turned around to ensure good quality water reaches more homes, if the land use practises in the watershed are changed.

A major challenge therefore, is finding ways that can guarantee the conservation and provision of environmental services through sustainable resource management of the Kuywa Watershed. This poses the practical and policy question: - 'how can farmers upstream be motivated to change to more sustainable land use practices?' Payment for environmental services has emerged as a policy instrument that can be used to motivate farmers to provide environmental services through change to more sustainable land use practices and thereby improved catchment conservation. PES paves the way to creating linkages between the farmers' upstream (sellers) and downstream/urban beneficiaries (buyers). Our research findings indicate that the PES concepts are in line with provisions of the constitution of Kenya, The water sector policies and several national ecosystem management policies, laws and regulatory frameworks and further that there is strong support for local, collective protection of the Kuywa watershed. Therefore, encouraging community participation offers the local community a chance to participate directly in decisions that affect them and to benefit from their efforts. The findings of this study have improved understanding of Payment for Environmental Services (PES), as a participatory, incentive based, financial tool, for conservation of watersheds in the Mt. Elgon ecosystem, encouraged the development of both local level management approaches and the use of incentive mechanisms to finance conservation of natural resources.

With regard to the viability of PES, there are good prospects for PES in the Kuywa Watershed in particular and the Mt. Elgon ecosystem in general. The study has identified potential for successful design and the country has a wide range of policy legal and regulatory instruments in place to provide an enabling environment for PES. The institutions in place are sufficient to support PES and where gaps are identified they can be filled by establishing new institutions or building the capacity of existing institutions to fill the identified gap. Initiating a PES scheme for the Kuywa watershed will not only supplement other conservation initiatives but can have both social and economic impacts. Implementing PES in this watershed can lead to sustainable natural resources management at the local level, while fostering community involvement in natural resource management. The schemes in meeting its environmental conservation objective can also contribute to livelihoods improvements of riparian communities. These communities depend on the natural resources for their livelihoods and therefore the improved ecosystem health ensures that they have a batter resource base which they can continue to sustainably use. Further, here are benefits to be gained by local ecosystem services producers in implementing payment for ecosystem services schemes. PES provides a mechanism through which the provider community can be paid for the stewardship of the natural resources. This ensures that the local community gains in economic terms from natural resources management. Following on experiences from literature and the findings of this study, it goes without saying that PES as a promising tool for environmental conservation presents opportunities for rural communities and ensures achievement of both conservation and poverty alleviation goals.

9.3 Recommendations

Recommendations made here for the Kuywa watershed and by extension to other watersheds in the Mt. Elgon Ecosystem are based on the study and cover management actions to secure ecosystem services, policy instruments to ensure way forward for PES schemes and further study. The study therefore makes the following recommendations:-

i. Education and increased awareness at the community level need to be carried out in order to empower them for effective participation. There is need to engender local awareness and interest in ecosystem market and ecosystem services for the local communities. It is recommended that this covers awareness on ecosystem services, the role PES can contribute to the halting of resources degradation and demonstration of returns to investment from participation in the scheme. Also important is providing access to market information that will help foster the link between buyers and sellers of environmental services. Education and awareness in this area can be carried out by community institutions, NGOs and government institutions already working in the region.

ii. The study found that the respondents did not have confidence in the Water resource Users association, which is supposed to be their participation vehicle. Leading from this need is identified for strengthening of community level institutions to enable them play a central role in the design and implementation of PES. This will ensure the level of community participation required to foster trust, transparency and all other tenets of PES is achieved. Although the management of natural resource has been decentralized and community participation encouraged these efforts have been insufficient and government needs to do more. This study recommends strengthening of community level institutions through expanded interactions training in various areas including organizational skills. These initiatives could be financed by the Water trust fund and the environment trust fund established in the country focus on building the institutional capacity of local level institutions since this will be the basis for success of all community level initiatives as they relate to Natural resource management. These funds could also be used to pilot PEs schemes at watershed level that would serve as a demonstration that can be replicated and or up-scaled as required. Further the county government should take steps to account for environmental services in their planning and decision making processes. It is anticipated that this will go a long way in increasing the perceived value of these resources and therefore contribute to reduced degradation of the natural resources that provide them.

iii. In the examples of PES in Africa, the scheme has been demonstrated through specific projects and programs. However sustainability requires that the concepts are mainstreamed at both central Government and county Government level. Although some initiative have been taken at the Ministry of Environment, Water and Natural Resources to acknowledge PES as a possible policy instrument for environmental conservation, this is not enough, and more needs to be done by the Central and County Governments in advancing and mainstreaming PES. The right to Land and other resources need to be looked into to ensure sufficient security for the community to participate in PES schemes. The study recommends that given the general acceptable institutional and legal framework in the country to support PES, effort should be made to develop PES specific regulations and strategies at the two levels of Government to facilitate its effective implementations and also sustain the concept as it grows and evolves to address emerging issues. PES specific strategies will provide guidelines for unclear issues like revenue sharing from ecosystems services; and designing funds transfer mechanisms that will ensure the payments made by beneficiaries actually reach the right providers/ stewards. A proactive intervention is required by government to create a framework for Markets of ecosystem services embedded in the overall strategy of natural resources management. Government could also facilitate the domestication of global issues and relevant policies to local level to improve understanding at this level on emerging markets of ES.

iv. Pagiola (2002) shows the national PES scheme for water services in Costa Rica as an example where a PES scheme set up utilized an existing institutional framework as a base to build on, which enabled the rapid implementation of the schemes once agreements were made with beneficiaries. For a PES schemes to successes it requires an institutional framework where the following functions can be carried out: (i) Development and implementation of a mechanism to collect and manage payments from service beneficiaries (buyers of ES); (ii) Develop and implement a mechanism to negotiate with and contract service providers, quantify the ecosystem service they are providing and monitor their participation (Including record keeping); (iii) Develop and implement a governing structure for making decisions and resolving disputes (Boonstra, 2010). Following up on these documented experiences, the study recommends an institutional structure that will include the institutions shown in Table 9.1:

Table 9.1: Institutions that should be involved in the PES scheme

• **Provider**	Farmers; KFS; Forest adjacent communities
• **Beneficiaries**	Urban residents; Water and sewerage Co; Industry; large institutions
INTERMEDIARY ORGANIZATION	
• **Collection of payment downstream**	Through water bills by the water service company
• **Collection and distribution of payment upstream**	Local NGO/ WRUA
• **Awareness**	NGOs, WRMA
• **Research**	Research institutions – ICRAF, KARI, ILRI
• **Regulatory**	Relevant GoK department
• **Financially**	Development partners, Trust funds

Source: Field Survey (2013)

v. There are several environmental services provided by watersheds and other ecosystems within the larger Mt. Elgon ecosystem. The study has looked at only the viability of a PES scheme for trading in water quality and quantity. For effective conservation of the whole ecosystem, the study recommends that effort is made to study markets for other environmental servies and also the possibility of bundling services. For the Kuywa watershed specifically the ares bordering the Mt. Elgon forest researve there is opportunity to explore the prospects for carbon and biodiversity markets and the study recomends that this can be done together with the water markets and packaged as a market bundle.

Kenya is a water-scarce country: renewable fresh water per capita currently stands at 647 m3 and is expected to fall to 235 m3 by 2025 if supply does not keep up with the population increase (GoK 2010a, GoK 2010b). The country's five water towers – the Aberdares, Mt Kenya, Mt Elgon, Cheranganyi Hills and Mau face high degradation, as a result many lakes and rivers have already reached critically low levels. This situation is attributed to several factors among them the destruction of catchment areas through forest destruction, river-bank cultivation and poor land use practices. Catchment degradation is causing increased run-off, flash flooding, reduced filtration, erosion and siltation, and is undermining the limited sustainable water resource base in the country. Siltation of water courses and storage facilities has led to serious degradation of the quantity and quality of water resources (GoK 2010a: 71). Development of Watershed PES schemes offers an instrument that could reverse this trend and set the Country on the way to achieving the MDG for both water and sanitation and Environment.

Two important policy implications from the research findings are drawn. First, the strong community support for decentralized management of natural resources and the participatory approached advanced by Government, is evidence that local participation in community-based management is not an obstacle for the viability of PES approaches for protecting and managing tropical watersheds and associated services. Second, the success for PES elsewhere in the world and in Africa and the demonstration that it is a viable option for the Kuywa watershed, indicate that there is potential for application of PES to other watershed in eth Mt. Elgon ecosystem and possibly elsewhere in Kenya.

9.4 Further Research

Further research is needed

i. to generate accurate hydrological information that would specifically link identified land use changes to the quality and quantity of a specific volume of water. This will help to concretize what environmental service is being provided and quantify it properly.

ii. Total economic valuation of environmental services is very useful for the establishment of PES. This will provide information to the steward of the services about the value of the resource and their individual and/or collective contributions to the provision of specific ES can be established.

iii. on the supply side of the potential market, an exhaustive examination is required to help identify potential matches or mismatches between water users' *WTP* for provision of watershed services and farmers' WTA that compensation.

iv. To establish the cost of conservation of the watershed. This study has presented what the buyers are willing to pay and what the sellers are willing to accept. However, is this adequate for the interventions that will be required to reverse degradation in the watershed?

v. That will consider areas of livelihood/income patterns, resource use, access and right and an assessment of their implications for and on PES design and the local poor.

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APPENDICES

Appendix 1: Questionnaire

Appendix 1.1 – Downstream and Urban Questionnaire

Appendix 1.2 –Upstream Questionnaire

Appendix 2: Focus Group Discussion Guide

Appendix 3: Lake Victoria North Water Service Board's Rural Water Service Providers in the Kuywa Watershed

APPENDIX ONE: QUESTIONNAIRES

APPENDIX 1-1
DOWNSTREAM AND URBAN QUESTIONNAIRE

University of Fort Hare
Together in Excellence

FACULTY OF SCIENCE AND AGRICULTURE
DEPARTMENT OF AGRICULTURAL ECONOMICS & EXTENSION

PAYMENT FOR ENVIRONMENTAL SERVICES

A SURVEY OF YOUR OPINION

DOWNSTREAM AND URBAN QUESTIONNAIRE

This survey aims to assess water users' willingness to pay for increased, reliable and safe water supply through improved catchment management in River Kuywa catchment. There are no right or wrong answer

YOUR OPINION MATTERS

By completing the questionnaire you are helping to inform the design of a Payment for Environmental Services scheme

Contingent valuation survey questionnaire for eliciting the willingness to Pay (WTP) of Water Users down stream and in Urban Areas for increased and reliable water supply via Catchment Management in River Kuywa catchment, Bungoma, Kenya (2013)

Respondent's ID. (Random sample point) _

Survey Point ______N/A_____; GPS Number: ______N/A______

Enumerator's name ____N/A__________________; Date of interview____N/A

Sub-Location name _____

INTRODUCTION

I am a PhD student in Agricultural Economics at the University of Fort Hare, South Africa. As part of this degree, I am undertaking a research project to explore the potential of a payment for environmental services (PES) scheme in Kuywa Sub-Catchment region. River Kuywa supplies water for domestic and industrial use to you. However, intensive human activities within the Kuywa Catchment have compromised the flow and quality of water in the river. Designing and implementing appropriate incentive schemes could provide incentive to landholders to adopt catchment conservation measures which could in turn increase water quality and quantity in the River. There is an opportunity for incentive based conservation of the catchment. This study will attempt to understand how this can work. I am currently collecting data and I would be grateful for your cooperation in this important piece of research work that will provide important information for the study.The information collected in this survey will be treated confidentially and used for the purpose of the study only. A PhD thesis will be prepared and subsequently published in part or as a whole. If you have any questions concerning this undertaking, please do not hesitate to address them to me or my principal supervisor.

PART A: Socio-Economic Data: *This section asks for background information to help identify patterns among different respondents. Your answers will be kept completely confidential.*

Section 1: Socio-Demographic data

1. Name of the respondent

2. **gender**	3. **Relationship to Household head**	4. **Age** What is your Age? (yr)	5. **Marital Status**	6. **Occupation** What is your occupation?	7. **Education** What is the highest level of schooling you completed?	8. **Household size** how many members of your household are in each of these age groups?	
						Adult (age >15 yrs)	Children (age <15 yrs)
Male ...1 Female..2	1 Head/self 2.Spouse 3 Child 4 Grandchild 5 Other blood relative 6 Other		1.Single 2.Married 3.Seperated 4.Widow/er 5. Divorced	1. Farming 2. Trading 3. Artisan 4. Casual 5. Salaried 6. Unemployed 7. Student 8. Other	1. No schooling 2. Religious/trad 3. Primary 4. Secondary 5. Technical 6. university		

Section 2: Socio-Economic data
Tick the selected answer

9.	What is your Main source of household income?	Farming	1
		Wage employment	2
		Artisan	3
		Salaried Employment	4
		Trading	5
		Rental Income	6
		Remittance	7

10.	State other sources of financial support for the family? (tick all relevant ones)	None	1
		Faith Based Organization/ Church	2
		Pension	3
		NGOs/CBO	4
		Remittances (Children and relatives)	5
		Others (Specify)	6

11.	What is your total income including external financial support per month?	**Source**	**Amount per month**
		Employment/business	
		Financial support	

12.	Expenditure per month (Note : If the respondent gives amount for the year then divide by 12)	**Item**	**Amount per month**
		Education -	1
		Health -	2
		Food	3
		Fuel -	4
		Rent -	5
		Transport -	6
		Water	6
		Others -	7

PART B: Awareness, identification of environmental services, and institutions: *This section provides information on environmental awareness, the environmental services available and information on the institutions available within the area. Your answers will be kept completely confidential.*

(*instruction to the enumerator:* *section 1 will be asked to downstream water users living within the Catchment, for the Urban respondents please go to section 2***)**

Section 1. Environmental Services

1.	What is your general perception of the environmental status of the Kuywa River catchment	Very good	1
		Good	2
		degraded	3
		Very Degraded	4

2.	Please rank the environmental problems in the catchment in order of their severity. Most severe ranked as 1 and the least severe as 6	Deforestation	1
		Poor water quality	2
		Loss of biodiversity	3
		Wetland degradation	4
		Poor agricultural yield	5
		Inadequate water	6

3.	Do you get any good and/or services from the Natural Resources?	Yes	1
		No	2

4.	If Yes which goods or services do you get	Water for domestic use	1
		Fuel Wood	2
		Raw materials for commercial use	3
		• Clay	
		• Reeds	
		• Timber	
		• NTFP (Specify)	
		Raw material for domestic use	4
		• Clay	
		• Reeds	
		• Timber	
		• NTFP (Specify)	
		Grazing	7
		Food crops (Specify)	8

5.	What is your general perception of the current quality of the water in the Kuywa River	Very good	1
		Good	2
		Poor	3
		Very Poor	4
6.	What is your general perception of the current availability/quantity of the water in the Kuywa River	Very reliable	1
		reliable	2

		Unreliable	3
		Very unreliable	4
7.	How have the activities farmers carry out on their land affected the quality and quantity of water?	Reduced water quantity	1
		Dried up natural springs/ headland of the river	2
		Increased soil in water	3
		Increased chemicals in the water	4
8.	Do you carry out any environmental conservation activities on your farm?	Yes	1
		No	2
9.	If yes, which environmental conservation activities do you carry out	Terracing	1
		Stone bands	2
		Water harvesting	3
		Fencing open area	4
		Forest restoration	5
		Commercial tree plantation	6
		Soil fertility improvement structures	7
		Others (specify)	8
10.	If no, why	Shortage of labour	1
		Shortage of finances	2
		Shortage of land	3
		Not profitable	4
		Lack of awareness	5
		Insecure land tenure	6
		Free rider (public Good) problem	7

Section 2. Environmental Services *(to be answered by respondents in urban areas)*

11.	Do you get any good and/or services from the Natural Resources?	Yes	1
		No	2

12.	If Yes which goods or services do you get? (Multiple answers allowed)	Water for domestic use	1
		Fuel Wood	2
		Raw materials for commercial use	3
		• Clay	
		• Reeds	
		• Timber	
		• NTFP (Specify)	
		Raw material for domestic use	4
		• Clay	
		• Reeds	
		• Timber	
		• NTFP (Specify)	
		Fish	5
		Food crops (Specify)	6

13.	Are you aware that management of water catchment areas upstream affect the water urban residents receive?	Yes	1
		No	2

14.	If yes, how ?	Reduced water quantity	1
		Dried up natural springs/ headland of the river)	2
		Increased soil in water	3
		Increased chemicals in the water	4
		Others (specify)	5

15.	What is your general perception of the current quality of the water you receive?	Very good	1
		Good	2
		poor	3
		Very poor	4

16.	What is your general perception of the current availability/reliability of the water you receive	Very reliable	1
		reliable	2
		unreliable	3
		Very unreliable	4

17.	Are you a member of any environmental conservation group?	Yes	1
		No	2

18.	If yes, which activities do you carry out?	Tree nursery	1
		Education and Awareness creation	2
		Lobbying and advocacy	3
		Tree planting	4
		Beautification	5
		Others (Specify)	6

Section 3. Local institutions membership/participation status and access

19.	Are you a member of/participating in any of the following organization? ***Name:***	Kuywa Water Resource User Association	1
		Farmers' co-operative/union	2
		Self –Help Group	3
		Community Based Organization	4
		Other organization or environmental initiative (Specify)	5

20.	If you are a member of the KWRUA, which user group do you belong to?	Fisherfolk	1
		farmers	2
		herders	3
		Tree nursery	4
		weavers	5
		Other (specify)	6

21.	Do you know any CBO or any other institution (local or foreign) Government or non-governmental) involved in environmental conservation in your area?	Yes	1
		No	2

22.	If yes Please name them		

23.	Does your household have access to financial services from any of the following institutions?	Commercial Bank	1
		Microfinance institutions	2
		Posta	3
		MPESA, AIRTEL MONEY	4
		Village bank	5
		Savings and Credit Cooperative	6
		Other Specify	7

24.	What is the distance from your house to the nearest market?		

25.	Do you have any prior information on any of the following aspects of trade in environmental services	No	1
		Carbon credit	2
		Payment for deforestation avoidance	3
		Share in Eco- tourism ventures income	4
		Others (specify)	5

PART C: Water Supply Data: *This section asks for information to help understand your experiences, attitudes, opinions on the reliability and management of water supply.*

Section 1. Water supply

1. What is your households' **MAIN** source of water and has this changed in the last three years? *(only one response)*

Protected Sources	Current		Three years ago	
	Wet season	Dry season	Wet season	Dry season
Protected Spring	1	1	1	1
Well hand dug	2	2	2	2
Borehole drilled	3	3	3	3
Rainwater tank on site	4	4	4	4
Piped tap water in dwelling	5	5	5	5
Public/communal tap/ water kiosk	6	6	6	6
Mobile Water tanker (bowser/ vendors)	7	7	7	7

Unprotected	Current		Three years ago	
	Wet season	Dry season	Wet season	Dry season
Unprotected spring	8	8	8	8
Pond	9	9	9	9
River	10	10	10	10
Water pan	11	11	11	11
Others (specify)	12	12	12	12

2. What is the distance to your nearest source of water and has this changed in the last three years?

Distance	Current		Three years ago	
	Wet season	Dry season	Wet season	Dry season
Within the compound	1	1	1	1
Less than 1 km	2	2	2	2
Between 1km and 3 km	3	3	3	3
Between 3km and 5 km	4	4	4	4
More than 5 km	5	5	5	5

3.	Who supplies you with water	Nzoia water and Sewerage Co	1
		Rural water supply Co	2
		Local community water Project	3
		Land lord/employer	4
		Self	5
		Neighbour	6

4.	Do you Pay for the water	Yes	1
		No	2

5.	If yes ,How do you make the payment for the water	Do not pay	1
		M-PESA	2
		Cash to the office	3
		Post Office	4
		Bank	5
		In Kind	6

6.	To whom does your household pay? [INTERVIEWER: CHOOSE ONLY ONE OPTION]	Local water service providers	1
		Business/water vendor	2
		Landlord/employer	3
		CBO/NGO	4
		Community contribution in kind	5
		Do not pay	6

			Mains connection	Water Kiosks	Water vendor	Other s
7.	How much does your household pay for water per month?	Do not pay	1	1	1	1
		State an exact amount for each source	2	2	2	2
		Do not Know	3	3	3	3
		N/A	4	4	4	4

8.	In your opinion do you consider the cost of water to be affordable?	Can easily pay	1
		Can pay	2
		Struggle to pay	3
		Can hardly pay	4

9.	Has the water supply been stopped for nonpayment?	Yes	1
		No	2

10.	What is the main reason for not paying? [INTERVIEWER: DO NOT READ OUT THE OPTIONS]	Source of water is free (not piped Water)	1
		Never received a bill	2
		Billing is irregular or incorrect	3
		Can't afford to pay for water	4
		Unhappy with the water provided	5
		Others do not pay	6
		The household only uses the free basic amount	7
		The cost of water is included in the rent	8
		Other specify,	9

11.	Does your household use water for OTHER purposes apart from the domestic use?	Yes	1
		No	2

12.	If Yes please explain (multiple answers allowed)	Irrigation of crops	1
		Irrigation for flowers	2
		Animal use	3
		Others Specify	4

13.	How much water does		

	your household use per day?		

14.	Is the amount of water you get adequate for your domestic requirement?	Yes	1
		No	2

15.	Do you agree that shortage of water supply is a serious problem in your area?	Strongly agree	1
		Agree	2
		Disagree	3
		Strongly disagree	4
		I do not know	5

16.	Over the last three years, what has been the trend in the severity of the water supply shortages	Increased significantly	1
		Increased	2
		Decreased	3
		Significantly decreased	4

17.	What was the cause of the water shortage	Water Rationing	1
		Burst Pipes, Illegal connections; Vandalism	2
		Increased upstream abstraction	3
		Dry Spell	4
		Decrease in water level in the river	5
		Do not Know	6
		Others, specify	7

18.	Which are the months in which scarcity is experienced (multiple answers allowed)	Jan	Feb	Mar	Apr	May	Jun	jul	Aug	Sept	Oct	Nov	Dec
		1	2	3	4	5	6	7	8	9	10	11	12

19.	Has water shortage affected the allocation of household income or labor time for alternative activities	Yes	1
		No	2

20.	If yes how?	More money spent on paying for water	1
		More time taken to reach source of water	2

21.	In your opinion is the water supply you use **(respond to each)**		I do not know	Yes	No
		Safe to drink?	1	2	3
		Clear?	1	2	3
		Good to taste?	1	2	3
		Free from odours?	1	2	3

22.	Has any of your house hold member suffered from any of the following water related diseases/condition recently (past 6months)	Diorrhoea	1
		Typhoid	2
		fluorosis (brown teeth)	3
		Scabies (skin diseases)	4
		Trachoma	5

23.	In your opinion, what should be done to increase the quantity and reliability of water supply to your area?	construct a dam	1
		regular maintenance of existing sources	2
		Rain water harvesting at household level	3
		increased water quantity at the source through catchment management and conservation	4
		improve efficiency of water services	5
		I do not know	6
		other Specify	7

24.	In your opinion, can consumers contribute to improving the quantity and reliability of water supply?	Yes	1
		No	2

25.	If yes How?	Make their voices heard through their local MP	1
		put pressure on water companies	2
		Sharing the cost of catchment Conservation	3
		Users have nothing to do	4
		I do not know	5
		others; Specify	6

PART D: Contingent Valuation Survey: *This section asks for information to help us estimate the value you attach to provision of safe and reliable water supply*

1. The Contingent Valuation Scenario

With growing population and increasing demand for water, quantity and reliability of water supply is becoming a common problem leading to frequent water rationing in many urban areas and unsafe drinking water downstream. One major contributing factor is the degradation of the River Kuywa Catchment since landowners in the River Kuywa Catchment currently adopt land use practises that favour meeting their short term food and income requirements which results in reduced water yield and pollution. If this continues unabated, your supply of water will decrease significantly and this will lead to an increase in the part of your income spent on getting water and or increased incidences of disease resulting from use of unsafe water. Conversely, if landholders adopt best catchment management practises, it can increase the quantity and quality of water in the river; bringing to an end the shortage and unreliable supply of water you have been experiencing

Suppose that there is a proposed plan to provide incentive to landholders upstream in order to motivate them to adopt catchment management and land use practises that significantly increase the flow, quantity and quality of water in River Kuywa. As it is the user who bears the burden of current problems and also the ultimate beneficiaries from increased and reliable water supply, final users are expected to cover the additional costs related to the adoption of catchment conservation. The decision to contribute is on voluntary basis and the payment amount will be added to your monthly water bill(urban) or paid to the selected local institution (Downstream users), Remember that you are paying to secure reliable supply of water to your household and if enough people are willing to pay enough money, the plan will be implemented; otherwise the current situation will remain unchanged or may even deteriorate. Bear in mind that when you pay to avoid water shortages, that money is not available for other alternative uses.

1.	Would you participate in this kind of a scheme?	1.Yes	1
		2.No	2

2.	If yes, why?	Monetary benefit	1
		Conservation is important	2
		I will make savings from reduced hospital bills	3
		I benefit from the increased water supply	4
		Other (specify)	5

3.	If No, Why	Water is already very expensive	1
		The scheme will not benefit me	2
		The scheme will have no effect on improving the water quality and quantity i receive	3
		Others (Specify)	4

4.	Would you be willing to pay Ksh. __________per m3 of water used monthly for an increase in water supply?	1.Yes	1
		2.No	2
5.	If **YES**: ask the respondent **ONE LEVEL HIGHER** value than the starting value. i.e.Ksh.______________:	1.Yes	1
		2.No	2
6.	If **YES**: ask the respondent **ONE LEVEL HIGHER** value than the starting value. i.e.Ksh.______________:	1.Yes	1
		2.No	2
7.	If **NO**: ask the respondent **ONE LEVEL LOWER** value than the starting value. i.e. Ksh.______________:	1.Yes	1
		2.No	2
8.	If **NO**: ask the respondent **ONE LEVEL LOWER** value than the starting value. i.e. Ksh.______________:	1.Yes	1
		2.No	2

Bid values: **[Ksh.25 Ksh.30 Ksh.45 Ksh.50 Ksh.75 Ksh.100**].

Enumerators: Choose any value randomly from the list given as starting point except the two extreme values and then increase the value/decrease the value on the basis of first response.

------------------------------ Thank you very much for your cooperation! -----------------------------

APPENDIX 1.2: UPSTREAM QUESTIONNAIRE

FACULTY OF SCIENCE AND AGRICULTURE
DEPARTMENT OF AGRICULTURAL ECONOMICS & EXTENSION

PAYMENT FOR ENVIRONMENTAL SERVICES

A SURVEY OF YOUR OPINION

UPSTREAM QUESTIONNAIRE

This research aims to understand landholders views on adopting various management practises that would improve water quality and quantity in river Kuywa. There is no right or wrong answer because everyone farms different grounds and has different management strategies

YOUR OPINION MATTERS

By completing the questionnaire you are helping to inform the design of a Payment for Environmental Services scheme

Conjoint and Contingent valuation survey questionnaire for assessing landholders' preferences for various land management scenarios aimed at improving water quality in River Kuywa and eliciting willingness to accept, Mt. Elgon, Kenya (2013)

Respondent's ID. (Random sample point) __________
Survey Point ______________________; GPS Number: ______________________

Enumerator's name ___________________________;
Date of interview____/ ____/ ______ (date/month/yr)
Sub-Location name ___________________; Checked by ______________________

Introduction

I am a PhD student in Agricultural Economics at the University of Fort Hare, South Africa. As part of this degree, I am undertaking a research project to explore the potential of a payment for environmental services (PES) scheme in Kuywa Sub-Catchment region and the likelihood of the community adopting them. Payment for Environmental Services (PES) is a mechanism through which beneficiaries of the environmental service reward the providers financially or in kind. PES is a voluntary transaction where a well-defined environmental service is being bought from a service provider if the service provider secures service provision. I am currently collecting data and I would be grateful for your cooperation in this important piece of research work that will provide important information for the study. The answers provided will be kept confidential and used only for scientific purposes. No unauthorized person will gain access to the information. PhD thesis will be prepared and subsequently published in part or as a whole. If you have any questions concerning this undertaking, please do not hesitate to address them to me or my principal supervisor

PART A: Socio-Economic Data: *This section asks for background information to help identify patterns among different kinds of landholders. Your answers will be kept completely confidential.*

Section 1: Socio-Demographic data

13. Name of the respondent ______________________________________

<table>
<tr><td rowspan="2">14. gender

Male ...1
Female..2</td><td rowspan="2">15. Relationship to Household head
1 Head/self
2.Spouse
3 Child
4 Grandchild
5 Other blood relative
6 Other</td><td rowspan="2">16. Age
What is your Age? (yr)</td><td rowspan="2">17. Marital Status
1.Single
2.Married
3.Seperated
4.Widow/er
5. Divorced</td><td rowspan="2">18. Occupation
What is your occupation? (code a)</td><td rowspan="2">19. Education
What is the highest level of schooling you completed? [code b]</td><td colspan="2">20. Household size
how many members of your household are in each of these age groups?</td></tr>
<tr><td>Adult (age >15 yrs)</td><td>Children (age <15 yrs)</td></tr>
</table>

Code (a)	Main Activity
1	Farming
2	Trading
3	Artisan
4	Wage/Casual Employment
5	Salaried employment
6	Unemployed
7	Student
8	Other (Specify)

Code (b)	Level of Education
1	No schooling
2	Religious/Traditional
3	Primary school
4	Secondary School
5	Technical/Vocational
6	College/University
7	Other (Specify

Section 2: Socio-Economic data

21.	What is your Main source of household income?	Farming	1
		Fishing	2
		Wage employment	3
		Artisan	4
		Salaried Employment	5
		Trading	6
		Others (specify)	7

22.	State other sources of financial support for the family (tick all relevant ones)?	None	1
		Faith Based Organization/Church	2
		Pension	3
		NGOS/CBO	4
		Remittances (Children, Relatives)	5
		Others (Specify)	6

23.	Approximate the amount of total income you receive per month	Source	Amount
		From Farm	
		From off – farm activities	
		From external sources	

24.	How much of your income do you spend on each of these items per month.	Item	Percentage of total income
		Education	
		Health	
		Food	
		Fuel	
		Rent	
		Transport	
		Water	
		Others	

________________________ End of Part A ______________________________

PART B: Awareness, identification of environmental services, institutions and land use: *This section provides information on the environmental services available for trade by the farmers and gauges their awareness levels. Information will also be provided on the institutions available within the area and the landholders current land use practices Your answers will be kept completely confidential.*

Section 1. Environmental Services

	What is your general perception of the environmental status of the Kuywa River catchment	Very good	1
		Good	2
		degraded	3
		Very Degraded	4

	Please rank the environmental problems in the catchment in order of their severity. Most severe ranked as 1 and the least severe as 6	deforestation	1
		Poor water quality	2
		Loss of biodiversity	3
		Wetland degradation	4
		Poor agricultural yield	5
		Inadequate water	6

	Do you get any good and/or services from the Natural Resources within your land?	Yes	1
		No	2

	If Yes which goods or services do you get (multiple answers are allowed)	Water for domestic use	1
		Fuel Wood	2
		Raw materials for commercial use	3
		• Clay	
		• Reeds	
		• Timber	
		• NTFP (Specify)	
		Raw material for domestic use	4
		• Clay	
		• Reeds	
		• Timber	
		• NTFP (Specify)	
		grazing	5
		Food crops (Specify)	6

	What is your general perception of the current quality of the water in the Kuywa River	Very good	1
		Good	2
		degraded	3
		Very Degraded	4
	What is your general perception of	Very reliable	1

	the current availability/quantity of the water in the Kuywa River	Reliable	2
		Not reliable	3
		Very Unreliable	4

	How have the activities farmers carry out on their land affected the quality and quantity of water? *(Multiple answers allowed)*	Do not affect in any way	1
		Reduced water quantity	2
		Dried up natural springs/ headland of the river)	3
		Reduced water quality (i.e. turbidity)	4
		Water unfit for domestic use	5
		I do not know	6

	Do you carry out any environmental conservation activities on your farm?	Yes	1
		No	2

	If yes, which environmental conservation activities do you carry out. *(Multiple answers allowed)*	Water harvesting	1
		Fencing open area	2
		Forest restoration	3
		Commercial tree plantation	4
		Soil fertility improvement structures	5
		Others (specify)	6

	If no, why *(Multiple answers allowed)*	Shortage of labour	1
		Shortage of finances	2
		Shortage of land	3
		Not profitable	4
		Lack of awareness	5
		Insecure land tenure	6
		Free rider (public Good) problem	7
		Other (Specify)	8

Section 2. Local institutions membership/participation status and access

3	Are you a member of/participating in any of the following organization? Name:	Kuywa Water Resource User Association(KWRUA)	1
		Farmers' co-operative/union (Name)	2
		Self –Help Group (Name)	3
		Community Based Organization (Name)	4
		Other organization or environmental initiative (Specify)	5
3	If you are a member of the KWRUA, which user group do you belong to?	Fisher folk	1
		Farmers	2
		Herders	3
		Tree nursery	4
		Weavers	5
		Other (specify)	6
3	Do you know any community –based organization or any other institution (local or foreign) Government or non-governmental) involved in environmental conservation in your area?	Yes	1
		No	2
3	If yes Please name them		1
4	Does your household have access to financial services from any of the following institutions? *(multiple answers allowed)*	Commercial Bank	1
		Microfinance institutions	2
		Posta	3
		MPESA, AIRTEL MONEY	4
		Village bank	5
		cooperative	6
		Other Specify	7
4	What is the distance from your house to the nearest market?	*(Please indicate the unit of measure eg Km)*	

4	Do you have any prior information on any of the following aspects of trade in environmental services	No	1
		Carbon credit	2
		Payment for deforestation avoidance	3
		Share in Eco- tourism ventures income	4
		Others (specify)	5

Section 3. Land Use

	How long have you lived on this farm (No of years)		

	How did you acquire this land?	Inherited from my parents	1
		Purchased	2
		Settlement scheme	3

	Under which tenure system do you operate this land?	Individual tenure	1
		Family Land (Not subdivided yet)	2
		Communal tenure (Community)	3
		Squatter	4

	How many acres is this land?		

	What percentage of your land is under these different land uses?	Land Use	Percentage
		1.Farming	
		2.Grazing land	
		3.Woodlot	
		4. Homestead	
		5.Leased out	
		6.Not developed	
		7.Other (Specify)	

	Is there a portion of your land that you are unable to utilize due to its characteristics?	Yes	1
		No	2

	If yes which characteristic is it?	Too steep	1
		Wetland/flooding	2
		Rocky	3
		Other (specify)	4

	Do you have access to any communal land other than the land mentioned above?	Yes	1
		No	2

	If yes what purpose do you use the land for?	1.Grazing	1
		2.collection of forest products	2
		3.Planting of food crops	3
		4.Others (specify)	4

52. Which key crops were grown in your farms, quantities harvested and sold during the year 2012? Rank the crops in order of importance to the farmer (1 being the highest and 6 being the least).

Crop code	Crop type	2012 SHORT RAINS								2012 LONG RAINS							
		Rank crop	Area /acres	Qty produced	Measurement Unit used	Qty sold	Measurement Unit used	Unit price Kshs	Total value Kshs	Rank crop	Area /acres	Qty produced	Measurement Unit used	Qty sold	Measurement Unit used	Unit price Kshs	Total value Kshs
1	Maize																
2	Beans																
3	Bananas																
4	Coffee																
5	Groundnuts																
6	Sweet Potatoes																
7	Vegetables																
8	Other commercial crops (specify)																
9																	
	TOTAL INCOME/VALUE																

KEY: UNITS										
	1	90Kg Bag	3	Debe (16Kg)	5	Crates	7	Bunches	9	Kgs
	2	50Kg Bag	4	GoroGoro (2Kg)	6	Number	8	Tonnes		

53. For each of the crops above indicate how the income you receive has changed over the last 5 years

Code	Crop type	Change in income (use Key Below)
1	Maize	
2	Beans	
3	Bananas	
4	Coffee	
5	Groundnuts	

Code	Crop type	Change in income (use Key Below)
6	Sweet Potatoes	
7	Vegetables	
8		
9		
10		

Key	1	Increased Significantly	3	Remained the Same	5	Significantly Reduced
	2	Increased	4	Reduced		

54. Do you have livestock? Yes = 1; No = 2. __________ If yes, would you tell us your herd of livestock at present?

code	Type of livestock	Number owned	Income received in 2012	Change in income over last 5 years (Key above)	If you would sell […] now, how much would you receive? (unit price in Ksh)
1	Cattle				
2	Donkeys				
3	Sheep				
4	Goats				
5	Chicken				
6	Pigs				

_________________________ End of Part B ________________________________

<u>PART C: </u>Conjoint Survey: *This section asks for information to help understand your preferences for different land management arrangements that are aimed at improving the water quality and quantity in River Kuywa.*

Section 1. Description of the situation

Your land is part of the larger Kuywa River Sub-catchment, where effective environmental management requires individual landowners to collaborate to manage their land as part of a larger system. Improved management of your land will ensure that the water users downstream get enough clean water. This study is examining the possibility of the downstream users providing some incentive to the farmers upstream who carry out conservation activities.

Please consider a scheme in which you are required to agree to set aside a certain proportion of your land on which you will carry out activities that will contribute to improving water quality and quantity in River Kuywa. In return, you will receive some incentive for your participation that is proportionate to the size of land you commit to the scheme. The activities that will be carried out on this land will depend on the type and location of your land and the selection of the options presented below. The decision to participate is on voluntary basis.

(ENUMERATOR: ASK IF THE RESPONDENT UNDERSTANDS THE SCHEME AND IF THEY HAVE ANY QUESTIONS BEFORE YOU PROCEED)

	Would you participate in this kind of a scheme?	1.Yes	1
		2.NO	2

I will now present to you *nine* arrangements that could be used to carry out this scheme. Please consider and compare the *nine* options presented below that vary according to The land area committed; Length of the commitment period; Rights to harvest products; Type of incentive; The administering agent; and the number of days your time/labor will be required to in a month.

Please understand the specific feature of each option and indicate how you would rate on a scale of [1-5] using the Key below:

1 = I would not undertake such an arrangement under any circumstances

2 = the agreement is not acceptable, but has one or two good points

3 = I am indifferent to the agreement

4 = the agreement is good and I would undertake it if one or two points were changed

5 = I would definitely undertake such an agreement

(ENUMERATOR: ASK IF THE RESPONDENT UNDERSTANDS THE TASK AND IF THEY HAVE ANY QUESTIONS BEFORE YOU PROCEED)

Scenario/Choice Sets : Rank each of these nine scenario on a scale of (1 – 5)

	Levels								
Attributes	Sc 1	Sc 2	Sc 3	Sc 4	Sc 5	Sc 6	Sc 7	Sc 8	Sc 9
1.Land area to be committed	10% of your land	10% of your land	10% of your land	10% of your land	10% of your land	10% of your land	40% of your land	20% of your land	20% of your land
2.Length of commitment period	5 years	5 years	15 years	30 years	30 years	15 years	5 years	5 years	5 years
3.Right to harvest products (grass/fodder/beekeeping)	Permitted	Partially permitted	permitted	Permitted	Partially permitted	Not permitted	Permitted	Not permitted	Partially permitted
4.Incentive scheme	Provide farm tools to each household	Agric. Extension services	Provide farm tools to each household	micro credit scheme for IGA	Agric. Extension services	micro credit scheme for IGA	Agric. Extension services	Provide farm tools to each household	Direct annual cash payment of Ksh. 5,000 per acre of land committed
5.Local scheme administering agent	Water Resource Users Association (WRUA)	WRUA	Water Resources Management Authority	WRMA	WRUA	Rural water supply company	WRUA	Local NGO/CBO	WRMA
6. Required free labour contribution related to the contractual scheme (training, attending scheme meetings; etc) per month	1 day	2 days	2 days	3 day	3 days	3 days	2 day	1 days	1 days
Rank									

For each of the above scenarios that are ranked 2 or 4, Please indicate which attributes you have singled out.

		Attributes singled out
1	Sc 1	
2	Sc 2	
3	Sc 3	
4	Sc 4	
5	Sc 5	
6	Sc 6	
7	Sc 7	
8	Sc 8	
9	Sc 9	

________________________ End of Part C _____________________________

PART D: Contingent Valuation Survey: *This section asks for information to help us estimate how much you would be willing to accept as incentive to carry out the required land use changes*

1. The Contingent Valuation Scenario

By participating in the scheme outlined above, (REPEAT DESCRIPTION IF REQUIRED)

[Your land is part of the larger Kuywa River Sub-catchment, where effective environmental management requires individual landowners to collaborate to manage their land as part of a larger system. Improved management of your land will ensure that the water users downstream get enough clean water. This study is examining the possibility of the downstream users providing some incentive to the farmers upstream who carry out conservation activities. Please consider a scheme in which you are required to agree to set aside a certain proportion of your land on which you will carry out activities that will contribute to improving water quality and quantity in River Kuywa. In return, you will receive some incentive for your participation that is proportionate to the size of land you commit to the scheme. The activities that will be carried out on this land will depend on the type and location of your land and the selection of the options presented below. The decision to participate is on voluntary basis.]

you will be making a great contribution towards environmental management and providing benefit to the downstream users of the water in river Kuywa. Given that you will not be using the portion of land you commit to the scheme to grow food crops, the major cost related to this activity is loss of farm income from the land committed to this arrangement. Please consider a situation where for participating in this scheme, cash compensation will be given to mitigate, in a small way, the loss in income. The compensation will be made each year before your main planting season; Compensation payments for the scheme will be in the form of direct cash transfer/payment channelled to you at your nearest collection point.

	Would you participate in this kind of a scheme?	1.Yes	1
		2.No	2

	If yes, why?	Monetary benefit	1
		Conservation is important	2
		I do no use the riparian land	3
		I would like to continue to get the environmental services i am currently receiving	4
		The community downstream require the environmental services	5
		Other (specify)	6

	If No, Why	Shortage of land	1
		The scheme will not benefit me	2
		The scheme will have no effect on improving the water quality and quantity in river Kuywa	3
		Others (Specify)	4

	If you get compensated Ksh. __________ annually per acre of land committed, would you be willing to accept the money?	1.Yes	1
		2.NO	2

	If YES: ask the respondent ONE LEVEL LOWER value than the starting value.	1.Yes	1
		2.NO	2

	i.e.Ksh.______________:		
	If YES: ask the respondent ONE LEVEL LOWER value than the starting value. i.e.Ksh.______________:	1.Yes	1
		2.NO	2
	If NO: ask the respondent ONE LEVEL HIGHER value than the starting value. i.e. Ksh.______________:	1.Yes	1
		2.NO	2
	If NO: ask the respondent ONE LEVEL HIGHER value than the starting value. i.e. Ksh.______________:	1.Yes	1
		2.NO	2

Bid Values	Ksh. 650	Ksh. 720	Ksh.1,600	Ksh.3000
	Ksh.5000	Ksh.6,500	Ksh. 8,000	

(*Enumerators: Choose any value randomly from the list given as starting point except the two extreme values and then increase the value/decrease the value on the basis of first response.*).

-- Thank you very much for your cooperation! ---------------

APPENDIX TWO: Focus Group Discussion Guide

Focus group discussions will be based on the following guiding questions.

1. Key local environmental problems: What are the major environmental problems in your local area? Are these problems only local or having implication to wider society?
2. What are the main causes/drivers of these problems?
3. In general, how do you evaluate the state of the trends of environmental changes/conditions in your area over the last 20-30 years?
4. Which land use and agricultural practices deemed to be environmentally harmful? Which land uses or management practices do you perceive environmentally friendly for land and water resources?
5. How to tackle/reduce land degradation (building some physical structures? Changing land uses? Adoption new management practices? etc.). i.e., What are the feasible set of options to tackle the general environmental problems (water and land degradation)?
6. What are your environmental priorities?
7. In your view, what are the major benefits conserving/managing your environment?
8. What are your major constraints to adopting land use and management practices environmentally friendly?
9. How do you perceive Compensation/incentive mechanism for environmental services as an alternative remedial measure for the environmental problems?
10. Are there any such schemes and how do they operate?
11. Which organization work in your area? And what activities do they carry out?
12. What are the limitations and strengths of your community as a group in terms of local natural resource and environmental management?
13. Do you have any by-laws and or regulations that guide what you do in your group and how members conduct themselves

APPENDIX THREE: **Lake Victoria North Water Service Board's Rural Water Service Providers In The Kuywa Watershed**

1	Elgon East	Chairman P.O. Box 138-50203 KAPSOKWONY
2	KipKunur	Chairman P.O. Box 68-30705 KAPSOWAR
3	Chesingei - Sogotio	Chairman P.O. Box 2-30706 CHEBIEMIT
4	Old Kibichori	Chairman P.O. Box 299-50202 CHWELE
5	Kaplamai	Chairman c/o DWO P.O. Box 2145 -30200 KAPSOWAR
6	Elgon West	hairman P.O. Box 42-50201 CHEPTAIS
7	Kermet	c/o DWO, P.O. Box 107-30705 KAPSOWAR
8	Kopsiro	c/o DWO, P.O. Box 234- 50203 KAPSOKWONY