Investigating the feasibility of instituting payment for environmental services (PES) scheme in Ghana: The Weija watershed case study

Gladys Peprah - Asante

March, 2009

Investigating the feasibility of instituting payment for environmental services (PES) scheme in Ghana: The Weija watershed case study

By

Gladys Peprah - Asante

Thesis submitted to the International Institute for Geo-information Science and Earth Observation in partial fulfilment of the requirements for the degree of Master of Science in Geo-information Science and Earth Observation, Specialisation: **(Governance and Spatial Information Management)**

Thesis assessment board

Prof. Dr.Ing. P.Y Georgiadou	Chair person
Dr. F.J.M. Coenen	External examiner
Prof. Dr. Ir. A. Stein	Examiner
Prof. Dr. A. Van der Veen	First supervisor
Drs. J.C. de Meijere	Second supervisor
Ir. M.C. Bronsveld	Observer

INTERNATIONAL INSTITUTE FOR GEO-INFORMATION SCIENCE AND EARTH OBSERVATION
ENSCHEDE, THE NETHERLANDS

Disclaimer

This document describes work undertaken as part of a programme of study at the International Institute for Geo-information Science and Earth Observation. All views and opinions expressed therein remain the sole responsibility of the author, and do not necessarily represent those of the institute.

Abstract

Access to sufficient clean water is essential to everyone's survival; however, without investments, specific watershed services that are beneficial to downstream users are likely to be degraded. There has been increased recognition that economic factors are behind many activities that cause declines in habitats and species. Payments for environmental services (PES)'s basic idea is that those who "provide" environmental services by conserving natural ecosystems should be compensated by beneficiaries of the service. This has received substantial interest as a way of creating incentive measures for managing natural resources, addressing livelihood issues for the rural poor, and providing sustainable financing for protected areas. The focus of this research is to assess the feasibility to institute payment for environmental services with emphasis on watershed services. In spite of numerous government policy attempts to address the several watershed problems none have given due recognition of incorporating and adopting PES in the management of catchments areas among a number of options. In addition, not much scientific studies have been done in Ghana to investigate the possibility of implementing PES at the catchments level.

The objectives of the research are to: assess changes in land use/cover types from 1990 – 2007, assess the institutional feasibility for designing PES mechanism for watershed services and conduct contingent valuation method to determine willingness to pay of beneficiaries. Remotely sensed data were used to identify changes in land use/cover changes types from 1990 and 2007. Water provision was selected as key ecosystem service and thus formed the basis for assessment. A feasibility study of PES design and implementation including a review and description of existing frameworks and guidelines of conditions and factors that have been proposed by expects in the field as crucial for the design of a PES scheme for local watershed was conducted. Institutional feasibility of PES scheme and government's policy on water and natural resources in Ghana and stakeholder analysis were also done. Interviews and questionnaire administration were used to elicit market and non-market values of watershed services from stakeholders using the contingent valuation method.

Seven (7) dominant land use / cover types namely, riverline, dense active, shrub herbaceous, grass herbaceous, built up/bare, water and swampy exist in the study area. Riverline and dense active vegetation covers decreased whereas built up/bare, grass and shrub herbaceous cover areas increased during the period studied. Dense active vegetation and built up/bare areas experienced the most negative and positive changes respectively. Shrub herbaceous cover increased by about 10% of the total area from 1990 – 2007. Built up/ bare area increased from 4% to 17% of the total area during the period. A total of 2197 ha of riverline vegetation was lost from 1990 – 2007. Total WTP bid for watershed services is ¢ 512 per month representing 15.95% of WTP/income ratio were recorded. Mean WTP per month was recorded as 5.8%. With regards to feasibility, Ghana has the potential for a successful PES design and implementation. Policy wise, the country has wide range of policies and regulations on water and natural resources which provide the institutional and political structures in place for PES design a way of complimenting environmental and economic policies, considering the role PES can play in preserving healthy ecosystem whiles providing an economic stimulus for local livelihood.

Keywords: Payment for environmental services, Land use/cover change, Willingness - to - pay

Acknowledgements

To God be the glory, great things he has done and greater things will he do.

First of all, I would like to express my appreciation and gratefulness to the Government of the Netherlands for sponsoring me to study in Enschede.

To my supervisors, Prof. Dr. Anne van der Veen and Drs. Johan de Meijere, I am highly indebted to you for the valuable advice, guidance and encouragement. I really appreciate your motivation and constructive criticisms towards my work.

I wish to express my heartfelt gratitude to my family (Ben, Esther, Sab, Abena, Kojo), Daddy Quaidoo, Mrs Paintsil, Pastor Noel, Mr Danso, Mr Bentum, Mr Owusu, Aunty Abena, Maa Christie, Aggie, Dee, Vivian, Yvonne, Helen, Maa Mercy, Maa Nyamekye not forgetting the entire Tawiah, Haizel, Ako-Hayford, Botie and Sam families in Takoradi. I am eternally grateful for your love, prayers, trust and encouragement. You have always been there encouraging me with love and I truly appreciate everything.

Many thanks to the Management and entire staff of the Office of the Administrator of Stool Lands especially to the former Administrator, Dr. Mrs Matilda Esi Fiadzigbey for the valuable advice, support and opportunity to pursue the programme.

To Akwasi Tutu, I say thanks for your assistance and advice. I am grateful for the time and effort you devoted for my work especially during the proposal development.

To Asare, Kofi, Fred, Prince, Koopman family (Enschede) and the Ghanaian students in Enschede, I say thanks for the wonderful times we spent together, your assistance, calls, prayers and visits made a whole lot of difference.

For their valuable contributions to this work, I express my sincere thanks to Richard, Josephine and the entire lovely people at Ghana Water Company Ltd especially the GIS Section, not forgetting Dinah, Mr Tetteh, Jennifer, Mabel, and Foster (CERSGIS) for your assistance, suggestions and advice.

Finally, many thanks to my GSIM colleagues, especially Deo for your friendship and readiness to assist.

Dedicated
To

To my nieces and nephews: Noel, Kwaku, Sueyiba, Naa, Caleb and Nii, I thank God for your lives and you all mean the world to me.

Asantewaa

Table of contents

List of figures

List of tables

List of Abbreviations and Acronym

PES	Payment for environmental services
ES	Environmental and Ecosystem Services
CVM	Contingent Valuation Method
WTP	Willingness To Pay
Note	Environmental and Ecosystem services used interchangeable
GWCL	Ghana Water Company Limited
WRC	Water Resources Commission
PURC	Public Utilities Regulatory Commission
FC	Forestry Commission
EPA	Environmental Protection Agency
CONIWAS	Coalition of non-governmental organizations in Water and Sanitation
ICDP	Integrated conservation and development projects
TM	Landsat Thematic Mapper
ETM+	Enhanced Thematic Mapper
RMSE	Root Mean Square Error
IWRM	Integrated Water Resources Management
CWSA	Community Water and Sanitation Agency
NWP	National Water Policy
DNR	Garmin software Minnesota Department of Natural Resource
IUCN	International Union for Conservation of Nature and Natural Resources
NOAA	National Oceanic and Atmospheric Administration
ICRAF	International Centre for Research in Agro-forestry

1. Introduction

1.1. Background Information

Access to sufficient clean water is essential to everyone's survival; however, nearly 20% of the world's population do not have ready access to drinking water with majority of those affected living in developing countries (Suleymanova 2002). The Economic and Social Council of the UN noted that "*The human right to water entitles everyone to sufficient, safe, physically accessible and affordable water for personal and domestic uses*." (UN 2002). However, without investments, specific watershed services that are beneficial to downstream users are likely to be degraded. It is believed that without monetary compensation, deforestation would continue in private lands because private decisions to convert forests fail to account for the value of the services that those forests provide to others (Chomitz, Brenes et al. 1998). The Dublin Conference on Water and Sustainable Development observed that: *"Water has an economic value in all its competing uses and should be recognized as an economic good"* (UN 1992). The Dublin principles further states that*:" Past failure to recognize the economic value of water has led to wasteful and environmentally damaging uses of the resource"*. Managing water as an economic good is an important way of achieving efficient and equitable use and of encouraging conservation of water resources. Improved management of the upper watershed for the maintenance of water services is a strategy implemented in several countries in Latin America and the Caribbean, including Brazil, Colombia, Costa Rica, the Dominican Republic, Ecuador, Honduras and Panama (World Bank and WWF 2003). With increasing recognition that economic factors are behind many activities that cause declines in habitats and species, economists and ecologists are of the view that to a larger extents measures that combine ecological and economic information will help in identifying strategies to reverse biodiversity and ecosystem loss (Troeng and Drews 2004).

The concept of payments for environmental services (PES) has received substantial interest as a way of creating incentive measures for managing natural resources, addressing livelihood issues for the rural poor, and providing sustainable financing for protected areas (Nature 2006). The basic idea is that those who "provide" environmental services by conserving natural ecosystems should be compensated by beneficiaries of the service. This is achieved through a variety of arrangements that transfer rewards from those who benefit from an environmental service to those who conserve, restore and manage the natural ecosystem which provides it (Wunder and Alban 2005). Rewards may be monetary or in kind, may involve private sector or government financing and can be made at local, national, and global levels. The economic logic of PES schemes dealing with the promotion of land use changes in watersheds is simple and straight forward. It is a means of establishing market transactions between downstream and upstream economic agents, the downstream effects are taken into account when upstream holders make decisions about their own land use. This should lead to a larger social economic efficiency. Besides, direct payments are expected to be more cost-effective in meeting the environmental and local development goals, as compared to indirect ways of financing a better stewardship of natural resources (Ferraro and Kiss 2002). Recent studies have identified markets for environmental services as having the ability to create a steady flow of funding needed to

achieve conservation objectives, 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 (Landell-Mills and Porras 2002). In tropical watersheds including Ghana, the most economically vulnerable groups tend to be located in upstream areas, where land is usually less productive and more prone to suffer from degradation of all forms due to the activities of social actors. Nevertheless, these rural communities are often providers of environmental services benefiting other groups with a better socioeconomic situation (normally located in downstream urban areas). PES schemes are also expected to contribute to poverty alleviation and to reduce the overall cost of improving the condition of natural resources, by means of creating rural and urban economic linkages and economic incentives for good land stewardship (Pagiola, Arcenas et al. 2005).

1.2. Justification

Following the Brundtland Report (Brundtland. 1987) and the Rio 1992 conference, tropical conservation gradually headed in a more people oriented direction. The trend reflected the conventional wisdom that alleviating poverty was the only way to conserve and protect the environment. Integrated conservation and development projects (ICDPs), and sustainable forest management were two major instruments intended to simultaneously increase incomes and conserve the environment (Salafsky and Wollenberg 2000; Pearce, Putz et al. 2003) yet despite scattered successes, neither approach was seen to have achieved major shifts in tropical land-use trends (Brandon, Redford et al. 1998.) There is also growing recognition that traditional watershed management projects, which rely either on regulatory approaches or subsidies to encourage the adoption of soil conservation techniques on private lands, have generally not proved effective (Kaimowitz 2000). Meanwhile, watersheds continue to degrade and most water-users around the world pay less than it costs to provide the service. Given these problems, investors and policy-makers around the world are exploring alternative, more effective and lower-cost approaches to achieve watershed management goals (Tognetti 2001.); (Trust for Public Lands. 1997).

Moreover, there were fundamental doubts about the extent to which it makes sense to forcibly link the conservation and poverty-alleviation agendas when the trade-offs outweigh the synergies (Wunder 2001). Based on these insights, much debate emerged around the need for new conservation paradigms. Conservationists have in recent years become interested in another aspect of conservation, the goods and services from ecological systems that benefit people (e.g., water purification, carbon sequestration, and crop pollination). These ‘‘ecosystem services’’ are currently the focus of intensive research, development and policy attention (Daily 1997; Sachs JD 2006; Wunder 2007). The concept of payments for environmental services (PES) came at the centre of calls for more direct conservation approaches (Ferraro and Kiss 2002; Niesten and Rice 2004; Scherr, White et al. 2004; Hardner 2002). Environmental Services (ES) previously provided free by nature are becoming increasingly threatened. This creates scarcity making them potentially subject to trade. Pagiola and Platais, (2007) defined Payments for Environmental Services (PES) as an innovative market-based mechanism based on the twin principles that those who benefit from environmental services should pay for their provision, and that those who provide environmental services should be compensated for doing so. The core idea of PES is that environmental service beneficiaries make direct, contractual and conditional payments to local landholders and users in return for adopting practices that secure ecosystem conservation and restoration. PES is also viewed as a reward for poor rural dwellers who

take care of the environment and continuously produce environmental services which was then for free. As noted by (Dudley and Stolton 2003) the future scope for using financial incentives to encourage the conservation of forest watersheds is potentially huge particularly in developing countries for at least three reasons. First, the growing population increase the demand for clean water usage is immense. Secondly, the majority of the world's population live downstream of forested watersheds, making them all susceptible to the costs of watershed degradation. With some 40% of the world's largest cities relying on protected areas and multiple use forests for their drinking water (Dudley and Stolton 2003). Payments for afforestation and agro forestry establishment may be justified in many more watersheds where forests were historically cleared. Third, investments in sustainable watershed management are often substantially cheaper than investments in new water supply and treatment facilities. Gelderblom and van Wilgen, (2000.) indicated that in South Africa, removing thirsty alien tree species in Cape Town's watershed and restoring native vegetation produces water at a fraction of the cost of water delivered through diversion or reservoir projects.

In the major urban centres, it is not just the slum dwellers and the poor who lack regular water supply, even the relatively affluent Ghanaians with water meters in their homes are often forced to buy from private water sellers because their taps have run dry and sometimes gush out water one or two days per week, a situation which tend to perpetrate to such an alarming proportion resulting in crisis situation with acute water scarcity in several parts of the country especially during the dry season. This is often attributed to the low level of water in the rivers resulting from the scarcity of rainfall in their catchments areas. With farming as the main occupation, rural communities continue to inhabit and rely on the forest and wetlands in search of water, food and basic livelihoods. Unfortunately there is not much incentive for local people to conserve and preserve watersheds from the multiple and conflicting uses leading to degradation, a national energy and water crisis and inability to support human livelihood. In-take points for the Weija Dam and the Kpong Treatment Plants for instance also fall accordingly with the ever increasing urban population, farming and fishing activities in Densu taking its source from the Atewa Range near Kibi supplying water to Accra metropolis.

A number of policy actions toward watershed management in Ghana have been primarily predicated on command-and-control principles. Human activities in active watershed areas are largely regulated by land-based statues yet, not much success has been chalked in the various government attempts in ensuring sustainable management of watershed. Most of these government policies either never see the light of day or fizzle out in the process of implementation. The successful application of PES in watershed management especially in Latin American countries offers practical justification for governments in tropical Africa. Other international bodies including the World Bank have provided substantial financial support for the implementation of PES. Nonetheless, little or no consideration has been given in most government water policies. In spite of numerous government policy attempts to address the several watershed problems none have given due recognition of incorporating and adopting PES. The current national water policy is short of intentions to adopt PES in the management of catchments areas among a number of options. In addition, not much scientific studies have been done in Ghana to investigate the possibility of implementing PES at the catchments level.

This research, however, aims at investigating the feasibility of instituting a PES scheme for the protection of the Weija watershed by identifying the institutional framework and potential intermediaries that could enable the design of a PES scheme for watershed and the willingness of

urban water consumers to pay for continuous and sustained supply of watershed services. The output of this research is expected to contribute to efforts toward archiving body of scientific knowledge in Ghana. It will be a classic demonstration case study of PES which would improve the quantity and quality of water resources and also enhance the wetland's habitat from which useful lessons could be drawn for further action.

1.3. Research problem

Ghana is well endowed with water resources, but the amount of water available changes markedly from season to season and from year to year. Also the distribution within the country is far from uniform with the south-western part better watered than the coastal and northern regions. However, availability of water is decreasing owning to rainfall variability (climate change), rapid population growth, and increased environmental degradation, pollution of rivers and draining of wetlands. Ghana with its estimated population of 20 million people, approximately 10.3 million (51%) have access to an improved water resource. Of the 8.4 million residents in the urban areas, only 61 % of the population have access to an improved water resource (World Bank Report 2004) while 34% have access to safe sanitation (DANIDA 2003). In the major urban centres, it is not just the slum dwellers and the poor who lack regular water supply but also the relatively affluent Ghanaians with water meters in their homes often suffer from cut offs in water supply which tend to perpetrate to such an alarming proportion resulting in crisis situation with acute water scarcity in several parts of the country especially the dry season often attributed to the low level of water in the rivers resulting from the scarcity of rainfall in their catchments areas.

The Water Resources Commission which was established by government to pave way for private sector involvement in the water sector warned in 2001 that Ghana could face a shortage of potable water if current negative practices such as unacceptable land use and fishing are allowed to continue. The Commission also noted that despite its socioeconomic and environmental importance, results of studies conducted showed that the Densu basin was extensively polluted and noted for its water quality deterioration. It served as a receptacle for the dumping and discharges of untreated urban domestic and industrial wastes, and leachates from agro-chemicals used by commercial farms. The basin was also characterised by accelerating land degradation. Though the original ecology of the Densu basin which was moist semi-deciduous forest with thick undergrowth featuring rich flora and fauna has greatly deteriorated due to human activities over time, not much has been done to revert the situation since forest is the source of many products on which the local people depend and complete protection of natural forests, although highly desirable, faces socio-economic constraints Farming practices such as excessive logging, slush and burn agriculture, mining and quarry, fuel wood collection coupled with wildfires, illegal occupation and conversion to other land uses (OTTO 2006) have impacted on the ability of the forest to supply environmental services.

Wagner and Cobbinah, (1993) also stated that the Ghana's tropical forest which support vital economic and ecological functions, as well as provide commercial trade and employment opportunities face an ever-increasing set of pressures resulting in the loss of forest and associated biodiversity throughout most of the forest areas. These human activities within and around river basins are drivers which have greatly changed demography producing severe effects on water and natural resources ability to provide environmental services. The Government of Ghana signed the

US$103 million Ghana Urban Water Project in 2005 with support from the World Bank Board. The project aims at assisting the Ghana Water Company Limited (GWCL) to improve access to safe, reliable and affordable water services to thousands of households. However, the focus is more on strengthening and pursuing the sectors' long-term financial stability, viability and sustainability than on the environmental sustainability and improvement in the economic wellbeing of local communities whose farming and fishing activities impact greatly on water quality and supply.

In order to manage and sustain the ability of forest resources to provide environmental services, government efforts have to focus on the promotion of economic development through sustainable use of forest and water resources with the involvement of local communities through. International literature on PES shows that most examples that are actually working are either on carbon or water (Landell-Mills and Porras 2002). This study however focuses on improving water provision through PES in Ghana which invariable will result in better managed conservation activities for improved and healthy ecosystem. It is in this vain that PES is advocated as a tool which could be used to create economic incentives for effective and efficient management and improvement of the ecosystem and watershed areas as a whole.

1.4. Research objectives

1. To assess changes in key land use/cover types and it impact on watershed services
2. To assess the institutional feasibility for designing PES mechanism for watershed services
3. To conduct Contingent Valuation to determine willingness to pay of users

1.5. Research questions

1. What changes have occurred in land use in the study area between 1990 and 2007?
2. To what extent does the existing water management plan addresses the possibility of incorporating PES around the weija catchments?
3. Who are the stakeholders?
4. How much economic value do users assign to watershed services?
5. How willing are they to pay for watershed services?

1.6. Research Approach

The research began with a review of existing literature of knowledge on environmental services and threats to its provision with emphasis on watershed services and the valuation of environmental services using contingent valuation method. Literature was also reviewed for assessing PES design feasibility with a focus on watershed services. The purpose was to help the researcher identify existing knowledge gaps in literature on the topic and subsequently conceptualize, define and formulate research problem, objective and questions. A case study area was then selected and field study trip undertaken to gather more information. The field study involved collecting remotely sensed and GIS data on the study area for land use change detection and the distribution and condition of water supply network of the area. Questionnaires on willingness to pay (WTP) were administered to elicit information on the use and non use values of ecosystem (watershed) services. Data from the fieldwork were processed and analysed for discussion and conclusions.

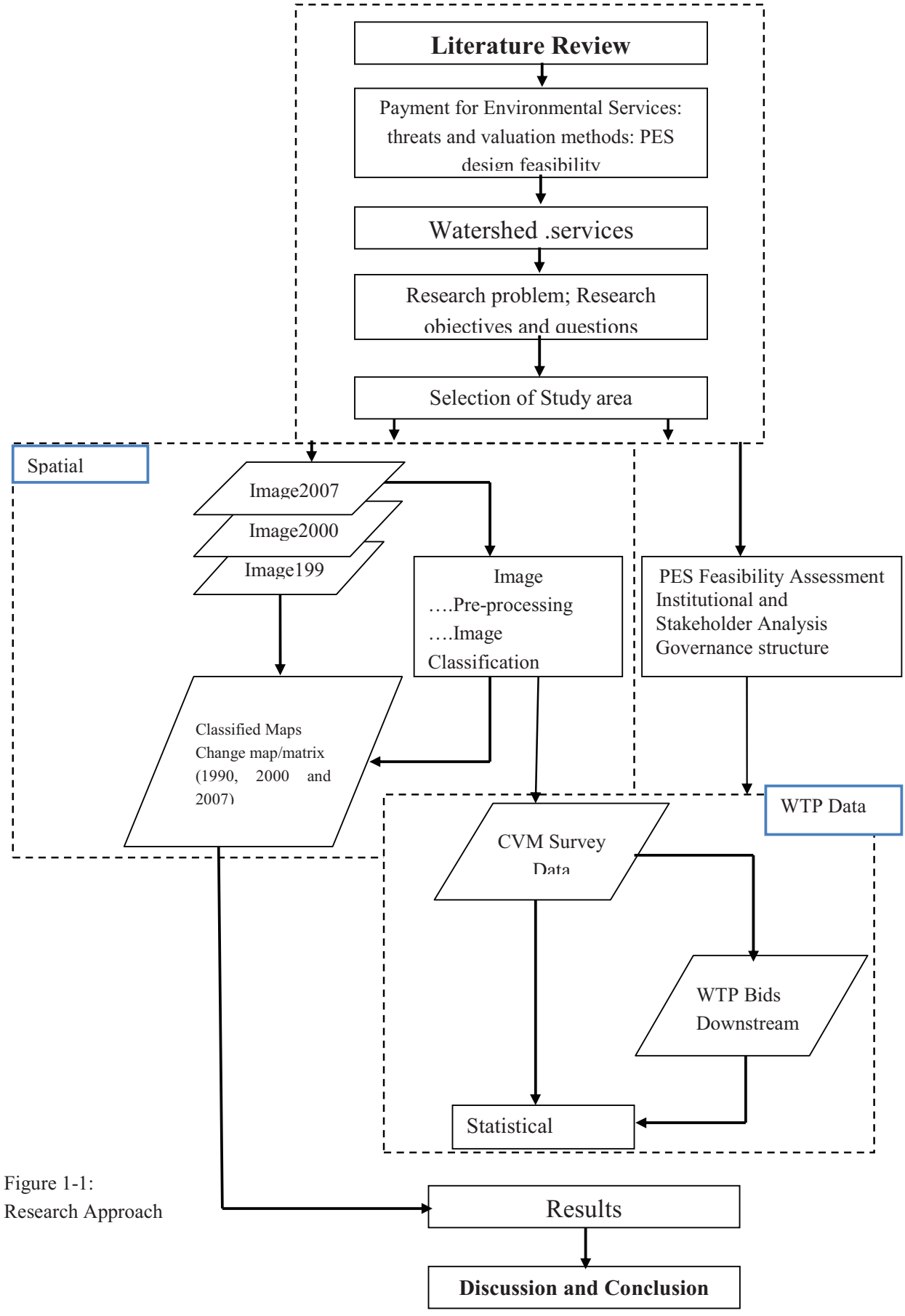


Figure 1-1:
Research Approach

1.7. Thesis Structure / Outline

The thesis is made up of seven (7) chapters. Chapter one (1) gives an introduction and overview of the research problem, the formulation of research objectives and questions.

Chapter two (2) deals an in-depth review on the subject matter with a focus on the conceptual basis of payment for environmental services (PES) and examines criteria feasible for the design and implementation of PES scheme for watershed services.

Chapter three (3) presents the materials and methodology used for the realization of each research objective. It includes a description of the study area, software and data employed and an account of procedures followed.

Chapter four (4) presents results obtained and discussion in respect of land use / cover change objective.

Chapter five (5) assess / examines the feasibility for a local payment for environmental services (PES) for watershed services for Weija catchments in the context of Ghana's policy and regulatory framework. The section also look at the institutional, water and natural resource management structure and concludes with an analysis of potential stakeholders for a local (PES) scheme.

Chapter six (6) presents results and discussion on Contingent Valuation Method.

Chapter seven (7) draws conclusions for the feasibility of a PES scheme for the Weija catchments in Ghana. Recommendation, references and appendix follow respectively.

2. Definition of Concept and Rationale

2.1. Introduction

Forests provide important environmental services including slowing global warming, sustaining biodiversity, protecting watersheds to maintain clean water, prevent erosion and flooding as well as offering direct and indirect economic opportunities for communities. In recent years there has been a growing interest in the creation of markets for these services to provide financial incentives for forest protection, as well as to improve the welfare of resource dependent rural communities. Whereas environmental degradation causes significant loss of nature's life supporting services, poverty commonly leads to unsustainable use of natural resources. Initiatives to pay resource managers for the provision of environmental services are new but the interest is growing lately due to increasing concern for environmental benefits and the need to reduce human dependency on natural resources. A number of environmental services of forestry including carbon sequestration, biodiversity conservation, and soil and water conservation have been identified. All over the world, environmental services commonly traded in as commodities, are carbon, water, productive potential, biodiversity and landscape beauty, with markets for carbon sequestration and hydrological services being dominant (Landell-Mills and Porras 2002; Pagiola and Platais 2007).

Payment for environmental services (PES) is a newly emerging initiative in forestry and agro forestry development programs. Van Noordwijk et al., (2007) explored new ways of addressing poverty with the programme rewarding the upland poor for their environmental services (RUPES) as a way to enhance livelihood and resource security to sustain environmental functions. Pagiola et al., (2005) noted that most PES schemes are designed for landowners to receive direct compensation for land use decisions that provide four types of environmental services, mitigation of greenhouse gases, provision of hydrological services, biodiversity conservation and provision of scenic beauty for ecotourism. De Los Angeles, (2007) argues that opportunities exist for local farmers to maintain or restore local agro-ecosystem functions that protect watersheds, conserve biodiversity and sequester carbon and that new market mechanisms that have the potential to create financial incentives and resources security to reward the upland poor communities for effective and sustainable natural resources management are emerging. These opportunities are supported by the global political commitment of halving poverty by 2015 (RUPES 2002). Costa Rica has experience with a national system of PES including an approach of direct payments to land users for land use decisions resulting in the provision of environmental services (Chomitz and Kumari 1998; FAO 2004; Salzman 2005).

2.2. Ecosystem Service/Functions and Economic Values

Contributions to the concepts of ecosystem functions, ecosystem services, and their economic value date back to 1960 and 1970 (King 1966; Odum 1972). Ecosystem services arise from and depend on the broader sets of ecological components, processes and functions. 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) and are the benefits of nature to households, communities and economies. The term has gained currency because it conveys an important idea: that ecosystem services are socially valuable and in ways that may not be immediately intuited (Daily 1997). The Millennium Ecosystem Assessment: Ecosystem and Human Well Being, A Framework for Assessment (Millennium Ecosystem Assessment 2003) combines the definitions to include "both natural and human modified ecosystems as sources of ecosystem services with the term "services" encompassing both the tangible and the intangible benefits humans obtain from ecosystems which are sometimes separated into "goods" and "services" respectively. According to (Boyd and Banzhaf 2006) final ecosystem services are components of nature, directly enjoyed, consumed, or used to yield human well-being most ecosystem services are public goods without available markets to provide clear units of account. 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). Constanza et al.,(1997) remarked that ecosystem functions also refer variously to the habitat, biological or system properties or processes of ecosystems and the goods (such as food) and services (such as waste assimilation) represent the benefits human populations derive, directly or indirectly, from ecosystem functions.

Meanwhile, values of services provided by nature do not fall into current economic equations because most of them fall outside marketplace due to their nature as public goods which contribute immensely to human welfare. Most ecosystem services are public goods for which markets are not available to provide for clean units of account, making government to define units of trade and compensation since governments in most cases are the trustees of environmental quality (Boyd and Banzhaf 2006). As such ecosystem services are not fully 'captured' in commercial markets or adequately quantified in terms comparable with economic services and manufactured capital thereby receiving too little weight in policy decisions. Turpie et al., (2003) emphasised that this has serious implication for the future health of terrestrial and aquatic ecosystems and their capacity to deliver goods and services which contribute to social and economic welfare. Economic indicators such as gross national product are increasingly recognized as flawed measures of both economic progress and sustainability, because they do not explicitly account for the degradation in ecological services that industry and commerce cause (Goodland and Daly 1996). Recognizing this will help to describe biodiversity values and the socio-economic impacts of ecosystem degradation. More recently some degree of consensus has been reached on these concepts and on the bio economic links between them (Pearce 1993; de Groot 1994; Costanza, d'Arge et al. 1997; Daily 1997; Pimentel and Wilson 1997). Constanza et al., (1997) assigned and estimated the annual value of the world's ecosystem of the world to worth US$33 trillion and further acknowledged that there are moral, ethical, and aesthetic reasons to value and protect nature quite apart from its benefits to humanity. While some authors believe that, even if such prices can be reasonably calculated, they cannot reflect the full value of these services, which reaches well beyond their importance to the world economy, (Sagoff 1997) suggested that prices should not be assigned to ecosystem services as is the case with conventional goods and services.

Depending on the type of economic benefits provided, ecosystem services can be ordered under broad categories of economic value, namely use and non-use values. Direct use values of forests relate to services that can be consumed directly such as timber, and those that are non-consumptive such as opportunities for recreation, aesthetic beauty, science, and education. Indirect use values relate to

services that sustain economic activities such as drinkable water production and hydroelectricity generation. Non-use values (or existence values) are the benefits not derived from current or future consumption of goods and services by consumers or producers, such as maintenance of biological and genetic biodiversity which is the basis for all other ecosystem goods and services. The sum of all categories of value is the Total Economic Value (TEV) (Pearce, Markandya et al. 1989). In figure 1, the relationship between ecosystem function, ecosystem services and economic values are explained.

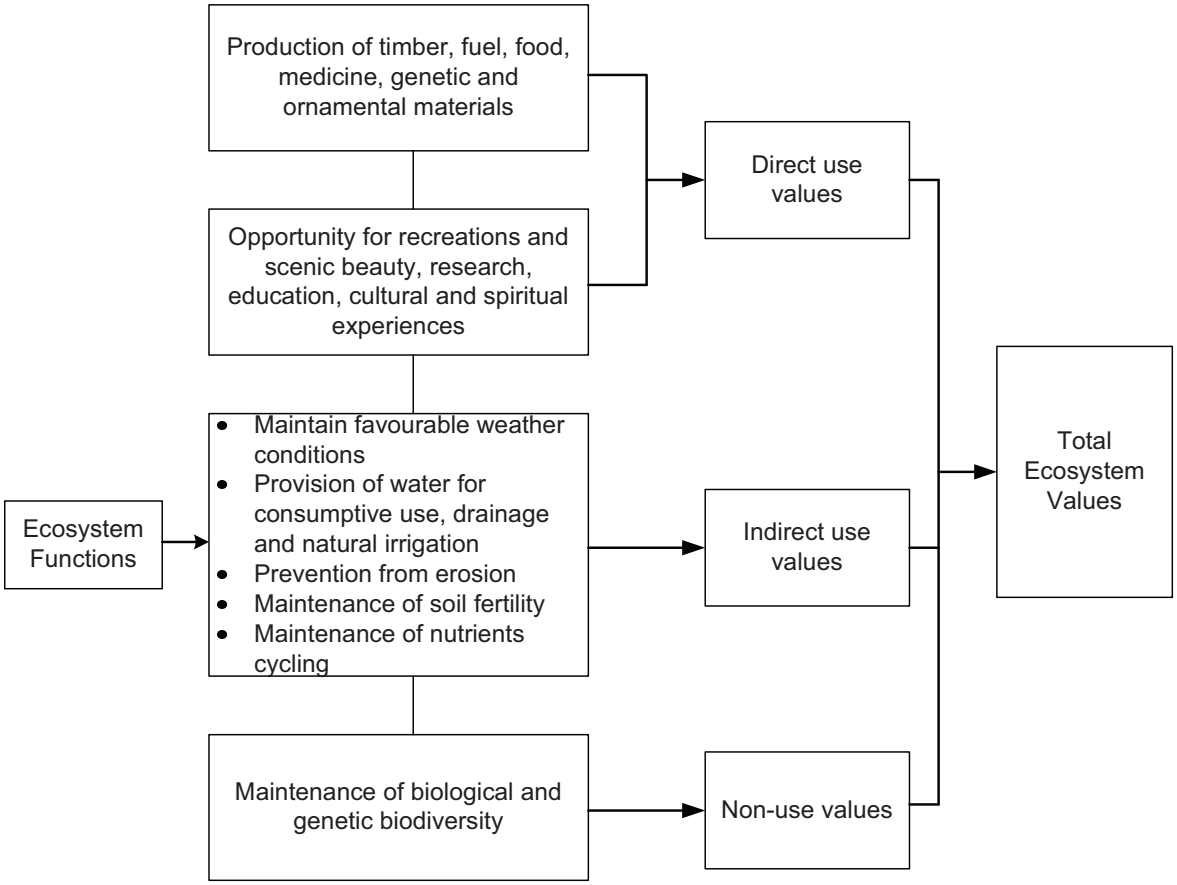


Figure 2-1: Relation between ecosystem functions, ecosystem services, and economic values.
Adopted from Pearce et al, 1989.ecosystem services

2.3. Defining Watershed Commodities

The provision of water as a watershed environmental service is a good with non market value. Non-market goods are often times characterized by high transaction costs in the form of incomplete information about the nature and magnitude of agents utility gains (Boggess, Lacewell et al. 1993). A PES approach for watershed service results in an arrangement which allows external beneficiaries of environmental services to make direct contractual quid pro quo payments to local landowners in return for adopting land and resource uses that secure ecosystem protection (Wunder 2007). Beneficiaries' willingness to pay is used to measure the value of non-market goods and it involves generating information about service value relative to cost of provision, in fact, has been acknowledge to be important for making good conservations decisions (Steven 2005). Also, literature on non-market values suggests that the process of commoditization of non-market services like the provision

of drinking water may require necessary preconditions such as rigorous identification and measurement of demand and assignment of money values with a particular and precise meaning, that is, to reflect social values non-market values (Loomis 2005).

Increasing scarcity of water has made ecosystem services that affect water supply valuable and eventually tradable commodity, thereby creating potential market for conservation activities within and around catchments. The absence of markets for most environmental services makes it difficult to estimate a payment mechanism acceptable to parties involved. The value of the watershed service is dependent on both the supply and demand of the resource, which implies that it is also necessary to account for water use in a basin. Environmental issues related to drinking water may be addressed within the context of watershed management. The extent of the effect of land uses such as forests or agriculture on watershed services has been argued to remain imprecise, though, (Pattanayak 2004) however, researchers working in PES programs argue, that a better understanding of demand for the services channelled by PES programs may be one necessary pre-condition for implementation of PES schemes (FAO 2004) and to potentially mainstream these institutional arrangements in the tropics (Wunder 2007). Also, understanding the biophysical service delivery pathway is important to identify which specific landscape management practices need to be encouraged (e.g., sustainable forest management or conservation agriculture) or, conversely, those that need to be discouraged by the policy instrument (e.g., deforestation or factor-intensive agriculture) to secure the provision of the watershed service (Salzman 2005). There is need to monitor how the transformation of ecosystems affects forest resource, hydrological services such as water regulation such as the maintenance of dry season flows and human welfare as a whole. Throughout the Americas, watershed-based payment for environmental services programs have been explored as means for promoting residents' conservation and development of hydrological services (Echavarría, Vogel et al. 2004; FAO 2004; Sandra and Barton 2005). In PES programs for watershed protection, upstream land users (e.g., farmers) are paid by downstream water users for adopting land use practices (e.g., forest land uses) that limit deforestation, erosion, and flooding risks (Wunder 2006). In the case of Costa Rica, the country's PES experience has been largely limited to a national level approach that, among other conservation goals, has focused on protecting upstream forests in large watershed that typically provide hydroelectricity(Pagiola 2002).

2.4. Managing Watershed

Water resource conservation and management occupy an increasingly important place in the international development agenda because of the growing pressures on important ecosystems and those relying on the associated ecosystem services (Millennium Ecosystem Assessment 2005). It has been asserted that new conservation and development efforts should be better tailored and more responsive to site-specific ecological and socio-economic conditions for effective and sustainable preservation and management of threatened natural habitats as local conditions are more likely to determine what is possible and how best to achieve it (Ferraro and Kiss 2002). All over the world, watershed management efforts aim to influence upstream-downstream relationship. This is done by encouraging upstream land-use practices that are consistent with maintaining watershed so that it yields water that is unpolluted, low in sediment, buffered against flash floods, and with minimal fluctuations in dry-season and groundwater flows (Swallow, Meinzen-Dick et al. 2005). The basic scientific challenge in managing watersheds is to understand how upstream land-use practices affect

natural resource conditions downstream, while the basic socioeconomic problem is to encourage people in an upper watershed to adopt practices to deliver environmental service. According to (Mikitin 1995) *"The basic legal concept behind a trust device is that property is managed by one person or group (usually referred to as "trustee(s)") for the identified goals or benefit of a second person or group (usually referred to as "beneficiary(ies)"*. Protecting natural landscapes in the watershed is essential for maintaining the water-cleansing capabilities of the land as well as prevents future contamination of the water supply and ensures filtering capability in the future. In PES programs for watershed protection, upstream land users (e.g., farmers) are paid by downstream water users for adopting land use practices (e.g., forest land uses) that limit deforestation, erosion, and flooding risks (Wunder 2006). Costa Rica for example has a PES experience which is largely limited to a national level approach which among other conservation goals, has focused on protecting upstream forests in large watershed that typically provide hydroelectricity (Pagiola 2002).

2.5. Threats to Ecosystem Services

Turpie et al., (2004) observed that as poverty and demand for land for urban and agricultural use increase habitats and therefore biodiversity are increasingly under threat. These pressures are further exacerbated by climate change particularly its impacts on water resources. Land use changes could result in changes in the flow of a number of ecosystem services in term of quantity and quality; these services and associated flows are parts of complex systems which due to complementarities, the flows of others are increased; similarly, the flows of some ecosystem services might be decreased. Meyer and Turner 11, (1992) categorized the main driving forces of land use changes into technological capacity, socio economic organization, level of development and culture. Negative contribution of increasing population growth to the pressure on natural resources has also been noted by most literatures (Meyer and Turner II 1992; 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, chemicals and biological components of the earth. A study by Muñoz et al., (2005) showed that the main correlates for deforestation in Mexico were proximity to cities and rural population centres, low slope, and soils 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, slush and burn agriculture, mining and quarry, fuel wood collection coupled with wildfires, illegal occupation and conversion to other land uses are drivers which have impacted on forest ability to supply environmental services (OTTO 2006).

Additionally, the conversion of natural watershed lands to agricultural, industrial, or urban uses add to watershed's 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 of aquatic habitats (Calder 2000). FAO, (2001) estimated that the world's forests were converted to other land use /cover at a rate of 0.38% annually in the 1990s and even more rapidly and diverse in developing tropical countries. Tropical deforestation, rangeland modification, agricultural exploitation and urbanisation are identified as the major land use /cover changes around the globe (Lambin, Turner et al. 2001). Of the uses, forest cover alone is estimated to have been reduced approximately by 40% in historical times (FAO 1996). The Millennium Ecosystem Assessment, (2003) identified key threats

to ecosystem services and categorised them into two drivers of change; indirect socioeconomic drivers (such as policies and legal framework), and direct drivers, which include changes in local land use/cover as shown in figure 2-2 below. The research also looks at the extent of land use/cover changes as direct driver in and around the Weija.

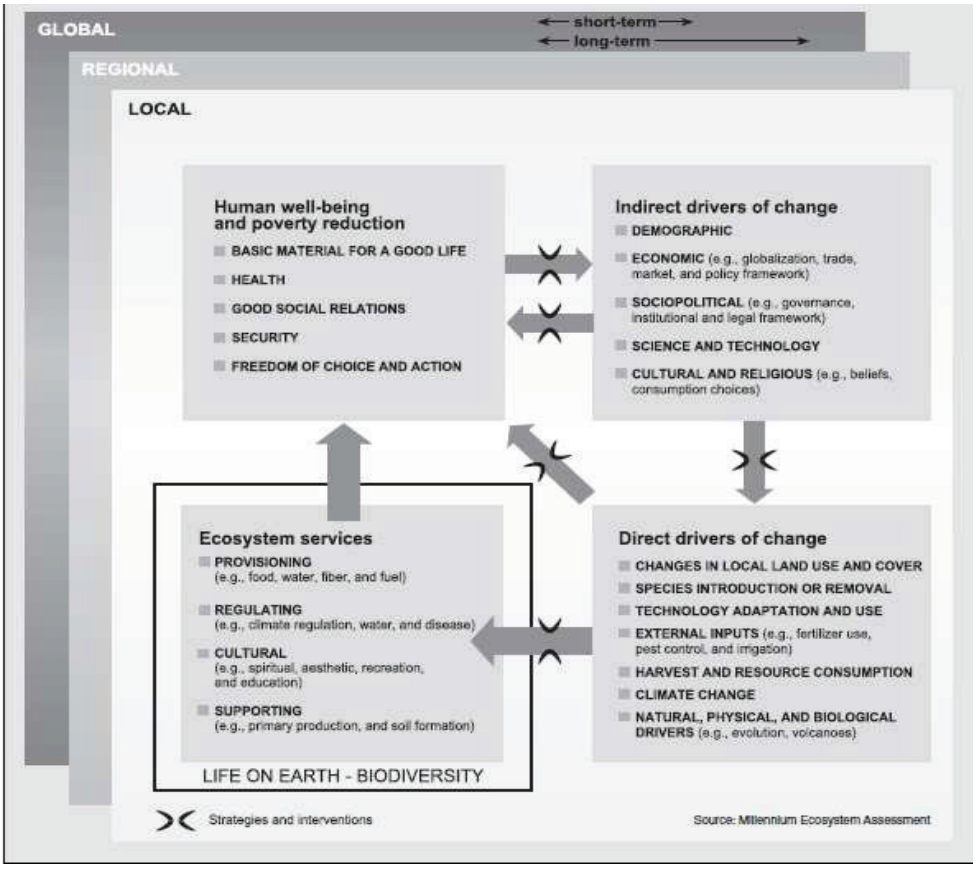


Figure 2-2: Adopted from MA, 2003

2.6. Ecosystem Services Valuation Framework

A PES approach for watershed service results in an arrangement which allows external beneficiaries of environmental services to make direct contractual quid pro quo payments to local landowners in return for adopting land and resource uses that secure ecosystem protection (Wunder 2007). The services provided by ecosystem results in a biophysical relationship between forests, water and people which links it Beneficiaries' willingness to pay is used to measure the value of non-market goods and it involves generating information about service value relative to cost of provision which has been acknowledge to be important for making good conservations decisions (Steven 2005). Methodologies for ecosystem services valuation have been developed by authors like (Pearce and Turner 1990; Freeman 1993; de Groot 2002). Hein et al.,(2006) also developed a framework for the valuation of three types of ecosystem services and four types of values based upon (Pearce and Turner 1990; Hein, Koppen et al. 2006). Hein et al., (2006) observed that the framework is applicable to all ecosystems but it will in general be more useful to the application to natural or semi-natural ecosystems. Specific attention is given to regulation and cultural services which are often higher in natural and semi-natural ecosystems (Pearce and Turner 1990). In this framework, (Hein, Koppen et al. 2006) grouped

valuation of ecosystem services in to four steps; specification of boundaries of ecosystem to be valued, assessment of the ecosystem services supplied by the system, valuation ecosystem services; and aggregation or comparison of values of the service Figure 2-3. De-groot, (2002) divided ecosystem values into 3 types: ecological, socio-cultural (non-use values) and economic values (use) and argued that once functions of ecosystem are known, the nature and magnitude of their values to humans can be evaluated through the goods and services ecosystem provide and that observed ecosystem functions can be reconceptualized as "ecosystem services and goods" when human values are implied. Turner et al., (2003) established a critical distinction between use and non use values of ecosystem services to mankind and concluded that the latter reflects value in addition to that which arises from usage.

The valuation of ecosystem services which is 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. Total Economic Value is typically disaggregated into two categories of use values and non-use values.

Use value is composed of three elements:

- Direct-use value, which is also known as the extractive, consumptive or structural use value, is mainly derived from goods that can be extracted, consumed or enjoyed directly. Examples of these goods include drinking water, fish and hydropower, as well as recreation activities.
- Indirect-use value, which mainly derives from the services that the environment provides, including regulation of river flows, flood control and water purification.
- Option value, which is the value attached to maintaining the possibility of obtaining benefits 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.

Non-use values, on the other hand, derive from the benefits the environment may provide that do not involve using it in any way, whether directly or indirectly, and it comprises:

- Existence value, which is the value people derive from the knowledge that something exists, even if they never plan to use it. Thus people place value on the existence of blue whales or pandas, even if they have never seen one and probably never will, as demonstrated by the sense of loss people would feel if they ever became extinct.
- Bequest value, which is the value derived from the desire to pass on ecosystems to future generations

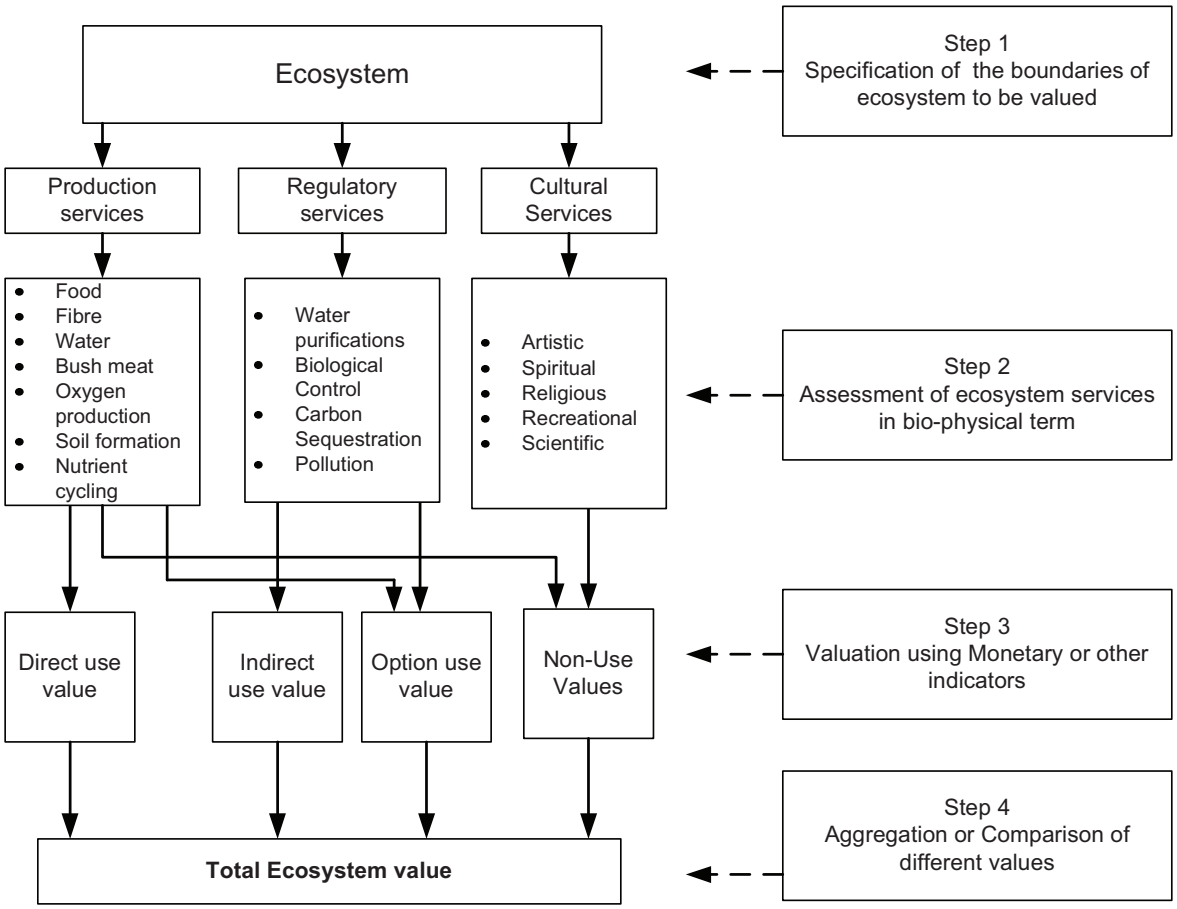


Figure 2-2-3: Ecosystem service valuation framework (Hein, Koppen et al. 2006) The links between the elements of the framework is shown as solid arrow. The dashed arrow represents the four principal steps in the valuation of ecosystem services.

In this work, the first step for ecosystem valuation framework involved the use of remotely sensed data to define land use/cover boundaries for the period 1990-2007. Secondly, watershed ecosystem service was identified though no biophysical nor agro economic studies were conducted. Thirdly, the valuation of use and non-use values assigned to watershed services via the contingent valuation method was undertaken while the values for watershed services were aggregated. The research also assesses changes in local land use /cover as direct driver of change affecting watershed services using (Hein, Koppen et al. 2006) valuation framework as shown in (Figure 2-3). This framework was adopted for the assessment of the ecosystem services (watershed service) because it is comprehensive, easy to use and thorough in literature.

2.7. Payment for Environmental Services

Payments for environmental services usually signal the value that service users attach to environmental services or the opportunity cost for land users to provide them. The basic principle is that those who "provide" environmental services should be rewarded for doing millennium so. This is achieved through a variety of arrangements that transfer rewards from those who benefit from an environmental service to those who conserve, restore, and manage the natural ecosystem which

provides it (Wunder and Alban 2005). Rewards may be monetary or in kind, may involve private sector or government financing, and can be made at local, national, and global levels. Indeed, many argue that the failure of society to compensate land managers for conserving these services is a key contributory factor to the rapid and environmentally damaging changes in land use that are taking place globally. Payment for environmental services (PES) programming is an incentive-based mechanism that has been used in efforts to protect watersheds and watershed services such as water quality (Pagiola 2002; FAO 2004; Sandra and Barton 2005). Water resources conservation and management was noted by MA to occupy an increasingly important place in the international development agenda because of the growing pressures on important ecosystems and those relying on the associated ecosystem services (Millennium Ecosystem Assessment 2005).

Although it is now well known that ecosystems generate numerous 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. Indeed, in PES systems around the world, it has been found that most examples are for a few main commodities, particularly carbon, water, productive potential, biodiversity and landscape beauty, with markets for carbon sequestration and hydrological services being dominant (Landell-Mills and Porras 2002; Pagiola and Platais 2007). Among these commodities, (Pagiola and Platais 2007) argue that water services have the most potential for application of the PES approach as water users are easy to identify, receive clear well-defined benefits and often already have financing mechanisms. They are well understood by the broad populace, making it more likely that willing-buyer and willing-seller combinations can be found. In PES programs for watershed protection, upstream land users (e.g., farmers) are paid by downstream water users for adopting land use practices (e.g., forest land uses) that limit deforestation, erosion, and flooding risks (Wunder 2006). It is important to communicate what is desired to potential participants in ways that they can understand and to let them know that payment measures are not for biodiversity itself, but for land uses that are hospitable to biodiversity and the provision of environmental services in general.

Participation of local beneficiaries (i.e. community based management) in natural resources management has received increasing support in literature because of the potential for such an approach to achieve environmental and natural resource goals (Agrawal and Gibson 1999). Baland and Platteau, (1996) noted that, one promising approach for rural communities to manage their natural resources is through local collective management systems. At the same time, multilateral agencies like the World Bank and countries across the globe have been increasing their support for ecosystem and incentive-based approaches for watershed management (Pagiola., Arcenas. et al. 2005). Identifying and understanding the factors influencing local beneficiaries' willingness to participate in the protection and management programs will help in improving the management of watersheds, especially those that support highly valuable hydrological services such as water quality and quantity. Downstream water users pay farmers who farm upstream lands for the provision or supply of multiple benefits by not using pesticides or other chemicals in order to reduce the extent of pollution to water and soil. The service can be directly consumed, or indirectly through the household production function or as factor inputs in production. Aylward and Fernández González, (1998). Sometimes in a

PES scheme, there can be a combination of one or more services brought together and a market formed for the bundled service (Mayrand and Paquin 2004).

A survey of 61 watershed-based payment schemes conducted by (Landell-Mills and Porras 2002) found that these markets are more institutionalized and rely on a cooperative relationship between demand and supply rather than on competition among service providers and beneficiaries. Wunder (2006) also distinguished four principal objectives for a PES scheme. Reid, (2001) noted that improved management of watersheds, especially those that support highly valuable hydrological services such as water quality and quantity might be advanced by identifying and understanding the factors influencing local beneficiaries' willingness to participate in such protection and management programs. According to in South Africa removing thirsty alien tree species in Cape Town's watershed and restoring native vegetation produced water at a Moreover throughout the Americas, watershed-based payment for environmental services PES programs have been explored as means for promoting residents' conservation and development of hydrological services (Echavarría, Vogel et al. 2004; FAO 2004; Postel and Thompson 2005). Costa Rica has experience with a national system of PES including an approach of direct payments to land users for land use decisions resulting in the provision of environmental services (Chomitz, Brenes et al. 1998; FAO 2004; Salzman 2005). Costa Rica's national system of environmental service payments was designed for landowners to receive direct compensation for land use decisions that provide four types of environmental services; mitigation of greenhouse gases; provision of hydrological services; biodiversity conservation, and provision of scenic beauty for ecotourism (Pagiola, Bishop et al. 2002)

2.8. Feasibility Assessment of PES for watershed services

In developing a PES scheme it is important to identify and quantify the environmental services (carbon sequestration, watersheds, biodiversity conservation or landscape beauty) that are to be generated under the system. The key is to identify which services are needed, by which beneficiaries and at which level (Bishop and Landell-Mills 2002). A PES programme could have different objectives which range from restoring natural habitat or tree planting as in Piracicaba, Brazil, where funds from municipal water revenues are used to assist farmers to plant trees in riparian areas. It can be focused on restricting land use by maintaining existing natural habitats and protecting them from destruction, an example is in Ecuado, where farmers are paid to conserve primary forest, natural grassland and already disturbed forest and grassland (Echavarría, Vogel et al. 2004). Another area of interest for a PES scheme is in improving existing land use for example a reduction in the use of pesticide, reducing the rate of harvesting to one that is sustainable or soil conservation.

Incentives for maintaining the provision of ecosystem services (Pagiola, Agostini et al. 2004) include not only environmental but also issues on poverty and health. A background assessment, international case study comparison and stakeholder analysis aim at giving a more interrelated institutional feasibility outline for a local-level PES scheme. It seeks to bring together components on existing frameworks, guidelines and criteria previously proposed by leaders in the field of PES some of which are already established whiles others are only just emerging to describe and prioritize factors relevant to PES design and implementation. PES scheme attempts to manage global and local investment with global climate goals and local forestry goal (Wunder and Alban 2005) and that given this existing situation a proper PES design must ensure that it delivers services contingent on payments based on a

mutual and voluntary definition or use of the resource, is pro-poor by reducing inequality in the negotiation phase or by ensuring additional financing to poverty-stricken sellers, and is realistic. These criteria are widely referenced, though they are not formally recognized, or even consistently demonstrated in PES schemes. In designing payment mechanism, the capacity of all stakeholders as well as the political, social and private sector context of the area must also be considered. Forest Trends incorporates relevant conceptual design components, government involvement and institutional support considerations (Waage and et al 2005). PES systems in Salvador for example focused on improvements in land use practices such as silvopastoral practices and agroforestry that generate environmental services while maintaining land under production.

Experts in the field see the involvement of stakeholders in PES schemes as a factor important and influential to the implementation process. A PES design therefore could include attractive corporate marketing and businesses to act as catalysts to convince and entice private sector in the use of PES to improve competitive advantage (Iftikhar, Mikkel et al. 2007). It has been suggested that institutional feasibility of a PES scheme should take into account the different actors, their inputs, and potential impacts. The (World Bank and WWF 2003) noted that PES schemes must ensure that it produces both ecological and socio-economic outcomes not possible without the scheme. Also, according to Powell et al., (2002) PES is a policy tool appropriate to certain circumstances and not others, and these circumstances should be considered when contemplating PES particularly where pro-poor outcomes are sought. Meanwhile, some of the circumstances for PES considered below appear to remain unchallenged by the literature and thus form a useful template for framing approaches to a local PES, these include:

- an economic value for the environmental services which are being provided
- potential buyers and sellers
- an appropriate legal and regulatory context
- property rights

Landell-Mills and Porras (2002) also proposed the following key steps to develop successful markets for environmental services:

- Identify benefits provided by a specific service and by determination of (forestry) activities that deliver this service;
- Undertake a feasibility study;
- Establish payment mechanisms and supporting institutions
- Formalize property rights
- Establish willingness to pay;
- Undertake pilot activities and feedback to market design. Pilot projects are seen to constitute an important element in the process of creating a successful PES.

Rosa et al., (2004) described the conventional approach to PES in the following way, that:

- It focuses on the use of economic instruments seeking the lowest possible costs for achieving environmental goals;
- It singles out environmental services (carbon sequestration, water regulation or filtration, or single species biodiversity);
- It shows a preference for simplified and large-scale ecosystems, preferably owned by few people, to reduce transaction and monitoring costs; and
- It seeks to secure private property rights and to reward landowners.

2.9. Payment Mechanism

Payment schemes for environmental services (PES) are innovative instruments for natural resource management. In PES programs for watershed protection, upstream land users (e.g., farmers) are paid by downstream water users for adopting land use practices (e.g., forest land uses) that limit deforestation, erosion and flooding risks (Wunder 2006). The Ecosystem Marketplace came up with three types of payment mechanisms applicable to a local PES scheme. These are direct public payments, direct private payments and tax incentives. Ecosystem Marketplace Matrix (2006) gave various degree of government's involvement. Additionally, the World Bank, ICRAF and the Tyndall Centre among others are particularly concerned with the impact PES designs have on the poor especially concerning equity and legitimacy of poor stakeholders (Mutunga and Samuel 2006). Powell and White (2001) typology of financial incentive mechanisms used to describe the wide variety of mechanisms in practice organizes the incentive mechanisms into three indicative categories, separated by the degree of government intervention in the administration of the mechanism. These categories are self-organized private deals, trading schemes, and public payment schemes. In reality, of course, there is a range of mechanisms involving public and private actors, and many cases involve a combination of different mechanisms. The development of an appropriate financing platform is instrumental in the establishment of a successful PES system to generate a continuous flow of financial resources into the system to fund payments over the long term. Government payments can be funded through earmarked taxes, user fees or other fiscal instrument. Payments from beneficiaries can be collected in the form of voluntary payments, user fees and charges or through negotiated arrangements between institutions and beneficiaries.

2.9.1. Self-organized private deals

Here private entities develop their own mechanisms to pay for watershed protection with little or no government involvement and are mostly found in areas where an ecosystem approach can provide private interests with water services at a cost lower than traditional treatment approaches. Private interests may need water quality or flow that goes beyond regulatory standards or where there is no effective regulatory system in place. Financing is from private sources but may take various forms as user fees, transfer payments, land purchases, cost sharing arrangements and/or low interest credit.

2.9.2. Trading schemes

This is organised in cases where there are regulated environments and government sets either a very strict water quality standard or a cap on total pollution emissions and individual facilities or landowners have a defined maximum allowable amount of emissions they can release. The opportunity for trading, however, requires the government to say that it does not care who takes action so long as the overall standard is met or the cap is not exceeded. By this companies or landowners trade emission credits between those who can achieve them cheaply and those who cannot. Emission credits are earned based on production of emissions lower than the set standard and companies and landowners can make economic decisions as to whether it is cheaper to lower their emissions or to buy credits from others who have been able to do so. Authority for trading schemes however must come from state, federal, or local regulatory agencies. A strong regulatory system and effective monitoring systems are thus key requirements.

2.9.3. Public payment schemes

Public payment schemes are where government or a public sector institution pays for the ecosystem service. Of the three categories of financial mechanisms, public payment schemes are the most predominant in the world today. Financing of PES can come from various sources including general tax revenues, bond issues or user fees. Payments are made to private landowners and private or public resource managers. Because of the public goods nature of hydrological services, publicly financed transfer payments are likely to remain the most common financial mechanism used to protect water-related ecosystem services. Government payments can be funded through earmarked taxes, user fees or other fiscal instruments and the rationale for government intervention in financing PES schemes is that, it may already be paying for the provision of environmental services through other means, or using different policy instruments to reach similar objectives.

2.10. An appropriate legal and regulatory context

Landell-Mills and Porras (2002) revealed in a review of diverse PES mechanisms in operation around the world that it may be true that PES implementation is facilitated by a supportive legal and regulatory environment. According to (Ruhl, Lant et al. 2003) institutions organized around relatively small-scale watersheds are very likely to grow as fora for stakeholder participation and to acquire legal authority in the process of meeting challenges. Wolf, (1998) also noted the role water can play in maintaining lines of communications even during times of political conflict and the dominance of cooperation over conflict in the international management of water. These are indications of the need for a conducive policy framework in place in PES design. All over the world, legal and water policy instruments are being revised to recognise and protect environmental flows in river basins, as explained in the IUCN-WANI toolkit flow (Perrot-Maître and Patsy Davis Esq 2001). Additionally, a well laid down national legal and policy framework will be required to involve the poor at the local level to support cooperatives for supply and marketing and the creation of extension services for implementation. This will allow governmental or international agencies to contribute to the development of payment schemes in order to bring together both direct and indirect beneficiaries to negotiate to mobilise funds for pilot schemes and to promote trust among stakeholders. It can also be used to encourage downstream users to pay and to set-up mechanisms for monitoring compliance by upstream landholders and the commitment of stakeholders.

2.10.1. Property Rights

In the design of a local PES scheme, a defined and secure property rights form part of the legal or regulatory context. Powell et al., (2002) also identified such rights as a separate specification for assessing PES feasibility and argues that property rights are particularly important and that where rights over services are not clearly defined, creating a PES mechanism will necessitate the clarification or assigning of rights thus clearly defined property rights of land, forest, water and other natural resources is essential in developing market for environmental services. Market will not function well if there are doubts over property rights within a local area. In the developing world issues bothering on land tenure can become a limiting factor to the implementation of PES schemes because of the challenge pose by customary and unwritten land law. The existence of numerous small landholdings will make transaction costs high for PES schemes. As such an understanding of property rights and the structure of livelihoods around such rights raises questions as to who should be rewarded in PES design. Land tenure reform may therefore be one of the best strategies to address the

overexploitation of resources as well as the existence of a strong and undisputed tenure are prerequisite for the creation of a successful PES scheme. (Schlager and Ostrom 1992) broke down property rights into a series of rights according to the authority they grant:

- Access: The right to enter a defined physical property and enjoy non-extractive benefits, primarily recreational activities.
- Withdrawal: The right to extract the resources or products of a system (e.g., catch fish; gather fuel wood and water for irrigation or human consumption).
- Management: The right to regulate internal use patterns and transform the resource.
- Exclusion: The right to determine who will have an access or withdrawal right, and how those rights may be transferred.
- Alienation: The right to transfer the rights of management and exclusion.

This conception allows much flexibility in adapting property rights to the specifics and gives an indication of whether PES schemes will benefit poor land users or not. If PES schemes are implemented in the context of secure and undisputed property rights over the landscape providing ecosystems services, poor communities are likely to benefit from the system. On the other hand, if poor communities' rights to the resource base are limited, it is likely that the PES system may contribute to their further marginalization by undermining their access to resources.

2.10.2. Pro-Poor Policy Objectives in PES Transaction Design

Powell et al., (2002) noted that approaches to property rights suggest that such rights are not the only precondition to PES design but that there should be an understanding of rights and their inter linkages with livelihood structures and natural resource management. In particular, certain PES transaction structures are more likely to be conducive to pro-poor outcomes. Wunder and Alban, (2005) questioned whether only property rights holders should be rewarded, or whether payments can be directed towards resource users too. Some PES authors have also suggested that PES could contribute to poverty reduction by transferring wealth from environmental service consumers to supposedly less affluent providers (for example (Landell-Mills and Porras 2002; Pagiola., Arcenas. et al. 2005). Various case studies have demonstrated the plausibility of this contention. Echavarría (2004) showed that certain ES providers in Ecuador derived 30% of their household spending on food and medicine from PES. Wunder and Alban, (2005) further pointed out that non-monetary benefits of PES such as increased social capital through improved internal organisation and business dealings with the outside world, increased land tenure security and improved visibility of environmental service providers to both donors and public entities. According to (Kosoy, Martinez-Tuna et al. 2007), where pro-poor objectives are pursued, there are explicit trade-offs between environmental efficiency and returns to environmental services investment which must be negotiated by policy-makers and accepted by service buyers.

2.11. Identifying brokers and supporting Intermediaries

Intermediaries initiate and maintain supporting institutional framework for the PES scheme. They provide technical assistance, scientific information, initiate and implement PES scheme and set up supervisory mechanisms to ensure continuous flow of environmental service by negotiating conservation concession and direct payment to managers (Maveneke 1998). Rosa et al., (2003) argued that supporting institutions through scientific research, capacity building, technical assistance,

certification, fund management, marketing, and linkages with national and international actors is crucial. And though it may be necessary to create new institutions to support new PES schemes, in practice however, such governance structures often take root into existing local institutions and communities. The setting up of governance structures may therefore require strong external leadership as well as confidence-building strategies to make sure that land users and beneficiaries will buy into the new system. These institutions act as brokers between service buyers and sellers to improve the process of negotiation. They help to define contractual terms, fill institutional gaps and facilitate financial transactions. These roles are vital and can also result in lower transaction costs and increased trust and transparency. Intermediaries are commonly local NGOs, community groups or government agencies who are funded or subsidised by donor organisations and often act in effect as administrators for a scheme. They seek to maximise downstream service buyers' demand by identifying sellers who will deliver the greatest improvement in services at the lowest cost.

2.12. Conclusion

The research focused on investigating the feasibility of establishing a local PES scheme for watershed services. Remotely sensed data were used to identify changes in land use/cover changes types from 1990, 2000 and 2007. Water provision was selected as key ecosystem service and thus formed the basis for assessment. A feasibility study of PES design and implementation including stakeholder analysis involving a review and description of existing frameworks and guidelines of conditions and factors that have been proposed by experts in the field as crucial for the design of a PES scheme for local watershed were conducted. The institutional feasibility of PES scheme and the assessment of government's policy on water and natural resources as well as the involvement of different stakeholders at the local level in water resource management aimed at considering the different actors, their inputs, potential impacts and the inclusion of attractive corporate marketing and businesses to act as catalysts to convince and entice private sector in the use of PES so as to improve competitive advantage as observed by (Iftikhar, Mikkel et al. 2007).

3. Materials and Methods

3.1. Study area

The study was conducted in Weija and communities around it receiving water supply from the Weija treatment plant falling within the Ga district and some part of the Accra Metropolitan Area of Greater Accra Region, Ghana. The selection of the location was based on the reason that there is rapid urban expansion and human activities are increasing the rate of land use transformation in and around the Weija shed. The communities selected were based on a criterion of the degree or condition of water supply from the plant to these areas. The condition of supply range from good, intermediate, rationed and poor/no supplies areas according to the Water Company. This was aimed at having an optimized representation of water consumers within these groupings and the extent of service delivery. The Ga district lies in the Coastal Savannah agro-ecological zone with a generally undulating Relief and a bi-modal Rainfall pattern which together with Densu River, predisposes the District to agricultural development.

The Densu catchment has an area of about 2,490 km2 and spans 10 districts assemblies. There are about 200 settlements in the basin and the total population approaching 600,000 equivalents to 240 persons per km2. This figure is considerably higher that the national average of about 100 persons per km2. The vegetation consists of coastal savannah, thicket and grassland in the south, and moist semi-deciduous forest in the north. The river takes its source from the Atewa Range near Kibi and flows for 116 km into the Weija Reservoir before entering the Gulf of Guinea through the Densu Delta Ramsar site. The mean annual runoff is 500x106 m3. The Densu River is of specific importance since it includes the Weija Reservoir which supplies water for approximately half of the Accra metropolitan area. However, the bulk of its over half a million population is concentrated along its boundary within the Accra Metropolitan Area (AMA). The AMA however, experiences an interesting dichotomy of enforced urbanization and a serene of rural set-up. The Accra Metropolitan Area is a very small land area with a large population of 1.6 million persons. Within the borders of AMA is a virtual beehive of industrial and commercial activities and pockets of educational institutions It area also has a coastline of 10 kilometers with white sandy beaches along Bortianor and Kokorbite. There is also the Ramsar “Wetlands” Site comprising the Densu River and the Panbros Saltpans.

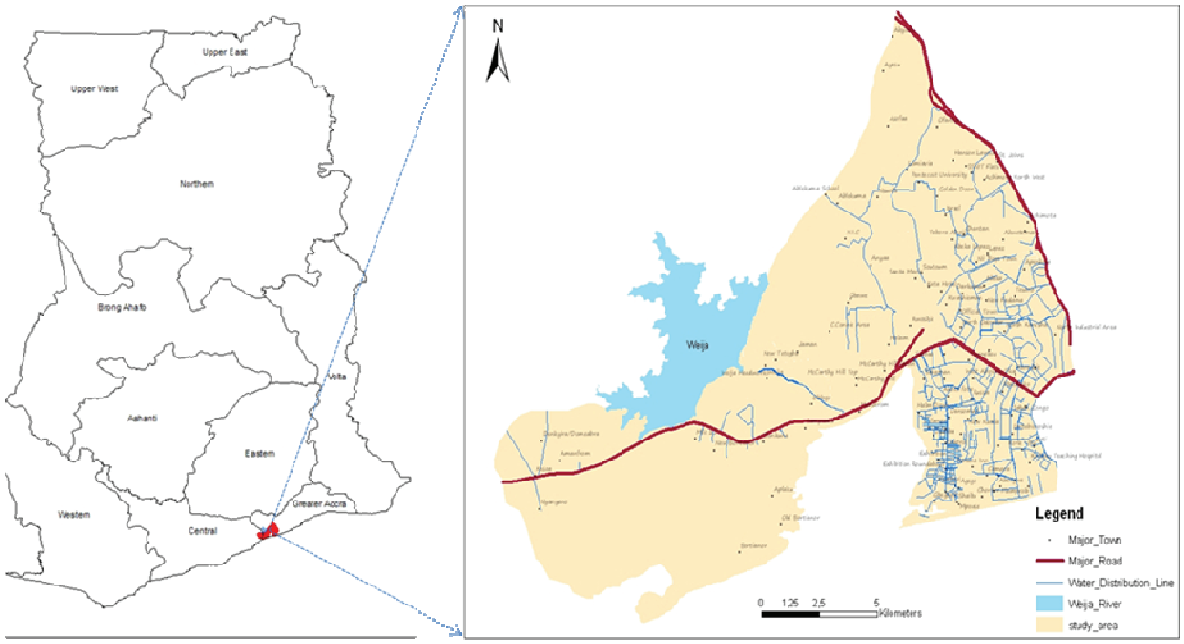


Figure 3-1: Location of study area

3.1.1. Origin and Population

The people of the region called the Ga/Dangmes are made up of the Gas, the Adas and the Krobos. Oral tradition has it that the Ga/ Dangmes came from Yorubaland in Southern Nigeria near the River Niger. The people throughout the region observe similar customs based on patrilineal system of inheritance and have a chieftaincy system which is largely influenced by the Akan system. It is the most densely populated region in the country in part because it contains the city of Accra, the capital of Ghana. Its population density from the 2000 census was 1,019 persons per square kilometre. Eighty eight percent (88%) of its population lives in localities defined as urban (population five thousand or more) and only 12 percent live in small rural communities. Many of its urban localities are very large with population running into tens of thousands. Greater Accra had a population of population of 953,505 in 1984 and 2,905,726 in the 2000 national population census with a growth rate of 4.4%. The high population growth rate in the region is thus a mixture of natural increase and rapid migration into the urban parts of the region from all over the country. As one moves away from Accra and Tema to the rural areas of the region however, the population density reduces. This is due to the rural - urban migration because of poor socio-economic conditions in the rural areas. Thus the majority of people in the Greater Accra Region are urban dwellers.

3.1.2. Economic Activities

The location of Accra in the region has made Greater Accra the industrial centre of the country with Accra and Tema accommodating greater part of the establishments. The location of the country's largest port at Tema, the relatively well developed infrastructure and good industrial atmosphere within Accra and Tema have undoubtedly helped to increase the growth of industrial establishments in the region. Fishing plays a major part in the region's economy even though it is controlled by the small-scale canoe fishermen in Ada, Loi , Pute, Azianya, Accra, Teshie, Nungua, Tema, Kpone,

Prampram, Bortianor, Ningo and Ahwiam. There are other big fishing establishment such as Mankoadze, State Fishing Corporation, Ocean Fisheries, Kaleawo Enterprise and Afko Fisheries all in Tema. Within the study area of Accra Metropolitan Assembly and the Ga districts, sales workers and general workers are the two major occupations whereas about half of the economically active population in other districts is engaged in agriculture, animal husbandry, fishing and hunting. Analysis of the economically active population by institutional sector underscores the dominance of the private sector in the economies of the districts (GOG 2003). Agriculture engages about 40% of the economically active population as such farming is a major economic activity of the rural areas of the region. Apart from the small-scale farms held by individual families there are some commercial crop farms and livestock farms. The main crops grown in the region are cassava, maize, groundnuts, vegetables, beans, cowpeas, coconut, pineapples, onions and shallots. The region is among the few regions in the country where livestock are reared because the vegetation is mainly grassland and less infested by tsetse flies. Cattle are therefore reared in settlements around Agataw, Dawa, Afienya, Mobili, Gbecheli, Katamanso areas in the central part of the region

3.1.3. Vegetation

The vegetation of the region is of the Coastal Savannah agro-ecological zone occurring here and there within the savanna are thickets of forests along the stream courses and mangrove and swampy vegetation along the coastal lagoons. A gallery of forests and remnants of high forest vegetation can be found along the north-western section of the Akwapim Ranges. The vegetation and soil types in the rest of the District greatly enhance large-scale commercial farming of both traditional crops like maize and cassava and other non-traditional export crops like pineapple, pawpaw and pepper.

3.1.4. Climate

Located at the inter-tropical convergence zone of a tropical continental air mass from the northeast and a tropical equatorial air mass from the southeast, the region has a tropical, warm and comparatively dry climate, which results in two rainfall seasons over Accra. The first one peak in May/June with approximately 19.8 cm rainfall and the subsidiary season is in October with approximately 6.35 cm. In between the rainy seasons Accra experiences harmattan winds, hot dry winds from the northeast. Accra's location which is adjacent to the ocean, the temperature is fairly stable, fluctuating between high 20s and mid 30s degrees celsius. Humidity also stays relatively constant at 90-100%, though can drop drastically in the harmattan season with generally undulating relief and a bi-modal rainfall pattern. Its peak elevation to the north is less than 300 ft and slopes southward towards the Atlantic Ocean. The drainage has created small scale spoon shaped valleys separated by low ridges, which follows the sloping topography towards the south. Its geology consists of underlying accrainan sandstone, grits and shales.

3.2. Materials

3.2.1. Data and Data Acquisition Method

Questionnaires were prepared and administered for willingness to pay contingent valuation survey. The use of structured questionnaires survey was meant to identify respondents' level of knowledge and concern about environmental issues, socio-demographic characteristics and behavioural profile with respect to water as an environmental service. Using the face-to-face interview recommended by the NOAA-panel as one of the most frequently applied questioning methods, ninety eight (98)

questionnaires were administered through random sampling to water users respondents in and around Weija. Respondents consisted of individuals with similar condition of water supply and for that matter had common interest in as far as water service delivery was concerned.

3.2.1.1. Interviews and Discussion

Informal discussions, interviews and consultation were conducted with representatives of selected key stakeholders and informants such as the Water Company, NGO's, Ministry and Public organization and private sector actors responsible for water resources and dealing with regulation, development and policy issues on water and natural resources management about perceptions on environmental services, PES and the policy regulation on natural resource management.

3.2.1.2. Field Observation

Direct field observations were used to verify the information provided by respondents and other stakeholders supplement information gathered from other sources. Tariffs were found to be relatively low reflecting the fact that water is still not treated as an economic good. Though demand has outstripped supply, some water supply infrastructure is old and inadequate to provide expected service Instances of illegal connections and leakage on distribution mains were noticed. Generally, the quality of treated water is good, however untreated water is highly polluted from sediments from increased clearing of land for housing, soil erosion on newly cleared slopes, agricultural practices and increased utilization of chemical and from sewage discharges.

3.2.1.3. Secondary Data

Three multi-dates near anniversary, Landsat satellite imageries with less than 10% cloud cover-Landsat Thematic Mapper (TM) 1990, 2000 and Enhanced Thematic Mapper (ETM+) 2007 and snap shots of the area were acquired for study. Other secondary data collected from the field included Policy documents, Acts and other regulations establishing institutions involved in the management of water and natural resources in Ghana, the National Water Policy, Public Utilities and Regulatory Commission Act 1997, Act 538, Water Resources Commission Act 1996, Act 522, Consumer Charter on water, Environmental Protection Agency Act 1990, Act 490, Forestry Commission Act, Act 571, 1999, Administration of Lands Act 1962, Act 123.

3.2.2. Software

Erdas imagine 9.1; ArcGIS 9.3, SPSS 15 and DNR Garmin were the software used in this study. Erdas imagine was used to in the remote sensing image processing and classification. GIS analysis was done in the ArcGIS 9.1. The Statistical Package for Social Science (SPSS) software was used for statistical analysis of data and field coordinates of plots down loaded using DNR Garmin software.

3.2.3. PES Feasibility Assessment

In addition, there was a review and description of existing framework and guidelines of conditions and factors that have been proposed by expects in the field as crucial for the design of a PES scheme for local watershed. A background analysis of the case study area and stakeholder analysis was undertaken to give an idea of potential buyers, sellers, as well as the situation of existing natural resources and for that matter water resources management conditions in the country. This aimed at comparing the Weija watershed situation to other PES schemes operating under similar objectives and conditions. Case study comparison aimed at establishing a relation between the Weija PES scheme

project and other PES schemes operating around the world was done. It looked at whether policy and institutional framework in Ghana would offer a feasible environmental for a PES scheme for watershed services at Weija. The stakeholder analysis discussed features of various actors and the roles they play in a PES scheme.

3.3. Methods

3.3.1. Image pre-processing

In this study, image differencing change detection method was adopted to assess change in major land-use cover systems over the period of study. Change detection is the process of identifying differences in the state of an object or phenomenon by observing it at different times (Singh 1989). It involved the use of multi-temporal data sets to discriminate areas of land cover change between dates of imaging. Usually, anniversary dates meaning images taken at the same season of the year are used to minimize sun angle and seasonal differences (Lillesand and Keifer 1994). This technique was used because it provided a change matrix where different transfers from one land-use cover system to another could be seen and the percentage change calculated.

3.3.1.1. Geometric Correction

Geometric correction procedure is use to register each pixel to real world coordinates. The three images were geometrically corrected to the global coordinate system – WGS 84 zone 30N projection using ERDAS Imagine 9.1. The 2007 ETM+ image was geo-referenced with thirty (30) pairs of well distributed tie points. The tie points were picked at road intersections and river confluence from the road and river digital maps respectively and subsequently co-registered to two TM 1990 and 2000 images using 2nd order polynomial transformation coefficients. Yuan et al., (2005) and (Attua and Laing 2001) used 35 and 30 pair of ground control points to geo-reference Landsat TM and Spot images respectively in their respective studies.

Root Mean Square Error (RMSE) could be defined as the deviation between ground control points (GCP) and geographic locations as predicted by fitted-polynomial and their actual locations (Shalaby and Tateishi 2007). RMSE between the three (3) geo-located images of 0.12 pixels, (equivalent to 3.36m) was recorded and accepted as the positional accuracy of the transformation of this study. This error margin was accepted for the study because it is within 0.5 pixels recommended by (Osei and Zhou 2004; Shalaby and Tateishi 2007) and Yuan et al., (2005) accepted 0.4 pixels, 0.25 pixel RMSE respectively in their respective studies. It is also instructive to indicate that, different levels of errors were accepted in different studies based on the spatial resolution of the image.

3.3.1.2. Radiometric Correction

Dealing with multi-date image dataset requires that images obtained by sensors of different times are comparable in terms of radiometric characteristics (Mas 1999). Radiometric correction techniques such as image enhancement, normalisation, calibration etc are applied to multi-date satellite images in order to increase visual discriminations between features and increase the amount of information to improve interpretability (Bektas and Goksel 2003). In this study, radiometric correction processes such as haze reduction and band co-linearity analysis were done on the Landsat multi-spectral images to reduce band correlation. The images were further subset to fit the study area using ERDAS IMAGINE 9.1 version.

3.3.1.3. Image classification using Unsupervised Classification

The major steps of image classification include determination of a suitable classification system which include; selection of training samples, image pre-processing, feature extraction, selection of suitable classification approaches and accuracy assessment (Lu and Wend 2005). Land-use/cover mapping could be defined as a process of segmenting images into mosaic of parcels with each parcel assigned to a class (Campbell 2002). Bektas and Gokel, (2003) also stated that the aim of image classification is converting image data to thematic data. Considering the heterogeneity of different land-use/cover types in the study area, of which most are less than the spatial resolution of the image coupled with complex variability in spectral response patterns for individual cover types, unsupervised classification was considered unbiased method to apply (Lillesand and Keifer 1994).

Lu and Weng (2005) defined unsupervised classification as clustering-based algorithms used to partition the spectral image into a number of spectral classes based on the statistical information inherent in the image. No prior definitions of the classes are used. The analyst is responsible for merging and labelling the spectral classes into meaningful classes. Attua and Laing, (2001) employed the unsupervised classification method in their work in Ghana because of the difficulties in accurately assigning pixels to its appropriate land-cover class. Unsupervised classification was performed on the three (3) Landsat images using ISODATA algorithms in ERDAS Imagine 9.1 and ENVI 4.2 resulting in fifty-five (55) spectral classes each. This was subsequently recoded into seven (7) spectral classes in the 1990, 2000 and 2007 images respectively using ground truthing data. "Salt and pepper" appearance in the classified images were smoothen out in the images by applying a 3*3 majority filter (Lillesand and Keifer 1994).

3.4. Contingent Valuation Methodology

The provision of water as an environmental service is a good with non market value. Watersheds provide significant benefits valuable to man; however these are often not accounted for in market-transactions. Such values can only be measured using non-market valuation techniques. Non-market goods are often times characterized by high transaction costs in the form of incomplete information about the nature and preferences magnitude of agents utility gains (Boggess, Lacewell et al. 1993). Contingent valuation method (CVM) has gained acceptance in recent times as a complete methodology for benefit estimation (Mitchell and Carson 1989; Day and Mourato 2002). The (CVM) is a non market valuation technique used to estimate the benefits derived from environmental amenities (Cummings, Brookshire et al. 1986; Chilton and Hutchinson 1999; Carson 2000; Carson and Groves 2007). CVM surveys are designed to uncover people's values, expressed as "willingness-to-pay" for non-market goods and services such as those provided by watersheds through the construction of a hypothetical market for a change in the level of provision of an environmental good or service. The CVM has also been used as one of the standard and flexible approaches to measure the economic values (Hanemann 1994)

In recent years, the CVM has been used to inform policy makers about individuals' preferences for basic infrastructural projects in developing countries such as water supply and sanitation (Whittington 1998) and surface water improvement (Choe, Whittington et al. 1996). A study on a micro-watershed in the hillsides of Nicaragua employed the CVM to assess the economic value of improving local watershed services for rural residents (Johnson 2004). In addition, (Gürlük 2006) and (Amirnejad,

Khalilian et al. 2006) used contingent valuation survey to estimate use and non-use values of ecosystem services forest ecosystems. In this case the method is used via questionnaire-based approach to estimate socio-economic value of use-ecosystem services (Hanemann, Loomis et al. 1991); (Venkatachalam 2003) and ecological value of non-use-ecosystem services (Pearce 1994).

3.4.1. Willingness to pay sample and design

A CVM survey elicits an individual's trade-off through questionnaires. Key elements of the questionnaires involve a constructed or contingent market featuring the reasons why a payment is needed, the good's description and a careful presentation of the payment vehicle (Zilberman, Wetzstein et al. 1993). Under a commonly used CV question format, the respondent is offered a binary choice between two alternatives often set in the context of a referendum (Carson and Groves 2007) one being the status quo policy and the other alternative policy having a cost greater than maintaining the status quo (Carson 2000). Beneficiaries' willingness to pay is used to measure the value of non-market goods and it involves generating information about service value relative to cost of provision, in fact, has been acknowledge to be important for making good conservations decisions (Steven 2005). Also, the literature on non-market values suggests that the process of commoditization of non-market services like the provision of drinking water may require necessary preconditions such as rigorous identification and measurement of demand and assignment of money values with a particular and precise meaning, that is, to reflect social values (Loomis 2005) non-market values, this study make use of the stated preference survey approached called the Contingent Valuation Method (CVM).

Respondents considered a hypothetical situation of an increased in water quantity and quality at an additional cost and another where water quality and quantity reduced without having to make any additional payment. The scenario offered an incentive for the respondent to reflect on the WTP question to her/him (Mitchell and Carson 1989). CVM has the ability to elicit an appropriate measure of value that individuals derive from environmental goods and services, as people are required to weigh the value of what is being offered to them against alternative uses of that income. According to (Wilson 1992) ecosystem services should be evaluated in manner that involves the fair treatment of competing social groups as a basis for social equity perspective. Since water supply in Accra is from two plants, Weija and Kpone, administration of questionnaires focused on areas that receive water from the Weija plant. Malam, Dansoman around about, Bubiashie and Gbawe MaCarthy Hills are the communities chosen for the administrations of questionnaires based on condition of water supply were randomly selected from the good, rationed, intermediate and poor or no water conditions respectively. The survey used willingness to pay (WTP) as an indicator of values respondents attach to watershed services. The WTP questions included the demographic, environmental perception, water characteristics and payment arrangement.

3.4.2. Supply Condition Areas

Water supply in the study area has been grouped based on the condition of supply as described by the water company. The condition of supply relate to the frequency or regularity of water supply from the Weija plant to households. Questionnaires were administered to respondents in the various groupings. It has to be noted that the Weija plant was designed for a certain number of people with a certain capacity. Increasing population and other human activities all affect pressure and capacity to supply water to various areas. As a result, water supply has been grouped into various conditions namely,

good, rationed, intermediate and poor or no water supply. For the good supply condition areas, water is received almost everyday uninterrupted when there are no technical hitches or power outages. The rationed areas receive water once, twice, thrice etc times per week as valves are closed and opened at certain times by the water company in for instance good areas so as to be able to build up pressure high enough to supply those areas. Water supply to areas designated as intermediate is received at certain times of the day and night usually late into the night when the demand and pressure on water is low to sustain flow at those times. With regards to poor or no water supply areas, it is important to note that there may be pipe network available in those areas which may even be in good condition but residents can still not have regular or no water supply. Since the survey was conducted within a sample of selected communities representing the whole study area, the design tried to ensured applicability and transferability of WTP from selected regions to the whole study area.

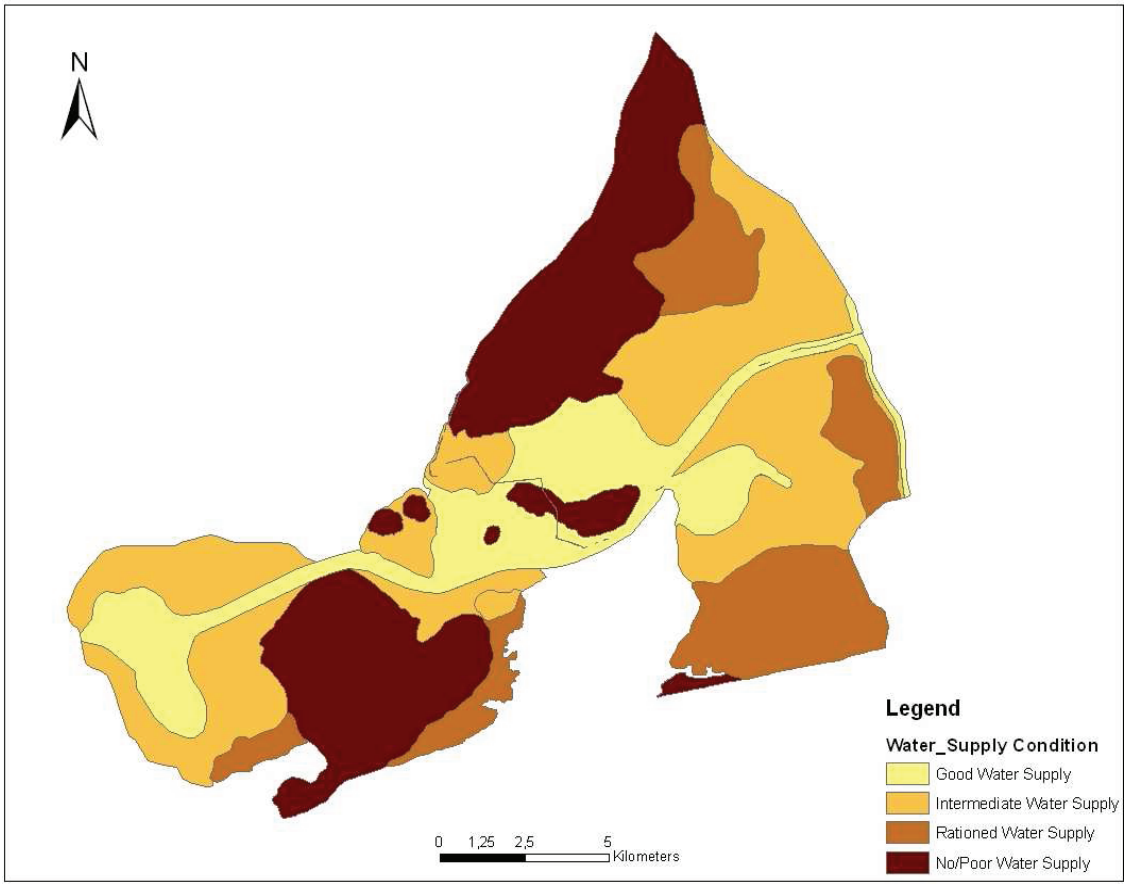


Figure 3-2: Supply condition map

3.4.3. WTP Elicitation Scenario

Three classified land use/cover change images for 1990, 2000 and 2007 showing extensive modification of the original ecology of the Weija were shown to respondents

Scenario 1 If the status quo, which is current rate of land use change, is maintained

Scenario 2 If a hypothetical conservation project is put in place to help mitigate and sustain water provision

3.4.4. Data quality and analysis

When using valuation data in developing a payment scheme, users also need to be watchful for potential biases in estimated values. Following Pearce et al., (2002) non-valid willingness-to-pay results were removed from the dataset. Non-valid responses are those where the valuation scenario is incorrectly completed, purposefully not answered or where a genuine WTP is not provided (for example "protest bids"). Ninety eight (98) questionnaires were returned. Nine (9) respondents out of the number rejected to commit to willingness to pay and they were asked to explain their choices. Responses are excluded when interviewer lack confidence in the genuineness of respondent's answers (Hadker, Sharma et al. 1997).

Contingent valuation survey data from the field was uploaded into SPSS for statistical analysis. Statistical analysis was conducted in descriptive statistics and regression methods. Econometric analysis was then undertaken to evaluate the effect of income and behavioural and demographic variables on WTP. The purpose of such analysis is to ascertain that WTP conforms to economic theory which informs assessment as to the reliability of the study (Pearce, Özdemiroglu et al. 2002).

4. Results

4.1. Land use / cover types for the period 1990 – 2007

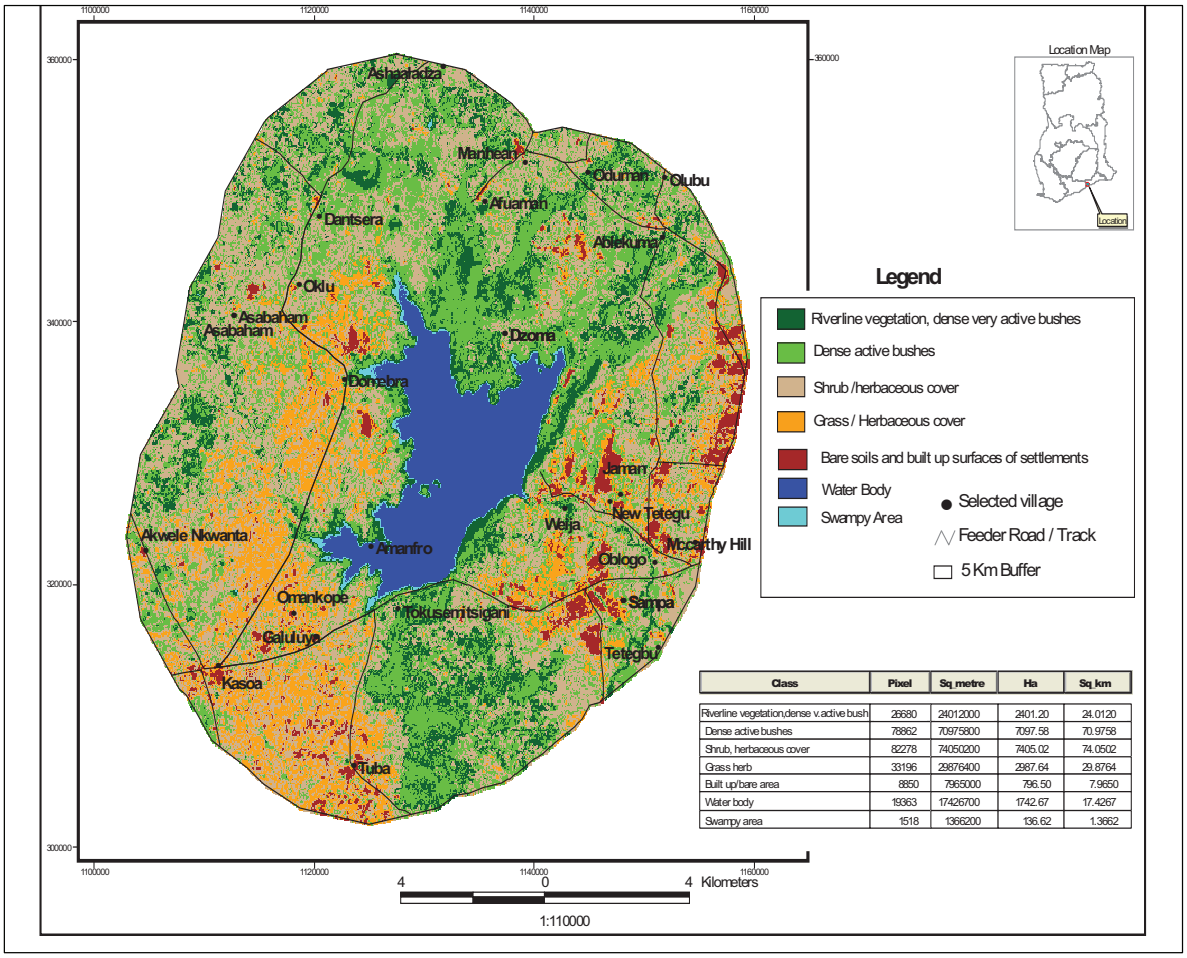
The output of the unsupervised classification is land use maps with different covers for the period 1990 – 2007. The images were differenced to indicate changes that have taken place in the area over the period giving an indication as to which use has increased or decreased and at what extent.

Table 4-1: Description of main land use / cover types in the study area

Land cover	Description
Riverline vegetation	very active dense shrub vegetation with scattered trees along water bodies, which looks greenish even in the dry season due to the moisture content
Dense active bushes	thick mat of vegetation, much closed fresh greenish bushes
Shrub Herbaceous cover	is a mixture of shrub (smaller plants) and herbs
Grass herbs	a mixture of all forms of grasses and sparsely distributed herbs
Built up / bare areas	areas with intense infrastructural developments and exposed surfaces due to human activities or natural factors
Water body	rivers, streams, lagoons and lakes
Swampy areas	marshy or areas liable to flood

4.2. Classification accuracy assessment

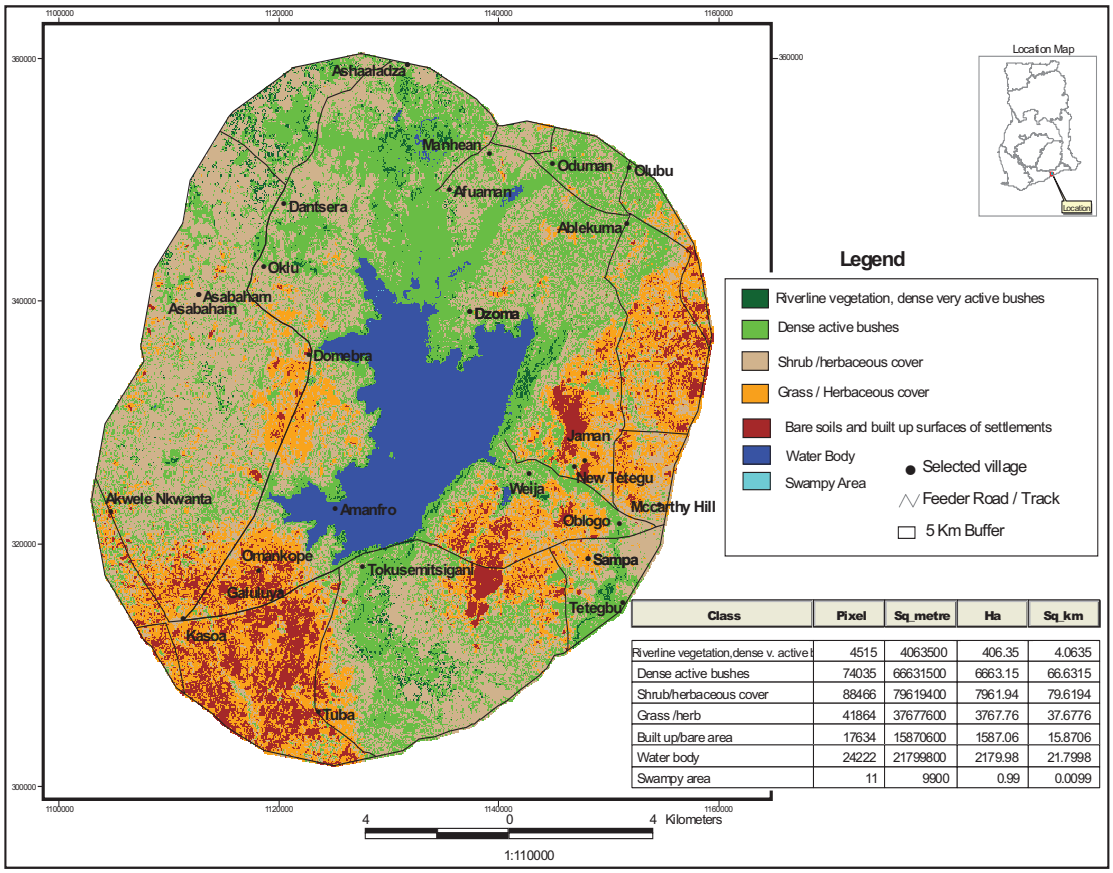
The overall land cover classification accuracy of the Landsat images was 82.86. The results generally suggest good conformity between the classification and the actual land cover categories with few misclassifications of pixels occurring in few of the categories. The accuracy level though not within the 85% and 90% classification accuracy standards used by (Campbell 2002) and (Lins and Kleckner 1996) respectively, is judged as an acceptable level of accuracy for the purpose of the study given that the maximum likelihood (0.82) is approaching 1 considered as true. The classification accuracy of the 1990 and 2000 images could not be statistically assessed due to unavailability of reference data. However, views gathered from the local people on the historical land cover of the study area coupled with information derived from “unchanged” areas in the ETM+ 2007 and TM, 1990 and 2000 images helped in the estimation of the classification accuracy. The result from image classification is indicated in figures 4-1, 2 and 3 below;



Class	Pixel	Sq_metre	Ha	Sq_km
Riverline vegetation,dense v.active bush	26680	24012000	2401.20	24.0120
Dense active bushes	78862	70975800	7097.58	70.9758
Shrub, herbaceous cover	82278	74050200	7405.02	74.0502
Grass herb	33196	29876400	2987.64	29.8764
Built up/bare area	8850	7965000	796.50	7.9650
Water body	19363	17426700	1742.67	17.4267
Swampy area	1518	1366200	136.62	1.3662

Figure 4-1: land use cover map 1990

In 1990, the shrub herbaceous, dense active bushes, and grass herbaceous formed the major land use cover covering 32.8%, 31.5% and 13.2% of the area respectively as indicated in figure 4-1 above covering the northern and southern parts of the Weija. It was followed by riverline vegetation (10.6%), waterbody (7.7%), built up area (3.5%) and swampy area (0.61%).



Class	Pixel	Sq_metre	Ha	Sq_km
Riverline vegetation,dense v. active b	4515	4063500	406.35	4.0635
Dense active bushes	74035	66631500	6663.15	66.6315
Shrub/herbaceous cover	88466	79619400	7961.94	79.6194
Grass /herb	41864	37677600	3767.76	37.6776
Built up/bare area	17634	15870600	1587.06	15.8706
Water body	24222	21799800	2179.98	21.7998
Swampy area	11	9900	0.99	0.0099

Figure 4-2: Land use cover map for 2000

In 2000, shrub herbaceous, grass herbaceous and built up cover areas increased to 35.3%, 16.7% and 7% respectively. However, dense active bush, riverline vegetation and swampy cover areas reduced greatly to 29.5%, 1.8% and 0.0%. The built up area covered the south-western part and eastern part but still with dense vegetation occupying most part of the northern part at a decreasing rate, see figure 4-2 above.

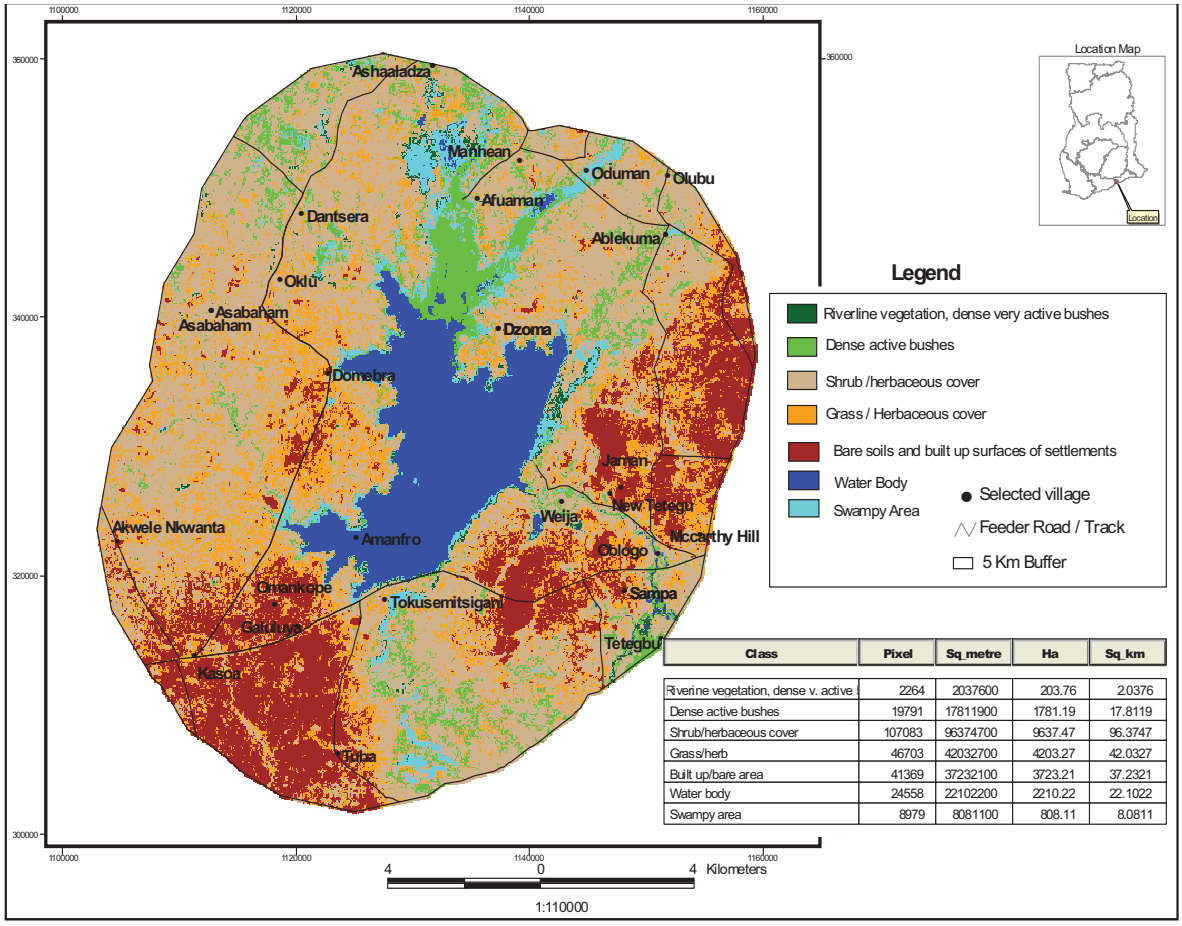


Figure 4-3: land use cover map for 2007

In 2007, the area experienced considerable changes in land use, shrub, grass, built up and water body formed the major land use changes occupying 42%, 18%, 16% and 9.8% respectively. Changes in the built up area in 2007 was dominant with most changes occurring in the eastern, south western and gradually covering greater part of the area along major roads. Also, the swampy area increased in the northern and southern parts along the outlet into the sea as indicated in figure 4-3 above.

Table 4-2: Land cover matrix

Class Name	1990		2000		2007	
	ha	%	ha	%	ha	%
Riverline vegetation	2401.21	10.64	406.35	1.80	203.76	0.90
Dense active bushes	7097.61	31.45	6663.18	29.53	1781.20	7.89
Shrub, herbaceous cover	7405.05	32.81	7961.98	35.28	9637.51	42.71
Grass herbaceous cover	2987.65	13.24	3767.78	16.70	4203.29	18.63
Built up/bare area	796.50	3.53	1587.07	7.03	3723.23	16.50
Water body	1742.68	7.72	2179.99	9.66	2210.23	9.79
Swampy area	136.62	0.61	0.99	0.00	808.11	3.58
Total Area	22567.33	100	22567.33	100	22567.33	100

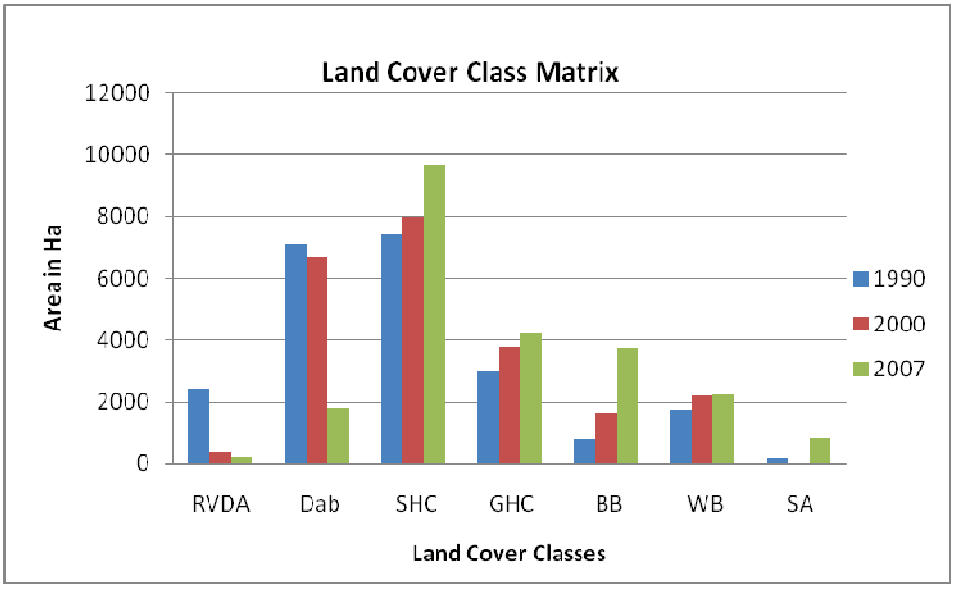


Figure 4-4: Land use/cover class matrix in 1990 – 2007

Table 4-3: Land cover change matrix

Land Cover Change Matrix				% Change		
Class Name	2000-1990	2007-2000	2007-1990	2000-1990	2007-2000	2007-1990
Riverline vegetation	-1994.86	-202.59	-2197.45	-8.84	-0.01	-9.74
Dense active bushes	-434.43	-4881.98	-5316.41	-1.93	-0.22	-23.56
Shrub, herbaceous cover	556.92	1675.54	2232.46	2.47	0.07	9.89
Grass herbaceous cover	780.12	435.51	1215.64	3.46	0.02	5.39
Built up/bare area	790.56	2136.16	2926.72	3.50	0.09	12.97
Water body	437.31	30.24	467.55	1.94	0.00	2.07
Swampy area	-135.63	807.12	671.49	-0.60	0.04	2.98

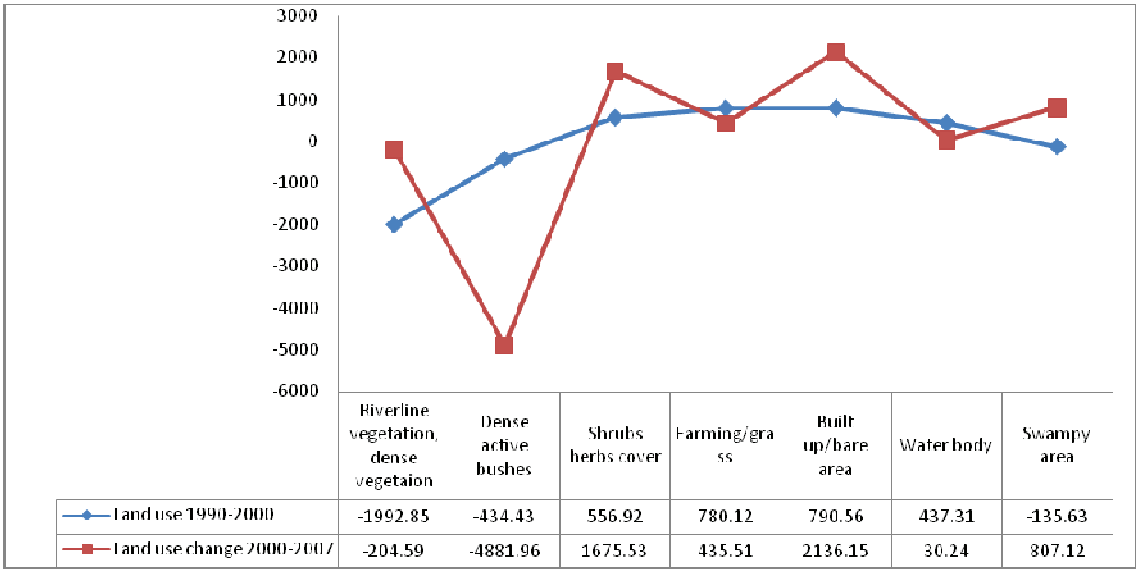


Figure 4-5: Land cover change matrix

4.3. Discussion

Throughout the years of study, shrub cover occupied larger portion of the study area and especially distributed across the landscape. However, its extent increased over ten percent of the total area from 1990 to 2007 indicating level of human interventions. The settlement areas expanded from nearly 4% to 17% of the total area, which occurred mostly on the north-east and south-west fringes of the Weija. This could be as a result of the development pressures being experienced in the study area. A total of 2197.5ha of riverline vegetation was lost from 1990 to 2000. By 2000, 1994.9ha riverine vegetation areas had been lost and subsequently by 202ha. The persistent loss of riverline vegetation across the landscape manifested the measure of threats human activities pose to the Weija Catchments area as shown in table 3 and figure 10 below. On the other hand grass areas expanded consistently over the period though marginal.

The bigger picture is that profound development and ecological pressures is being exerted from upper stream close to the city and thereby impacting negatively on the natural purification functions of the rivers feeding the catchments. With the expansion of grass areas across the landscape forest cover loss is likely to be rife if management interventions are not fashioned and implemented to safeguard the catchments. Each category of land use/cover over the years is associated with a number of environmental consequences and their actions together have been identified to be pervasive because of the significant effects they have on the earth's system functioning such as changes in the atmospheric composition and extensive modification of the ecosystem (Lambin, Turner et al. 2001). Sela, (2000) also found that changes in land use/cover directly impact on biotic diversity world wide. The loss of riverine vegetation seems to be principally driven by human-sanctioned activities especially areas where physical and socio-economic factors are such heavily influence demand for lands. The development direction from the city as manifested in the NE-SW direction of the Weija is the accurate reflection of the intensity of demand for land-based businesses in the area. There has been conversion and utilization of natural vegetation around river basins to other uses. Land use changes and conversion around the Weija was done to see the extent of changes in various land uses and its impact on water provision, though no chemical or other analysis were undertaken.

The study shows that the various human centred activities by the inhabitants in the area have adversely reduced the vegetation cover around the Weija reservoir. The situation also confirms to an extent, a measure of the lack of implementation of land and building-related laws which are meant to shape physical planning and development of the catchments area. The complete and permanent conversions of natural vegetation to built up and bare land areas wit grass is observed close to already constructed settlements and along roads and this is confirmed by the land use / cover changes pattern recognised by (Lambin, Geist et al. 2003) and (Braimoh 2006) in Ghana and emphasised by Konarska et al., (2002) that associated land use/cover types with specific ecosystem services and noted ecosystem value include the aggregate sum of use and non-use ecosystem services provided by specific land use/cover types at different spatial scales of measurement which is a useful for the valuation of watershed service based on the elicitation scenario of land use/cover change over the years is however useful for the study area.

5. Feasibility Assessment of PES for Watershed Services

5.1. Introduction

The section looks at the basic concepts of PES and the rational for establishing PES scheme for watershed services in Weija. It identifies institutional framework and potential intermediaries that could enable the design of a PES scheme for watershed for Weija catchments in Ghana. A background analysis of the case study area and stakeholder analysis were undertaken to give an idea of potential buyers, sellers, as well as the situation of existing natural and water resources management conditions in the country. The stakeholder analysis discussed features of various actors and their roles in relation to the design of a local watershed PES scheme for Weija. There was also an overview of the institutional arrangements, activities, payment scheme and financing mechanism in place that could enable the design of PES scheme for watershed.

5.2. Need or Importance for Watershed Services

There has been increasing recognition of the contribution of watershed services to water security and the need to invest in the maintenance of watershed services. Payment for environmental services aims at influencing and regulating the activities of landowners through policy framework that seeks to build capacity and enhance local support to participate in resource management through financial incentives. Water supplies need to be secured for specific uses such as drinking water, agriculture, industry; transport or downstream ecosystems. The Economic and Social Council of the UN noted that "The human right to water entitles everyone to sufficient, safe, physically accessible and affordable water for personal and domestic uses." (UN 2002). However, without investments, specific watershed services that are beneficial to downstream users are likely to be degraded. It is believed that without monetary compensation, deforestation would continue in private lands because private decisions to convert forests fail to account for the value of the services that those forests provide to others (Chomitz, Brenes et al. 1998). Also, at the Dublin Conference on Water and Sustainable Development" it was stated that: "*Water has an economic value in all its competing uses and should be recognized as an economic good.* "The Dublin principles further states that:" *Past failure to recognize the economic value of water has led to wasteful and environmentally damaging uses of the resource. Managing water as an economic good is an important way of achieving efficient and equitable use and of encouraging conservation of water resources"*.

The improved management of the upper watershed for the maintenance of water services is a strategy implemented in several countries in Latin America and the Caribbean, including Brazil, Colombia, Costa Rica, the Dominican Republic, Ecuador, Honduras and Panama (World Bank and WWF 2003). In the Cauca Valley in Colombia, farmer associations initiated a PES system to address concerns regarding the sustainable supply of water for irrigation (Landell-Mills and Porras 2002). Markets for environmental services can arise from policy-related or regulatory drivers where new regulations, user fees or fiscal incentives may be introduced to create a new set of incentives that will drive the development of a market for environmental services. A PES scheme, can involve the combination of

one or more services brought together and a market formed for the bundled service (Mayrand and Paquin 2004). (Kerr 2002) noted that one area that lends itself to both local community participation and incentive-based approaches is watershed management Markets for watershed protection usually involve the financing of land use practices generating watershed benefits and not trading commodities such as water quantity or quality, . Watershed-based services are usually funded through user fees to finance improved management of the protected area upstream (Pagiola 2003).

Difficulty in enforcing conservation measures, land use regulations or specific agricultural or forest management practiced by communities who depend on resource exploitation for their livelihood development of forest dependents brings about degradation of natural resources. PES provides the advantage of both environmental and economic benefits to create a condition to restore and manage ecosystems by which changes in behaviour and management choices of landowners can be facilitated through a series of positive incentives instead of threats of penalties that cause resentment amongst stakeholders. With the implementation of PES, local communities could be provided with technical support, advice and incentives to encourage them to participate in decision making and care for forest and water resources management through increased education and awareness by both government and private institutions. PES promotes the establishment of ecologically stable forest and protect watershed while guaranteeing the flow of environmental goods and services for the socio economic.

5.3. Bases for Designing PES for Watershed in Weija catchments

In developing a PES scheme it is important to define, measure and quantify the environmental services (carbon sequestration, watersheds, biodiversity conservation or landscape beauty) that are to be generated under the system. The key is to identify which services are needed, by which beneficiaries and at which level (Bishop and Landell-Mills 2002). A PES programme could have different objectives. Objectives of PES scheme range from restoring natural habitat or tree planting as in Piracicaba, Brazil, where funds from municipal water revenues are used to assist farmers to plant trees in riparian areas (Viana et al., 2002). It can be focused on restricting land use by maintaining existing natural habitats and protecting them from destruction, an example is in Ecuado, where farmers are paid to conserve primary forest, natural grassland and already disturbed forest and grassland (Echavarría, Vogel et al. 2004). Another area of interest for a PES scheme is in improving existing land use for example a reduction in the use of pesticide, reducing the rate of harvesting to one that is sustainable or soil conservation.

Payment schemes for environmental services (PES) are innovative instruments for natural resource management. However, incentives for maintaining the provision of ecosystem services (Pagiola, Agostini et al. 2004) include not only environmental but also issues on poverty and health, the background assessment, international case study comparison, and stakeholder analysis aimed at giving a more interrelated institutional feasibility outline for a local-level PES scheme. It seeks to bring together components on existing frameworks, guidelines, and criteria previously proposed by leaders in the field of PES some of which are already established whiles others are only just emerging to describe and prioritize factors relevant to PES implementation. PES scheme attempts to manage global and local investment with global climate goals and local forestry goal (Wunder and Alban 2005) and that given this existing situation a proper PES design must ensure that it delivers services contingent on payments based on a mutual and voluntary definition or use of the resource, is pro-poor

by reducing inequality in the negotiation phase or by ensuring additional financing to poverty-stricken sellers, and is realistic. These criteria are widely referenced, though they are not formally recognized, or even consistently demonstrated in PES schemes. In designing payment mechanism, the capacity of all stakeholders as well as the political, social and private sector context of the area must be considered. Forest Trends incorporates relevant conceptual design components, government involvement, and institutional support considerations (Waage, Jenkins et al. 2006). PES systems in Salvador for example focused on improvements in land use practices such as silvopastoral practices and agroforestry that generate environmental services while maintaining land under production.

With regards to payment mechanism, the Ecosystem Marketplace came up with three types of payment mechanisms applicable to a local PES scheme in the developing. These are direct public payments, direct private payments, and tax incentives Ecosystem Marketplace Matrix (2006)which have various degree of government's involvement. Additionally, the World Bank, ICRAF, and the Tyndall Centre among others are particularly concerned with the impact PES designs have on the poor; especially concerning equity and legitimacy of poor stakeholders (Mutunga and Samuel 2006). Some expects in the field see the involvement of stakeholders in PES schemes as a factor important and influential to the implementation process. A PES design therefore could include attractive corporate marketing and businesses to act as catalysts to convince and entice private sector in the use of PES to improve competitive advantage. Iftikhar et al., (2007) It has been suggested that institutional feasibility of a PES scheme should take into account the different actors, their inputs, and potential impacts. The (WWF 2006) noted that PES schemes must ensure that it produces both ecological and socio-economic outcomes not possible without the scheme.

Meanwhile, the circumstances for PES, considered below, appear to remain unchallenged by the literature and thus form a useful template for framing approaches to a local PES.
Landell-Mills and Porras (2002) proposed the following key steps to develop successful markets for environmental services which were adopted in this study.

1. Identify benefits provided by a specific service and by determination of (forestry) activities that deliver this service;
2. Undertake a feasibility study;
3. Establish payment mechanisms and supporting institutions
4. Formalize property rights
5. Establish willingness to pay;

The design and implementation of PES scheme for watershed recognizes the relationship between the condition of ecosystems in a watershed and its capacity to provide watershed services as fundamental to the concept of payments for watershed services. It establishes a basis for connecting the needs and wellbeing of downstream users of water to the actions of upstream managers responsible for upstream waterways, vegetation cover, and soil use and land management. Acknowledging benefits of watershed services to downstream water needs will help to influence upstream land use and management practices, thereby linking directly, the economic interests of downstream water users and water supply companies to upstream landowners. In this respect, stakeholders' commitment and respective contributions and support should be immensely valued in the whole process. Stakeholders have to understand and be able to appreciate the basic tenets of a PES scheme, what they stand to gain and or lose and the impact of the scheme on their total living condition and of course on ecosystem as a whole through watershed management practices.

5.4. Historical Overview of Water Provision in Ghana

The First piped water supply system in the country was constructed in Cape Coast in 1928 under the Water Supply Division of the then Public Works Department. The Department was responsible for water provision in both the urban and rural areas of the country. After the country's independence in 1957, the division was moved under the Ministry of Works and Housing and has been transformed to the Ghana Water and Sewerage Corporation (GWSC) responsible for the provision of water supply for public domestic and industrial purposes. Since, 1993, various reforms have were introduced to address the problems of the sector. This led to the separation of rural and urban water provision services, the introduction of independent regulatory agencies and the promotion of private sector participation. In 1999, the GWSC was replaced by the publicly owned Ghana Water Company Limited (GWCL). Urban water provision rested with the GWCL and water use charged through a fixed system or a pay-as-you-fetch system to date. The Community Water and Sanitation Division and later Community Water and Sanitation Agency founded in 1994 became fully responsible for rural water supply and responsibility of sanitation decentralized to the District Assemblies. Over the years, regulation and management of water resources in Ghana have been under various entities and has involved public, private and international organizations.

5.4.1. Problems in Water Resource Management over the Years

Urban water supply faced many problems such as lack of funds for investment coupled with increasing urban population in Ghana. Government made various attempts aimed at increasing efficiency in service delivery, however, the sector continued to face difficulties. The World Development Report, in its Project Appraisal Document indicated that approximately 10.3 million (51%) of Ghana's estimated population of 20 million people has access to an improved water resource (World Development Report 2004). In the urban areas, comprising about 8.4 million residents, only 61 % of the population have access to an improved water resource (World Bank Report 2004) while 34% have access to safe sanitation (DANIDA 2003). Even those connected to the piped water system frequently suffer from cut offs when the capacity to deliver fails

Though many institutions were involved in water provision in the country and the sector made substantial progress, water provision faced many problems including overlapping responsibilities and lack of coherence in policy formulation which resulted in a multitude of implementation strategies. Each sector agency planned, controlled and regulated its own activities with respect to water management with little effort towards coordinated initiatives. Additionally, the sustainability of livelihoods of some of the poorest communities appeared to be threatened by the poor exploration practices of natural resources, especially water and forests. Poor enforcement of regulations on natural resource utilization, inefficient management of forest resources and the dependence on fuel wood by the poor have been cited as the major causes of loss of Ghana's natural resource. The Ghana Water Sector Restructuring Secretariat also noted that in the urban areas close to 50% of water produced was lost through leakage and illegal connection. These were enough disincentives for efficient and effective operation of water delivery. Lack of funding in the sector coupled with low water levels of water tariffs also resulted in low investment and operational activities of the company. The water company was not able to function well which affected water supply to the people.

Government realized the need for strong political commitment, stakeholder ownership, as well as strong support for initiatives and initiated institutional and policy framework measures in conjunction with international and local bodies with respect to water resource management.

5.5. Policy Framework and PES Feasibility

In setting up PES schemes, it is essential to assess the existing regulatory and fiscal environment. This is important to make sure that even if newly created system are established, they do not run into regulatory or fiscal hurdles that would affect its development or positive impacts. Policy reforms can be instrumental in the development of PES schemes. Reforms may be necessary to undertake regulatory and fiscal reforms to remove existing policy distortions and counter-incentives to conservation or sustainable land uses in the creation of a PES scheme. In Costa Rica for example the Forest Law specifically recognized four types of environmental services: carbon sequestration, biodiversity conservation services, hydrological services, scenic beauty and ecotourism However, a new fuel tax to finance forest conservation, established Fonafifo to raise funds and manage the PES scheme (Pagiola 2002).

The Ghana's Poverty Reduction Strategy (GPRS 2003) acknowledged the role water and sanitation play in the well being of Ghanaians. The GPRS focuses on improving access in rural, peri-urban and poor urban areas and emphasizes restructuring of the urban water sector to improve management and attract investment. This focused on institutional re-strengthening for service delivery and regulation with respect to water provision to promote and sustain water and forest resource management in the country. It also aimed at placing emphasis on stakeholder participation in an effort to efficiently manage natural resource by looking at the commitment of local communities and the benefits to be derived from whatever scheme put in place. Policy goals for water and natural resource management has had wider range of policy framework for sustainable environmental resource management and poverty reduction seen as essential and consistent with wider theory on environment, poverty and development (Bucknall, Kraus et al. 2000). PES could lead to more sustainable outcomes by generating a continuous flow of payments while conserving the environment.

The water resources management part of Ghana's National Water Policy is guided by the vision of achieving an efficient and effective management system for the sustainable development of water resources to assure full socio-economic benefits for present and future generations. It also recognises as vital the involvement of other organizations and ministries in water resource management and thus the adoption of cross-sectoral river basin decentralized approach to water resources management in the country. It seeks to bring together all water users including water managers and practitioners, decision makers, policy makers, NGOs and international organizations. The adoption of Integrated Water Resources Management (IWRM) in the management and regulation of the nation's water resources for example (including shared resources with her riparian neighbours), aims at promoting a change from unsustainable to sustainable water resource management thereby widening the analytic framework and the involvement of all stakeholders to participate in the management of water resources. It comprises representatives of all main stakeholder groups and sectors involved in water resources, i.e. hydrological services, water supply, irrigation development, water research, environmental protection, forestry, minerals, customary authorities, the NGO community and women interests with the Secretariat - the technical arm of the Commission responsible for implementing the

decisions of the WRC. The approach of involving private and other actors who play key roles a PES scheme could be directly established with support from government with the responsibility for coordinating and monitoring PES programmes and activities.

Planning systems were also decentralized to allow decisions to be made in consultation with those closer or most likely to be affected in resource management in general. As a result, water provision for the country was divided into urban and rural supply sectors. Urban water supply became the responsibility of the Ghana Water Company Limited whereas the Community Water and Sanitation Agency (CWSA) were established to administer and manage rural water supply and sanitation. The government as part of its water sector reforms established regulatory bodies. These are the Water Resources Commission (WRC), Public Utilities Regulatory Commission (PURC) and the Environmental Protection Agency (EPA). They were established to be responsible for the overall resource management, utility tariff regulation and the environmental concerns. The restructuring process aimed at ensuring the involvement and commitment of all stakeholders for sustainable improvement in water provision and natural resources supply in the country could form a base for a local PES scheme.

5.5.1. Regulation of utility

The PURC was established to "*regulate and oversee the provision of utility services by public utilities to consumers and to provide for related matters (PURC, 1997)"*. It is regulates the operations of utility company and takes responsibility for the economic regulation of urban water supply in Ghana. Legislative Instruments which gives the PURC its mandate include;

- the Energy Commission's Act 1997 (Act 541)
- The Public Utilities (Termination of Service) Regulations 1999, LI 1651
- Public Utilities (Complaints Procedure) regulations 1999, LI 1651

5.5.2. Environmental Regulation

Established by the EPA Act 1994, Act 490, the Environmental Protection Agency (EPA) is responsible for advising government on all aspect of environmental policies and with the implementation of the National Environmental Action Plan. The main objective of the plan is to improve the surroundings, living condition and enhance the quality of life of all Ghanaians by reconciling economic development, natural resource conservation and enhance sustainable use of natural resources in Ghana. The Agency could also draw attention to innovative partnerships and transfer mechanisms that may be adopted to control water pollution and wastage discharge into water bodies by incorporating watershed management and protection as an integral part of its strategies. The Environmental Impact Assessment (EIA Regulations, 1999) is aimed at ensuring the promotion of the integration of environmental and social issues in screening, monitoring and the implementation of measures.

5.5.3. The Nation Land Policy

In 1999, the National Land Policy was enacted as a guide for the general land management in the country. This brings to bare the fact in the management of forest and water resources for sustainable provision of environmental service, differences with regards to the property rights of producers need to be clarified. So that payment and compensation arrangements allow for benefit streams to be derived by both stools and farmers who would actually be engaged to practice one form of

conservation activity or the other. The aim of the policy is to ensure judicious use of the nation's land as well as its natural resources for the socio economic benefit of the Ghanaian populace while promoting sustainable resource management principles, and in the maintenance of viable ecosystems. The 1999 Land Policy sought to provide the necessary framework for the sustainable, equitable and environmentally stable utilization of the country's natural and land resources. The document aims to bring about economic development, reduce poverty, promote social stability by improving security of tenure, and simplifying the process of accessing land which would make it fair, transparent and efficient to develop an efficient land market.

5.5.4. Water Resource Management Intervention

In view of the problems faced in the provision of water, government's intervention in water resource management started with institutional reforms. As part of the water sector reform three new regulatory bodies were established; the Environmental Protection Agency (EPA), Public Utilities Regulatory Commission (PURC) and Water Resources Commission (WRC). Those agencies were formed to be in charge of environmental, tariff and overall resource management issues respectively. By an Act of Parliament (Act 522 of 1996), the Water Resources Commission was established by government in 1999 to pave way for private sector involvement in the water sector has the over all responsibility for water resources management in Ghana. The Commission has the mandate to regulate and manage the country's water resources and co-ordinate government policies in relation to them. It's provides a forum for integration and collaboration of different interests and is composed of major stakeholders involved in the water sector. Individuals, institutions, NGO's, agencies and authorities are required to apply for and be granted a permit to use water for any purpose by the Water Resource Commission before engaging in its utilization and use. Section 2 (2) of the Act, spells out the responsibilities of WRC as:

- Processing of water rights and permits;
- Planning for water resources development and management with river basins (catchments) as the natural units of planning
- Collating, storing and disseminating data and information on water resources in Ghana;
- Monitoring and assessing activities and programmes for the utilisation and conservation of water resources.

The 1992 Constitution of Ghana enabled the Commission to initiate actions on the enactment of the country's National Water Policy in 2002 to bring about an integrated approach to water resource management. The document focused on formulating a comprehensive sector policy which included all relevant actors in the sector and made it easier for development partners to provide necessary support to the sector. The policy framework for the National Water Policy was based on the Ghana Poverty Reduction Strategy, the Millennium Development Goals (MDG) targets and the Government's coordination with donor assistance (Water-Aid Ghana, 2005). With a focus on water resource management, urban water supply and community water and sanitation, the National Water Policy sought to provide a framework for the development of Ghana's water resources. The NWP aimed to enhance the importance of water resource management and the need for coordinated institutional as well as stakeholder involvement for sustained water provision. It considered the need for sustainable utilization of natural resources and enhance livelihood of poor communities depending on land and natural resources through the enforcement of regulations on natural resource utilization and inefficient management of forest resources seen as the major causes of loss of country's natural resource and for

that matter water provision. The water resources management part of the National Water Policy is guided by the vision of achieving an efficient and effective management system for the sustainable development of water resources in Ghana, to assure full socio-economic benefits for present and future generations. The underlying principles of the NWP include;

- The fact that it's the fundamental rights of all people to safe and adequate water to meet basic human needs.
- Recognition of water as a finite and vulnerable resource given its multiple uses.
- Integrating water resources management and development with environmental management in order to ensure the sustainability of water resources in both quantity and quality.

5.5.5. Forest Resource Policy Intervention

The natural resources of the country also play an important role and contribution to the country's gross domestic production as well as livelihood and sustenance of the populace especially rural communities in Ghana. Forestry Sector of Ghana provides 43% of Gross Domestic Product, 50% of export earnings and 70% of total employment (Agyarko 2001). (Agyarko 2001) also mentioned that the forest offers a conducive microclimatic condition for the production of the country's cash crops, namely cocoa and coffee; main watersheds and rivers which serve as source of drinking water directly for rural areas and indirectly for urban centres. According to Amanor (2000), legislation to conserve forest resources has included direct ban of specific activities e.g. ban against chainsaw activities, ban against the export of round logs and the use of chain sawn timber.

Government's on-going strategy to address challenges in natural resource management is embodied largely in the National Environmental Action Plan (1990-2000), the 1994 Forest and Wildlife Policy, the Forestry Development Master Plan (1996-2000), the 1999 National Land Policy, the Science and Technology Policy (2000), and the Action Plan for Science and Technology Management. The Forest and Wildlife Policy of Ghana aims at conservation and sustainable development of the nation's forest and wildlife resources for maintenance of environmentally quality and perpetual flow of optimum benefits to all segments of society. Legislations such as the Timber Resources Management Act of 1997 aimed at consolidating and replacing existing forestry legislation was introduced with establishment of the Timber Utilization Contract (TUC), which require a Social Responsibility Agreement with local landowners and traditional authorities to help mitigate the forest and environmental impacts associated with timber resource utilization. The mechanism stresses on the need to give farmers some form of rewards or incentives which is an important basis for PES design. The forestry policy recognises the need to extend benefits to forest fringe communities and other stakeholders. Upstream farmers could be encouraged to adopt sound management of the watersheds to maintain the provision of environmental benefits with a mechanism to enhance their livelihoods through the payment of financial incentives and rewards under a PES scheme.

5.6. Drivers of Environmental Service Change

Meyer and Turner II categorized the main driving forces of land use changes into technological capacity, socio economic organization, level of development and culture. Negative contribution of increasing population growth to the pressure on natural resources has been noted by most literatures (Meyer and Turner II, 1992; (Lambin and Ehrlich 1997; Wright 2005; Verburg, Overmars et al. 2006). Lambin et al., (2003) also noted that these changes have significant short and long term impacts on

the functions of physical, chemicals and biological components of earth. A study by (Muñoz-Piñaa, Alejandro Guevarab et al. 2005) showed that the main correlates for deforestation in Mexico were proximity to cities and rural population centres, low slope, and soils 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, slush and burn agriculture, mining and quarry, fuel wood collection coupled with wildfires, illegal occupation and conversion to other land uses (OTTO 2006) are drivers which have impacted on the ability of forest to supply environmental services.

Figure 5-1: Quarry and construction activities around Weija catchments

(Wagner and Cobbinah 1993) also stated that Ghana's tropical forest which support vital economic and ecological functions, as well as provide commercial trade and employment opportunities face an ever-increasing set of pressures resulting in the loss of forest and associated biodiversity throughout most of the forest areas. These human activities within and around river basins are drivers which have greatly changed demography producing severe effects on water and natural resources ability to provide environmental services. Barraclough and Ghimire, (2000) observed that the process of forest destruction through increasing agricultural output to meet subsistence needs done by the local farmers is known to cause about 50% of deforestation in tropical forests. Communities and households with very limited sources of income, food, and energy naturally clear more forests to meet these basic requirements. The combined effects of these activities have resulted in a decline of the Ghana's tropical high forest from 8.2 million hectares at the beginning of the 20th century to 1.7 million hectares (Friends of the Earth International, 1999) with an estimated annual forest cover change of 120,000 hectares between 1990 and 2000 (FAO 2001).

Generally, there has been rising rural and urban population growth in Ghana. The population of Ghana was estimated to be 21.8 million in 2005 with an annual population growth rate of 2.17 % (UN 2005). The growing population of both people and animals and urbanisation have all contributed to the deteriorating nature of natural resources putting the continued supply of the resources on a sustained basis under constant threat. In addition, Heilig, (1994) mentioned unprecedented increase in population as a driving force in this change. Government acquisitions over the years for various infrastructural and developmental purposes have also had diverse effects on water and natural resources. These coupled with lack of government policies and appropriate institutional structures to

sustain resource have contributed to increasing degradation and destruction due to over exploitation. Increasing need for money, energy, food, and forest products increase with increasing household members, households either increase the output of land currently under cultivation, or increase the cultivated area. Kosoy et al., (2007) noted that an effective means to control non-point source pollution, resulting from aggregated individual actions carried out by geographically contiguous and homogenous agents therefore present a solution to frequently widespread watershed degradation.

5.7. Upstream Service Providers and Their Activities

Watershed management is socially important because we are very dependent upon having a clean, well-functioning watershed where we live. Upstream landowners make decisions that affect the environment and human health. Increasing population has resulted in an equally increased pressure on forest land for construction and farming with increased forest clearance and in some cases permanent nutrient lost. The main occupation of the people upstream and along the Densu is agriculture and this engages about 40% of the economically active population of the communities. Most communities use the River Densu for their domestic, recreational, farming, fish farming and the washing of vehicles. The local people depend on their farming practices and forest products for their subsistence. Agricultural practices systems include shifting cultivation and slash-and-burn field preparation within individual holdings. Farmers use fertilizer and chemicals for the cultivation of their vegetables and cocoa especially farming on water courses. Farming is also done on arable lands close to the banks of the river. These activities make a difference to downstream water quality, quantity and flow regime. With this practice, they cultivate both shifting plots of short –long term crops leading to the destruction of forest tree species and associated biodiversity. Kosoy et al., (2007) indicate that other land uses can also deliver improved water services, for example “no burning before, during or after planting, construction of vegetal fences, irrigation ditches and fence and implementation of organic agriculture”. Literature focusing on watershed degradation is primarily focused on the positive externalities delivered by forests to downstream beneficiaries ((Powell, White et al. 2002; Pagiola, Agostini et al. 2004).

Communities and households with very limited sources of income, food, and energy, would naturally clear more forests to meet those basic requirements. Due to lack of knowledge on how to improve existing farming systems more forest land is cleared as cultivated land losses its fertility. also reiterated the fact that specific land use practices rather than the generation of specific and quantifiable levels of water services is crucial thereby reinforcing the importance of upstream farming activities on watershed service production. The flow into Weija is directly influenced by activities such as alternative land uses, such as those highlighted by (Kosoy, Martinez-Tuna et al. 2007). These activities inhibit the ability of the forest to enhance the provision of environmental services such as water provision and the ability of the soil to absorb, vegetation filtration potential, water flow rates, and weather buffering capacity of the wetland and for that matter water quality and flow seen as the most valuable of hydrological services of forests. With agriculture constituting greater part of household’s income in the rural areas, poverty, lack of alternative rural wage employment increasing population growth, and bad farming practices are some of the causes of deforestation.

5.8. Environmental Service Beneficiaries

Watershed-based services are usually funded through user fees to finance improved management of the protected area upstream (Pagiola S et al., 2003b). The service can be directly consumed, or indirectly through the household production function or as factor inputs in production (Aylward and Fernández González 1998; Lele 2006). Beneficiaries of environmental services are vital in watershed payment scheme because the willingness of a given group of beneficiaries to pay depends on the specific service they receive and on the value of that service compared with the cost of alternatives. Identifying potential buyers for watershed services is crucial to PES scheme negotiation. Some of the downstream water users who can be brought together in a PES scheme include such as irrigators, hydropower operators, municipalities, industries and nature conservationist

In the case of Weija water service, demand comes from both direct and indirect downstream users of water. The main indirect user or beneficiaries of water services would be the Ghana Water Company (GWCL) responsible for providing, distributing, and conserving water for domestic, public, and industrial purposes in the urban areas as well as all the other companies engaged by the GWCL in charge of meter installation, customer billing, and revenue collection engaged by the company could be seen as indirect users or provision. The direct users of watershed services in this case would include individuals or organised groups who depend on water for direct consumption and are directly affected by land management upstream. In the case of Weija, this included communities in the Greater Accra Region which receive water from the Weija. These communities are located within the Ga district and some part of the Accra Metropolitan Area and are categorized according to the degree or condition of water supply to these areas. Also firms and industries whose operations have the potential to damage the environment could be made to pay environmental taxes under PES.

5.9. Land tenure regime in Ghana

The Ghanaian land tenure system is pluralistic. Land law in Ghana has grown from a complex mix of constitutional and legislative sources, judicial decisions, and customary laws. Ghana's land rights and tenure systems result from the coexistence of these different systems in the regulation of such rights. In the process, customary law has been modified and regulated by statute, with common law and equitable principles grafted onto it. Statutory land arrangements have influenced tenure security in the country. Most of the land are controlled and managed by chiefs or family head through customary systems (Bentsi-Enchil 1975) and this has sustained the chieftaincy system in Ghana over the years. For the majority of the rural populations and majority of Ghanaians in general, decentralised customary land tenure systems are still the norm, though marked variations exist between north and south of Ghana. Customary land ownership recognises rights of the members of the land owning community to the community's common resources. Usage and control is based on customary rules of rights to land used for settlements, food and cash crop farming, or even rested as fallow lands. Communal rights were, and are still exercised over any grazing land and fishing grounds by community members ((Benneh 1975; Kasanga 2002).

Statutory land arrangements have influenced significantly tenure security in Ghana. A number of legislation and policies have been made in the past to initiate, encourage and improve registration of interest in land in Ghana in the hope that security of land holding would improve and subsequently increase agricultural productivity. The state has powers granted through legislations such as the

Administration of Lands Act, 1962, State Lands Act, 1962, the 1965 Public Conveyance Act among others. These allow the government to acquire and hold land in the interest or for public purposes. The 1992 Constitution however left the state's powers to acquire and hold land intact but are subject to constitutional limitations. The Article 36 (8) of the 1992 Constitution of Ghana recognises the concept of trusteeship in landholding thereby emphasising that those responsible for the management of land act in the interest of the wider communities. Registration of deeds started in 1843. This was coined into the Land Registry Ordinance of 1895, which was repealed in 1962 but re-enacted as the Land Registry Act, 1962 (Act 122). Under customary land tenure, four categories of interests can be identified under Land Title Registration Law, 1986, PNDCL 152. These are the allodial title, freehold title, leasehold title and lesser interests in land. Customary land tenure is characterised by its largely unwritten nature, and is based on local practices and norms, flexible, negotiable and location specific. Its principles stem from rights established through first clearance of land, or conquest. Customary systems are usually managed by a traditional authority such as a chief or a family head (Bentsi-Enchil 1975). As a natural resource, land must be managed on a sustained basis such that the needs of the present generation good housing, farmlands, forest reserves, water resources, minerals, etc. are met without compromising the ability of future generation to meet their own needs.

Powell et al., (2002) noted that approaches to property rights suggest that such rights are not the only precondition to PES design but that there should be an understanding of rights and their inter linkages with livelihood structures and natural resource management. The establishment of PES scheme requires that property rights are well defined, institutional hindrances removed and that there is clear modality for negotiations and involvement of stakeholders to ensure commitment and trust in the process by all concerned for natural resource management. Recognition of indigenous land management institutions by government will facilitate the ability of these indigenous institutions to play legitimate role in land administration without legal or political hindrance. This is needed to promote the effective functioning of these indigenous land institutions thereby increase access and security to land by all. There is need for a land market environment that creates certainty and security for tenures and land rights and for the enforcement of contracts. Land security is an important component in effective land management. Among other things secure rights in land can reduce the incidence of land disputes, increase land transactions, provide greater incentives for investment, and enhance the collateral value of land. It can also promote food security and protect the interests of land users with derived rights to land. Land registration system for either title or deed was aimed to ensure security of tenure or ownership. Unfortunately, not much gain were made under both systems of registration due to weak implementation, over-centralized nature, and the general lack of knowledge among Ghanaians of the possible benefits to be derived from registration with large amounts of land under customary tenure arrangements characterized by lack of documentation.

5.10. Role of Water Provision Stakeholders in Respect to PES

5.10.1. Institutional Arrangements

Water is a vital resource for human existence. Decisions regarding its use, allocation and management require the decisive support of principal decision makers. A survey of 61 watershed-based payment schemes conducted by (Landell-Mills and Porras 2002) found that markets for environmental services are more institutionalized and rely on the cooperative relationship between demand and supply rather

than on competition among service providers and beneficiaries. The establishment of PES requires that institutional hindrances are removed and there is clear modality for negotiations and involvement of stakeholders to ensure commitment and trust in the process by all concerned for natural resource management. The diagram below adopted and modified gives an illustration of how various stakeholders in this case could be organised for a PES scheme and implementation.

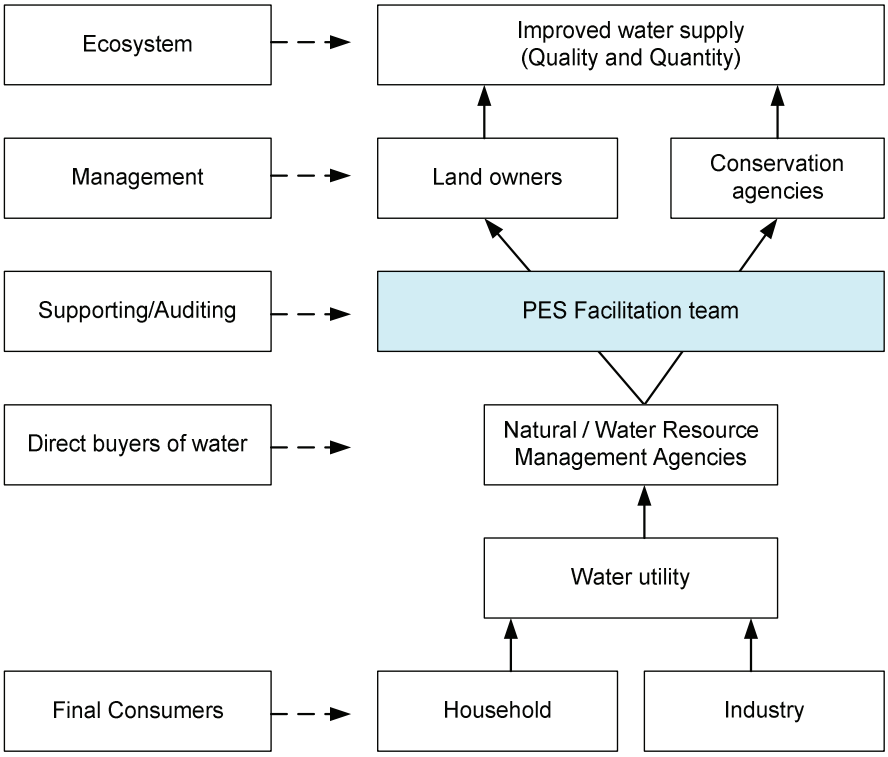


Figure 5-2: Potential design for watershed PES scheme; Adopted from South Africa's Working for Water program (Turpie et al., 2008)

Water sector policies for both rural and urban areas in Ghana are set by the Water Directorate within the Ministry of Water Resources, Works and Housing (MWRWH) whereas the. The Water Sector Restructuring Secretariat, created in 1997 in the Ministry of Water Resources, Works and Housing, oversees the process of private sector participation in the sector (Doe 2007). However, the mandate and roles played by the Water Resources Commission makes it the most likely institution to lead a watershed PES scheme in the country. The WRC authorized to control water resources in the country could play a lead role in a PES scheme for water services is chosen as the implementing agency for this program, and as such it is accountable to the policymakers to operationalize the policy that has been designed. Its role in integrated water resources management (IWRM) for example would allow for government scrutiny for institutional and policy framework required for PES.

Financial contributions from beneficiaries can take several forms, including charges and user fees. Charges and user fees are common in watershed-based PES schemes since water fees are usually in place for urban water utilities, hydroelectric producers or industries. They can be collected in the form of new user fees for water users or simply by using part of water utility revenues to fund the PES scheme (WWF 2006). The water company which has the responsibility to provide water and

responsible for billing and collecting of water fees to urban dwellers would be an indirect beneficiary in a local PES scheme for the protection of the Weija watershed. In this case, water users receiving water from the Weija are already known and organised with a payment mechanism in place. Existing water payment regime could be adopted for the design of PES financing for the water service by directly charging water users additional fee for conservation or it could be incorporated as part of the consumer's water fee for conservation purposes. This mechanism could be useful to facilitate the financial and payment mechanisms for PES scheme.

The WRC could be responsible for managing and disbursing funds to service providers for the provision of conservation activities. With the responsibility of regulating and controlling the use of water resources by granting water rights and water use permits as stipulated by the Water Use Regulations Legislative Instrument (LI 1692 of 2001) would be important. It is also important to identify potential free riders that could benefit from the provision of services without contributing in the PES system. This is important because, for most PES schemes for enhancing the provision of watershed services, willingness to pay is likely to be undermined by the de facto open access regime surrounding access to catchment's water (Becht and Harper 2002). With the degree of financial autonomy the WRC has, the issuance of water use permits to users could provide a means to financially sustain additional funds which could also be channelled into PES scheme activities for the management of water resources. This will ensure a stable and continuous flow of revenues that will ensure the long-term sustainability of the system. It will also enable the PES scheme to financially operate independently of external financial resources should they be part in the initial stages. Generally, legislations and policies on water resources would give a guarantee to those paying for watershed services that access and use by 'free riders' would be controlled or prevented as much as possible.

The Environmental Protection Agency as part of its role works with other institutions to promote soil and water conservation practices in both rain fed and irrigated agriculture production to meet health and environmental standards the of solid and liquid wastes disposal especially in water bodies to ensure they do not pose risk to the health and quality of human and aquatic life. This could be helpful in PES a scheme by strengthening the capacity of the farming communities to adopt environmentally-sound farming practices for instance where farming activities involve irrigation programmes along rivers that may cause deforestation of natural gallery forests on river banks, increase soil erosion due to land clearing, increase siltation of waterways which might affect the quality and provision of water resources for downstream ecosystems

The Ministry of Lands and Forestry is currently implementing a comprehensive ten-year sector investment programme, the Natural Resource Management Programme. The programme aims to protect, rehabilitate and sustainably manage the national land, forest and wildlife resources through collaborative management and aimed at increasing the incomes of rural communities who own these resources through enhanced community involvement in the management of forest and wildlife and savannah woodland resources and improve benefit flows to communities from resource sales; increased community and farmer adoption of improved land and water management techniques and improved management of wildlife while increasing their contribution to local livelihoods and economic development. The National Land Policy of 1999 also has in place regulatory framework structured to ensure that every socio-economic activities is consistent with sound land use through

sustainable land use planning in the long-term national interest. The Forestry Commission could then be responsible for coming out with farming activities and practices farmers could undertake in a PES scheme. Expertise of the Forestry Commission could be useful in the implementation and monitoring of activities of upstream local communities to ensure compliance. With the forest policies in place, the Forestry Commission through PES programs could be responsible for the implementation of policies on sustainable forestry with the conditional cash incentive for effective conservation and preservation of the forest in the long term. This will encourage and maintain good relationships with farming communities, guaranteeing the achievement and success of preserving water production through forest conservation. This would be useful especially where payment by beneficiaries will depend on service provision by mangers and hence need for effective mechanisms in place for implementation of practices, monitoring and enforcement of regulations with regards to upstream activities.

Additionally, the implementation of a PES scheme for watershed would also require the involvement Ministry of Water Resources, Works and Housing (MWRWH) responsible for monitoring, soliciting external funds and oversee the process of private sector participation in the sector. This could include the Ministries of Lands, forestry and Mines as well as Environment and Science responsible for land administration and the enforcement of environmental quality laws in Ghana. The involvement of the ministries will create an appropriate management institutional framework with participation from all relevant stakeholders of water and natural resources for effective design, implementation and monitoring of a PES scheme for watershed. The WRC has also devolved its functions to a decentralized level with the river basin as the geographical area of focus with the view to recover deteriorated ecology of river basins as a way to promote coordinated development and management of water, land and related resources, in order to maximize the economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems. There is a Board in place for IWRM programme for river basin which is responsible for coordinating the activities of institutions involved in the management of water and natural resources. Comprising of representatives from the District Assemblies, Ministries and agencies, NGO, s, Chiefs etc, an appropriate institutional framework is already in place which could thus be used to mobilize stakeholders and organize them for conserving nature and the ecosystem as a whole under a proposed PES scheme for watershed services.

5.10.2. Payment Mechanism

In PES programs for watershed protection, upstream land users (e.g., farmers) are paid by downstream water users for adopting land use practices (e.g., forest land uses) that limit deforestation, erosion, and flooding risks (Wunder 2006). Powell and White, (2001) developed a typology of financial incentive mechanisms to describe the wide variety of mechanisms in practice. This typology organizes the incentive mechanisms into three indicative categories, separated by the degree of government intervention in the administration of the mechanism. These three categories include self-organized private deals, trading schemes, and public payment schemes. In developing strategies to support sustainable agro-forestry practices that can maximize environmental benefits as well as economic benefits for poor communities, an appropriate financing platform in a PES scheme is essential for the generation of continuous flow of financial resources to fund payments over the long term required to financing various needs under a PES scheme. These may include cost of establishing the system (e.g.,

scientific research, creation of institutions, stakeholder consultations, training), payments to land users and ongoing management costs of the system (management, monitoring etc) (WWF 2006), Watershed-based services are usually funded through user fees to finance improved management of the protected area upstream (Pagiola 2003). A private scheme involves direct payment to service providers, the purchase of land or the sharing of costs among involved private parties. A cap-and-trade scheme establishes a cap for water abstraction or pollution and enables trading of permits among water users. With a certification or eco-labelling scheme, costs of services are included in the price paid for a traded product. Finally, public payment schemes, the most common schemes, involve public agencies and include user fees, land purchase and granting of rights to use land resources, as well as fiscal mechanisms based on taxes and subsidies.

Currently, urban dwellers in Ghana pay for water consumed through the issuance of water bills by the water company. Though rates differ for domestic and commercial uses, the amount payable as water bill per month is dependent of a household's consumption. Payments from beneficiaries could be collected in the form of user fees, voluntary payments, and charges or through negotiated arrangements between the financing mechanism and beneficiaries. PES design and implementation could thrive well on an arrangement which allows consumers to pay an extra amount in addition to the monthly payment to fund PES activities. Water Resources Management Account is a financial instrument into which proceeds from raw water abstraction charges and other related paid to WRC as per LI (1692) are lodged. Funds from the account are used for water resource management activities undertaken by WRC and this could be used for the lodgement of PES funds received by the water company as consumers PES contribution each month. Revenue collected from urban water consumers could help reduce dependence on external funding for water provision. In the case of Weija, direct payment could be made to upstream landowners to undertake management practices aimed at protecting water and natural resources as well as ensure sustainable water provision. The management practices could include land use practices or planting of vegetation cover that will conserve ecosystem.

5.10.3. Supporting Stakeholders

In watershed-based PES, the presence of watershed institutions can facilitate the setting-up of PES systems. Government institutions have a significant role but civil society and the market often drive PES. Evidence from developed countries suggests that market-based mechanisms, combined with civil society institutions, are best able to deliver the highest combined levels of efficiency and equity (Gouyon 2003). NGOs and community-based organisations can play an important role in this process through mediation with markets (Rosa, Barry et al. 2004) while Civil society organisations have also been involved in channelling and implementing functions. Supporting institutions in a PES scheme can be national, local, as well as international agencies with interests in financing of development or nature conservation issues. They initiate and implement PES scheme and set up supervisory mechanisms to ensure continuous flow of environmental service by negotiating conservation concession and direct payment to managers. (Maveneke 1998). (Rosa, Kandel et al. 2003) also noted that these institutions assume key functions in PES schemes, including scientific research, capacity building, technical assistance, certification, fund management, marketing, and linkages with national and international actors. Their involvement create an enabling environment to facilitate the involvement of stakeholders in water resource management at the local level, clearly establish roles

and responsibilities and integrate traditional knowledge of users in water management. For examples the FONAFIFO in Costa Rica though administers the national PES programme, it delegates, monitor and liaise at the local level with local groups such as FUNDECOR as part of management plan . Currently, the Water Resources Commission has established partnerships with a number of local and international organisations upon which PES deign could be built to facilitate the achievement of its objectives.

Local community associations and the Community Water and Sanitation Agency are enabled to contract external actors, such as private sector consultants or NGOs, to provide technical assistance, goods, or services (Water Aid, 205). (Komives, Akanbang et al. 2008) noted that rural communities and small towns form gender-balanced voluntary groups with support from private institutions. Other stakeholders could include the Friends of Rivers and Water Bodies and the Ghana Coalition of non-governmental organizations in Water and Sanitation (CONIWAS). These institutions could play vital roles in a local PES scheme for watershed by working in partnership with sector players to influence policies, remove barriers and promote access to potable water, sanitation and improved hygiene for the poor and vulnerable thereby giving NGOs one voice for advocacy and lobbying for major benefits for the rural poor and venerable through the adoption of positive management practices. Such an approach would help to improve decisions from both economic and environmental perceptive and also create a sense of community ownership and management, thereby contributing to the establishment and maintenance of improved water-supply systems through PES. Their direct contact with local farmers would help in monitoring intermediaries, support farmers in drafting management plans and prepare applications and obtain contracts for payments. They help in the establishment of structures for effective communication and negotiation among various actors, establish and influence policies, remove barriers and promote access to potable water, sanitation and improved hygiene the communities. They provide technical assistance, goods, or services to local communities as well as.

These institutions also act as brokers between service buyers and sellers to improve the process of negotiation. They help to define contractual terms, fill institutional gaps and facilitate financial transactions. These roles are vital and can also result in lower transaction costs and increased trust and transparency. Intermediaries are commonly local NGOs, community groups or government agencies who are funded or subsidised by donor organisations and often act in effect as administrators for a scheme who help to ensure that land users and beneficiaries develop trust and confidence in the system to get involve. Such involvements could take the form of providing technical assistance, goods, or services to local communities as well as establish and influence policies, remove barriers and promote access to potable water, sanitation and improved hygiene the communities. Local and international bodies could be responsible for assessing the effectiveness and efficiency of government policy regulations on water and natural resources to ensure that objectives and targets are reached.

5.11. Discussion

Sustainable management of water and natural resources requires a strong legal and regulatory framework, stakeholder ownership and strong support of local communities which has the potential to reduce transaction cost associated with establishing and maintaining a financial mechanism. Institutional and policy framework already in place for regulating resources management and conservation are essential due to their effects on public and private actions. In the design and

implementation of PES, specific legislation and institutions have sometimes been enacted, however most PES schemes operate without such a legal framework designed for PES without any obstacle to success (FAO 2004). Arocena-Francisco, (2003) observed that other types of legal framework, not specifically designed for PES also support PES projects for protection of watershed in the Philippines. Government institutions have a significant role but civil society and the market often drive PES. Evidence from developed countries suggests that market-based mechanisms combined with civil society institutions are best able to deliver the highest combined levels of efficiency and equity (Gouyon 2003). NGOs and community-based organisations can play an important role in this process through mediation with markets (Rosa, Barry et al. 2004). These institutional mechanisms in PES for watershed services system must be appropriate for the participant's capacities (FAO/REDLACH, 2004). But even if this is the case, a very careful design of the scheme is required in order to secure that poor people are able to participate as service providers (Pagiola, Arcenas et al. 2005).

The role of communities under PES is by no means limited to finance and maintenance, communities must be involved, from the start to improve decisions about the introduction of the scheme from economic and environmental perceptive. A study by Perrot-Maître and Davis, (2001) illustrated that stakeholder participation, negotiation, and institution building are fundamental to creating any new mechanism and can be expensive. India's experience with participatory watershed management is extensive (Farrington and Lobo 1997; Hinchcliffe, Thompson et al. eds.1999) and success stories frequently held up to illustrate the potential for cooperative arrangements to outperform centralised, state- led approaches. Increased local ownership, improved access to local information on problems faced and reduced bureaucratic interference are a few of the benefits associated with a participatory approach which PES seeks to highlight. Such an approach would ensure community ownership and management, thereby contributing to the establishment and maintenance of improved water-supply systems whiles been given an incentive. Indigenous institutions possess worth of ideas, principles, and institutional structures that can serve as starting points for the inclusion of traditional knowledge of resource management while empowering local communities economically in the country. For this reason, the collective environmental understanding and beliefs of local communities through various traditional and cultural practices in the country must not be overlooked in PES design and implementation. For example the belief that smaller gods live in natural resources such as forest and water bodies and that deserve respect and due diligence, failure of which may provoke anger and vengeance in the form of natural calamities such as famine, excessive rainfall, or death. Similarly, in the Western world, many of the environmental concerns are also rooted in the intrinsic value of nature, for instance, wilderness areas and scenic landscapes are valued by many people in the West because of the symbolic, aesthetic and cultural values attached to these areas (Desjardins 1993).

With similar objectives of decentralized watershed management with community participation which hinges on socio economic and environmental concerns, case studies in South Africa, (Suyanto, Beria et al. 2005), Colombia (Perrot-Maître and Patsy Davis Esq 2001) and in Indonesia (Wise and Musango 2006) watershed PES design and implementation, PES scheme is feasible in Ghana and the country has the potential for a successful PES design. Kopp and Smith, (1993) observed that in the design of PES, it is important to define service specific zones or service areas across landscape since boundaries are needed to define likely users of the service, the areas in which access to a service is possible and the area over which services might be scarce to have substitute. As such, the location and timing of the ecosystem services matter economically because the benefits of services depends on

where and when the demand for, complements to and substitute for those arise. Adopting PES scheme will help to build on appropriate national legislation and regulations as well as provide for the involvement and integration of all stakeholders in the planning and decision process and the establishment of organisational integration by setting up an effective coordination mechanism.

Policy wise, Ghana has wide range of policies and regulations on water and natural resources which provide the institutional and political structures in place to support the design and implementation of a PES scheme thereby complimenting environmental and economic policies considering the role PES can play in preserving healthy ecosystem whiles providing an economic stimulus for local livelihood. The potential for the design and implementation of a PES scheme for watershed can be seen. Additionally, supportive national policy and regulatory environments may also have a major impact on PES schemes; for instance, they can address and eliminate perverse incentives like subsidies for irrigation and industrial water use, necessary preliminary step for successful PES implementation (Gouyon 2003; Mayrand and Paquin 2004). Environmental services depend on access to land and water resources implying that laws and institutions must confer some minimum security of property rights, land tenure or recognised rights of access to the resource for the custodians or managers of land and water in the catchments. This does not necessary mean that PES schemes can not operate without clear definition of land titles since several cases from Latin America demonstrate that the clear definition of land title is not a prerequisite for PES to succeed (FAO 2004), however, participants must be able to demonstrate land stewardship in order to guarantee provision of the service. As part of the objectives, the Project has enabled the creation and maintenance of effective institutional capacity and capability at the national, regional, district and at community levels for land service delivery which could be adopted for PES scheme implementation. Various land management and administration institutions which previously worked separately have now been brought together under the Land Administration Project to facilitate cost effective and efficient processing of titles and rights to land by owners and lessees which can also provide for ease implementation of payment schemes under PES.

Studies have shown that the main buyers of biodiversity services are private corporations international NGO,s, research institutions, donors, governments and private individuals whereas most intermediaries of PES schemes include conservation agencies who negotiate direct payments for the conservation concession and forest conservation easements (Mayrand and Paquin 2004; Michael, Scherr et al. 2004). Further (Michael, Scherr et al. 2004) noted that the main sellers of biodiversity in order of prevalence include communities, public agencies and private individuals. From beneficiaries and institutional perspectives, actors have realized the stake they have and the influence they can make to sustain water provision and thus will gladly support its implementation. The Stakeholder analysis indicates that majority of actors are willing to contribute both as public and private entities to payment for watershed services. Wunder (2005) defined PES as a voluntary operation between two parties, as such individuals and industries whose activities though may not negatively impact on water provision would be involved or will voluntarily contribute to the scheme. Even though cost-benefit analysis was not conducted in this case, it is not likely to pose any problem though of relevance in PES design. Ghana's trans-boundary water management cooperation with her West African neighbours like Burkina Faso in coordinating and monitoring of the Integrated Water Resource Management of the Volta Basin for example has the potential for supporting PES. Payment distribution would be managed by intermediaries such as the WRC together with decentralized local

environmental agencies who would determine amount through a cost benefit analysis of what current and future gains and losses actors may incur for continued watershed service provision. These intermediaries would also be involved in managing the transactions, administration, and environmental monitoring that would be required and actors have to decide on the payment mechanism to be adopted which could also be scaled up in future to include other environmental services like carbon and biodiversity thereby providing for the implementation of policies which enhance healthy ecosystem preservation.

Meanwhile, institutional capacities and arrangements need to be strengthened for developing, delivering and monitoring policies and involvement of all stakeholders necessary to mainstream policy objectives and implementation. As noted by (Swallow, Meinzen-Dick et al. 2005) Ghana just like South Africa have introduced new policies and legislation for water and environmental management and in some cases involving the creation of catchments and basin authorities, institutional capacity is lacking. It is important to ensure adequate capacity of stakeholders in both government and private water management institutions to implement these policies to ensure a successful PES design and implementation in Ghana. This is because; capacity building is both an output of PES initiatives and, also, a prerequisite of their success. For instance in Pimampiro, farmers have received help with soil conservation, organic farming and forest management, which has enabled them to increase productivity and quality (Echavarría, Vogel et al. 2004). Also, institutional mechanism for PES must be appropriate for the participants especially where it involves poor people. Ostrom, (1990) observed that most institutions which have used common pool resources in a sustainable way over long period of times, monitoring and sanctioning are not undertaken by external agents but by participants themselves and in other cases those who monitor the system are officials that are accountable to participants. This approach aims at ensuring that officials whether government or private are transparent and impartial in the discharge of their duties because institutions that are transparent and empower people to voice their discontentment are particularly necessary in order to tackle corruption which is at the core of governance problems in water sector worldwide (Stålgren 2006).

Institutional arrangements need to be strengthened for developing, delivering and monitoring policies and involvement of all stakeholders necessary to mainstream any policy objectives and implementation. Also, facilitators should examine the institutional set up of local communities before the scheme is introduced. Another fundamental key to making PES institutions work is the need for free flow of information among public and private stakeholders institutions. FAO, (2004) emphasised that this should be the case even before the implementation of the system, where the initiative has to be widely publicised and discussed, and after implementation in order to sustainably ensure acceptance and proper operation through transparency to prevent gaps in communication or information flow which can be very detrimental to the success of a PES scheme.

The design and implementation of PES scheme considers the capacity of all stakeholders as well as the political, social and private sector context of the area under study. Forest Trends incorporates relevant conceptual design components, government involvement, and institutional support considerations as important and influential factor by experts in the field (Waage, Mulder I et al. 2007). Institutional feasibility of PES scheme will consider the different actors, their inputs, potential impacts and the inclusion of attractive corporate marketing and businesses to act as catalysts to

convince and entice private sector in the use of PES to improve competitive advantage as observed by (Iftikhar, Mikkel et al. 2007). The assessment of government's policy on water and natural resources and the involvement of different stakeholders at the local level in water resource management aim at integrating traditional knowledge of users and their roles in water management empowering local communities economically. Such a scheme would ensure community ownership and management, thereby contributing to the establishment and maintenance of improved water-supply systems whiles been given an incentive.

Additionally, it is important to recognise the relationship between the condition of the ecosystems in a watershed and their ability to provide and support services and acknowledge benefits of watershed services to downstream water needs to help influence upstream land use and management practices as a way of linking directly, the economic interests of downstream water users and water supply companies to upstream landowners. Landell-Mills and Porras (2002) proposed key steps to develop successful markets for environmental services. The (World Bank and WWF 2003) also noted that PES schemes must ensure that it produces both ecological and socio-economic outcomes not possible without the scheme. In this respect, stakeholders' commitment and respective contributions and support should be immensely valued in the whole process. Stakeholders have to understand and be able to appreciate the basic tenets of a PES scheme, what they stand to gain and or lose and the impact of the scheme on their total living condition and of course on ecosystem as a whole through watershed management practices. These will help to establish a basis for connecting the needs and wellbeing of downstream users of water to the actions of upstream managers responsible for upstream waterways, vegetation cover, and soil use and land management. The circumstances for PES design feasibility considered above which are basically unchallenged by literature, thus form a useful template for framing approaches to a local watershed services PES scheme for adoption in this study.

6. Data Analysis and Discussion on CVM

6.1. Introduction

In this work, willingness to pay (WTP) which is preferred and used in most analyses (Mitchell and Carson 1989) is applied. Various factors influencing willingness to pay for environmental services by respondents were analysed. Household willingness to pay for watershed services seen is a function of the proposed change in the attributes of the services and of other factors which influence household's valuation of that change (Whittington 1998). Respondents' positive response to a hypothetical improvement in water provision was seen as a function of their socio-economic, water supply condition and environmental awareness perception characteristics. Below is a description of the influence of various independent variables on households' WTP for environmental service, in this case watershed service. Below are tables which summarise key sample characteristics.

6.2. Socio-economic characteristics of respondents

The purpose of this analysis is to ascertain that WTP conforms to economic theory which informs assessment as to the reliability of the study (Pearce, Özdemiroglu et al. 2002). This provides basic information on households. In all 59% and 41% of the respondents were male and female respectively. The educational level ranged from illiterate to tertiary. Respondents within the secondary level had the highest percentage of 40%, followed by tertiary 34%, primary 19% and illiterate recording 7%. The occupation of respondents was categorized into public and private institutions. 64% work in the private (formal or informal) sector and 36% in the public (government).

Table 6-1: Education Level

			Education Level				Total
			illiterate	Primary	Secondary	Tertiary	
Sex of respondent	Male		4	12	27	15	58
		% within Sex of respondent	6.9%	20.7%	46.6%	25.9%	100.0%
	Female	Count	3	7	12	18	40
		% within Sex of respondent	7.5%	17.5%	30.0%	45.0%	100.0%
Total		Count	7	19	39	33	98
		% within Sex of respondent	7.1%	19.4%	39.8%	33.7%	100.0%

Source: Computed based on survey data, 2008

Table 6-2: Occupation

			Occupation			Total
			Public / Government	Private Informal	Private Formal	
Sex of respondent	Male		21	29	8	58
		% within Sex of respondent	36.2%	50.0%	13.8%	100.0%
	Female	Count	14	18	8	40
		% within Sex of respondent	35.0%	45.0%	20.0%	100.0%
Total		Count	35	47	16	98
		% within Sex of respondent	35.7%	48.0%	16.3%	100.0%

Source: Computed based on survey data, 2008

Table 6-3: Income Level in Ghana Cedis ¢

			Income level				Total
			¢0-100	¢100-200	¢200-500	Above ¢500	
Sex of respondent	Male		7	17	23	11	58
		% within Sex of respondent	12.1%	29.3%	39.7%	19.0%	100.0%
	Female		1	15	19	5	40
		% within Sex of respondent	2.5%	37.5%	47.5%	12.5%	100.0%
Total			8	32	42	16	98
		% within	8.2%	32.7%	42.9%	16.3%	100.0%

Source: Computed based on survey data, 2008

Table 6-4: Household size

Household size	Frequency	Valid Percent
1	8	8.2
2	11	11.2
3	19	19.4
4	24	24.5
5	19	19.4
6	8	8.2
7	7	7.1
8	1	1.0
10	1	1.0
Total	98	100.0

Source: Computed based on survey data, 2008

6.3. Water Supply and Quality Characteristics

This shows respondents perception of water services and use characteristics. Consideration is given to source of water, quality, cost, regularity of supply among others. In all 24 respondents representing 24.5%, 25 respondents representing 25.5%, 22 respondents representing 22.4% and 27 respondents representing 27.6% were identified in the good, rationed, intermediate and poor water condition areas respectively. 75% of respondents in households not connected to pipe mains indicated they wanted to be connected as against 25% indicated their readiness to be connected to the pipe mains.

Table 6-5: Community

							Total
			Good	Rationed	Intermediate	Poor/ No	
Sex of respondent	Male		13	12	15	16	56
		% within Sex of respondent	23.2%	21.4%	26.8%	28.6%	100.0%
	Female		11	13	7	11	42
		% within Sex of respondent	26.2%	30.9%	16.7%	26.2%	100.0%
Total			24	25	22	27	98
		% within Sex of	24.5%	25.5%	22.4%	27.6%	100.0%

Table 6-6: Maximum amount paid for water

			Maximum amount paid for water			Total
			1-5 Ghana cedis per month	5-10 Ghana cedis	Above 10 Ghana cedis	
Sex of respondent	Male		22	21	9	52
		% within Sex of respondent	42.3%	40.4%	17.3%	100.0%
	Female		16	17	3	36
		% within Sex of respondent	44.4%	47.2%	8.3%	100.0%
Total			38	38	12	88
		% within Sex of respondent	43.2%	43.2%	13.6%	100.0%

Source: Computed based on survey data, 2008

Table 6-7: Rate of water quality

			Rate of water quality		Total
			Good	Poor	
Sex of respondent	Male		29	10	39
		% within Sex of respondent	74.4%	25.6%	100.0%
	Female		26	5	31
		% within Sex of respondent	84.0%	16.0%	100.0%
Total			56	15	70
		% within Sex of respondent	78.9%	21.1%	100.0%

Source: Computed based on survey data, 2008

Table 6-8: Satisfaction of service condition

			Satisfaction of service condition		Total
			Yes	No	
Sex of respondent	Male		34	8	42
		% within Sex of respondent	81.0%	19.0%	100.0%
	Female		16	13	29
		% within Sex of respondent	55.2%	44.8%	100.0%
Total			50	21	71
		% within Sex of respondent	70. 4%	29.6%	100.0%

Source: Computed based on survey data, 2008

Table 6-9: Absence of pipe or regular flow

			Absence of pipe or regular flow			Total
			Well	Tanker	Bottled	
Sex of respondent	Male		21	16	1	38
		% within Sex of respondent	55.3%	42.1%	2.6%	100.0%
	Female		9	15	1	25
		% within Sex of respondent	36.0%	60.0%	4.0%	100.0%
Total			30	31	2	63
		% within Sex of	47.6%	49.2%	3.2%	100.0%

Table 6-10: Quality of other water sources

			Good	Poor	Very Poor	Total
Sex of respondent	Male		25	5	1	31
		% within Sex of respondent	80.6%	16.1%	3.2%	100.0%
	Female		17	1	0	18
		% within Sex of respondent	94.4%	5.6%	.0%	100.0%
Total			42	6	1	49
		% within Sex of respondent	85.7%	12.2%	2.0%	100.0%

Source: Computed based on survey data, 2008

6.4. Characteristics of Environmental Service Awareness and Perception

In terms of awareness of environmental services, 84% of the respondents responded they had knowledge of them whiles 16% indicated they did not. Benefits or environmental services identified by respondents include rainfall, food, medicinal, fuel wood and clean air all recorded 34%, 20%, 10%, 6% and 11% respectively. Respondents gave 39%, 36% and 17% to deforestations, water pollution and construction activities respectively as some of the effects of the human activities which impact negatively on water provision and nature conservation. Responding to willingness to pay for environmental service, 92% of respondents indicated they were willing to pay.

Table 6-11: what other environmental service do we derive

			What other benefit do we derive						Total
				Food	Rainfall / Water	Medicine	Fuel wood	Clean air	
Sex of respondent	Male		12	9	22	4	4	7	58
		% within Sex of respondent	20.7 %	15.5 %	37.9%	6.9%	6.9%	12.1%	100.0 %
	Female		6	11	11	6	2	4	40
		% within Sex of respondent	15.0 %	27.5 %	27.5%	15.0%	5.0%	10.0%	100.0 %
Total			18	20	33	10	6	11	98
		% within Sex of respondent	18.4 %	20.4 %	33.7%	10.2%	6.1%	11.2%	100.0 %

Source: Computed based on survey data, 2008

Table 6-12: Maximum amount WTP

			Maximum amount (WTP)			Total
			¢ 1-5	5-10 Ghana cedis	Above 10 Ghana cedis	
Sex of respondent	Male		22	21	9	52
		% within Sex of respondent	42.3%	40.4%	17.3%	100.0%
	Female		15	19	3	37
		% within Sex of respondent	40.5%	51.4%	8.1%	100.0%
Total			37	40	12	89
		% within Sex of respondent	41.6%	44.9%	13.5%	100.0%

Source: Computed based on survey data, 2008

Table 6-13: Knowledge of environmental services

			Knowledge of water as env. service		Total
			Yes	No	
Sex of respondent	Male		49	9	58
		% within Sex of respondent	84.5%	15.5%	100.0%
	Female	Count	35	5	40
		% within Sex of respondent	87.5%	12.5%	100.0%
Total		Count	84	14	98
		% within Sex of respondent	85.7%	14.3%	100.0%

Source: Computed based on survey data, 2008

Table 6-14: Why want to contribute an amount

			Why want to contribute an amount			Total
			Improve / regular water supply	Protect and conserve nature	Clean air	
Sex of respondent	Male		35	19	4	58
		% within Sex of respondent	60.3%	32.8%	6.9%	100.0%
	Female		23	11	6	40
		% within Sex of respondent	57.5%	27.5%	15.0%	100.0%
Total			58	30	10	98
		% within Sex of respondent	59.2%	30.6%	10.2%	100.0%

Source: Computed based on survey data, 2008

6.5. Discussion

6.5.1. Socio-economic Characteristics of Respondents

A respondent's response to willingly pay for watershed services was seen to have a relation to their socio economic characteristics. Analysis was undertaken to evaluate the effect of income and demographic variables on WTP. In this work, the private sector reported a higher percentage of employment. This confirms the Population and Housing Census report on the region that the informal sector employs more than half (51.8%) of the economically active population thereby playing a leading role in the economy of the region (GOG 2003). WTP for watershed services increases with increasing improvement in service provided as it became clear and evident that respondents would want to have value for money. According to (Limburg, O'Neill et al. 2002) economic valuations and incentives tend to be linear in nature and less reliable when the ecosystem is in danger of a flip. As stated by Enneking (2004), WTP thus conform to the amount of money respondents believe society expects them to pay, an approach believed to be a better option than the control and command forms in which restrictions and regulations feature prominently without having regards to the effect on local livelihood and support.

Though the urban poor pay more for water than middle and upper class households, some respondents were generally willing to make substantial contribution towards improving their water supply while others wished payment scheme could exempt them from paying at all. Respondents in the no or poor water supply condition areas, still not interested in being connected to pipe mentioned that the pricing system of the water company did not favour them. This is because household pay as much as they consume, however, staying in compound and big family houses means a high rate of consumption.

Unfortunately, most of them are not financially sustained to pay for the system of billing which is usually based on per head charges not favourable to the poor or low income earners living under those conditions. These are some of the reasons for which they prefer buying from water vendors in the urban areas. Respondents however mentioned they face inconveniences such as joining long queues for hour's un-end buying water from water vendors with the situation worsening when there are water shortages.

6.5.2. Water Supply and Quality Characteristics

In the urban areas, only 61 % of the population have access to an improved water resource (World Bank Report 2004) while 34% have access to safe sanitation (DANIDA 2003). Residents connected to main pipe system experience irregular water supply due to low pressure and capacity of water delivery. This creates avenues for an informal water market which serves all those without access to public water services as well as those connected. In Ghana small scale informal business of water vendors using carts or trucks to deliver water, or neighbours with water connections reselling water (Kjellén 2003). Water vendors and tanker drivers are engaged in informal water supply business to consumers where by water is stored in poly tanks and other storage facilities and later sold out.

Currently, the Ghana Water Company has been treating wells or dug wells for households, all they need is electricity power connected to pump water or suck water and pump it into houses for use. All these account for the improvement in the quality of other water sources as indicated by respondents. A few of the respondents' mainly affluent households patronize bottled water basically for drinking purposes. Some household irrespective of their connection to main pipe or not, do have other water sources such as well or tanker supplies whiles others store water in barrels, concrete and other storage facilities for keep due to low pressure, power and water outages. The connection of urban sanitation services to water supply system was seen to influence respondents' not connected to pipe mains readiness to be connected to pipe mains. Respondents indicated that this will help in flushing out flush sewer and other wastages failure of which can result in sanitation and health problems. The poor response to pipe water quality is attributed to the irregularity in water flows and old pipe lines in some areas which results in rustiness affecting water colour and smell. This takes time to clear out after re-opening, thereby contributing to the poor quality of pipe water indicated by respondents.

Figure 6-1: Informal water sale businesses where individual and tanker drivers sell water to households

6.5.3. Characteristics of Environmental Service Awareness and Perception

Respondents identified improvement in water provision; nature conservation and protection as important considerations for respondent's WTP bid. A high degree of environmental awareness was exhibited by respondents, for example regarding the relationship between forest cover and water flows and of the role forests plays in provision. As observed by (Landell-Mills and Porras 2002; Postel 2003), of the many of the ecosystem services that watersheds provide, hydrological services constitute some of the most economically and socially valuable However, watersheds without adequate protection inevitably deliver less clean and less reliable water to their downstream dependents. These activities when checked could help to prevent certain natural phenomenon whose effects are detrimental to the environment and ecosystem.

The ranking of improvement in water quality and quantity together with natural resource conservation as factors necessary for enhancing water provision is an indication of the fact that payment would be made for water services, in this instance could be seen as bundle payment for both water provision and biodiversity. Rapid alterations of land use have great implication not only for nature but also the very existence of humans who depend on it. (Vitousek 1994; Turner, Paavola et al. 2003; Verburg, Overmars et al. 2006) mentioned that these changes have enormous effects on hydrological balance and biodiversity. In this regard responses to environmental issues in this work are a clear indication of respondents understanding and appreciation of the impact of human activities on the provision of environmental. There is therefore the need to conserve and protect watershed and forest which are the main source of water provision not only for urban but also rural consumption. Below are some human activities engaged in and around the Weija catchment.

6.6. Statistical analysis

6.6.1. Description of variables in regression analysis

Choosing an appropriate analytical technique depends on the type of variable being investigated. Normally, the dependent variable of interest is a continuous variable assumed to be normally distributed. However, in many applications, the dependent variable is not on continuous scale and may have two possible outcomes which can be represented by an indicator variable with values 0 and 1. In this study, the dependent variable willingness to pay (WTP) for watershed services was defined to have two possible outcomes: (1) respondents are willing to pay for watershed services and (2) respondents are not willing to pay for watershed services, making the dependent variable a

dichotomous one. The two outcomes were coded 1 and 0 respectively. To be able to know which independent variables are most closely rated or are more explanatory to the dependent variable (WTP), six independent variables namely, knowledge of water as environmental service, effects of human activities, income, household size, rate of water quality and number of times water runs per week and WTP were explored to assess the statistical significance between them in terms of which factors affect respondents (WTP) for watershed services.

6.6.2. Ordinary Least Square regression analysis

Table 6-15: Least square regression analysis

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.643[a]	.414	.334	.585
a. Predictors: (Constant), Number of times water runs per week, Income level, Knowledge of water as env. service, Mention some, Rate of water quality, Household Size				
b. Dependent Variable: Maximum amount				

This was done to find out whether the set of explanatory variables contribute significantly to respondent's willingness to pay for watershed services. In running a normal regression, six independent variables were used to establish their importance or influence on the dependent variable of WTP. The R value (r = 64%) of all the independent variables shows the variables have an influence on respondent's WTP. It gives an indication of the importance the variables pay on WTP. It can be deduced that they explain and contribute to the reasoning of respondents WTP for watershed services. However, the R-Square shows that these variables contribute over 40% to dependent variable WTP.

Table 6-16: Analysis of Variance

ANOVAb						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	10.628	6	1.771	5.176	.000a
	Residual	15.058	44	.342		
	Total	25.686	50			
a. Predictors: (Constant), Number of times water runs per week, Income level, Knowledge of water as env. service, Mention some, Rate of water quality, Household Size						
b. Dependent Variable: Maximum amount						

Table 6-17: Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	.890	.690		1.290	.204	-.500	2.280
	Knowledge of water as env. service	-.238	.282	-.107	-.844	.403	-.807	.330
	Effect of any human activity known	1.428	.647	.276	2.208	.032	.126	2.730
	Income level	.002	.000	.405	3.494	.001	.001	.003
	Household Size	.060	.050	.147	1.212	.232	-.040	.161
	Number of times water runs per week	-.363	.091	-.474	-3.992	.000	-.546	-.180
	Rate of water quality	-.004	.202	-.002	-.021	.983	-.410	.402
a. Dependent Variable: Maximum amount								

The result gave an R-Square of just above 40%, table 16 which means that other variables need to be considered. The result indicates that three out of the seven predicators are statistically significant to influence on respondents WTP for watershed service. Income of respondent is statistically significant to WTP to pay and that increase change in the unit of income has a positive influence on maximum amount. The importance of frequency of water supply of availability of water per week is also significant. However, the effect of human activity on water provision is significant but weak, not having a strong significant influence on WTP.

According to table 6-16, income is statistically and positively significantly related to a respondent's willingness to pay for watershed services. This shows that as one's income increases his ability to contribute also increases as reflected in figure 6-17, below. The regression result however shows that the other variables do not have any significant influence on WTP, that is no positive importance or influence were seen to have made by them on WTP of respondents.

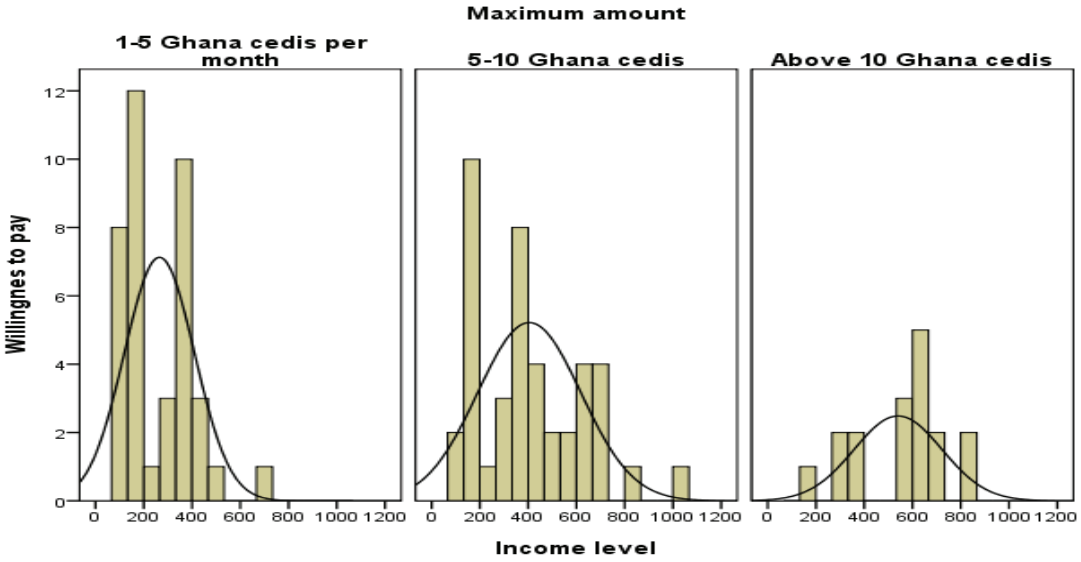


Figure 6-2: Relation between WTP and income

From the above figure 6-17, there is an indication of a positive correlation between WTP and their income, the first column shows that respondent who were willing to pay between ¢1-5 (Ghana cedis per month) their mean income is ¢ 200, while those with mean income of ¢600 per month their willingness to pay was above ¢10 per month.

Table 6-18: WTP for water shed service

Ecosystem service	No	Yes	Sum Income in ¢Cedis/month	Mean Income/Month	Sum WTP in ¢ cedis/ month	Mean WTP/Month	Percentage WTP/Income Ratio
Water	9	89	32100	328	512	5.8	15.95

With a total income of ¢32100 per month, 15.9% representing WTP/income ratio was recorded as maximum willingness to pay bid for watershed services.

6.7. Conclusion

The finding from the regression show that income, frequency of water supply per week and effect of human activities significantly contribute to respondents WTP for watershed services. It is found out that income has a stronger influence. Frequency of water supply per week also showed statistical significance, however effect of human activities though shoed some significant, it was not strong. Other variables considered did not show any importance to respondents WTP. According to Pearce and Özdemiroglu, (2002), a sample of 500- 1000 is required for a dichotomous choice method. This could be the reason why the result did not give a good representation of reality though the model mathematically fit. Also of relevance could be the fact that communities chosen within various supply condition areas were not representative enough.

The F-ratio representing the ratio of improvement in the prediction that results from fitting the model, relative to the inaccuracy that still exists in the model, though very weak in this case was however seen to be increasing with increasing data set. This shows that if greater amount of data had been collected, the findings would have given a much practical view of predictors on WTP.

The elicitation scenario for WTP bid for watershed services was based on the hypothetical conservation scenario of (1) If the status quo that is current rate of land use change is maintained and (2) If a hypothetical conservation project is put in place to help mitigate and sustain water provision. Various authors have undertaken similar elicitation scenarios in their work though with different content (Cho, Newman et al. 2005; Amirnejad, Khalilian et al. 2006; Gürlük 2006), to elicit WTP bids also, determined specific values of different ecosystem services. However, benefit estimates in respect of indirect values were dependent on assumptions about future changes in watershed service provision. As Pattanayak, (2004) demonstrates, predicting impacts is dependent on the availability of hydrological and soil data to index watershed services provision which were not available and quantification of benefits was restricted by assumptions as to future impacts in the catchments. The 10% zero or no WTP bid for watershed services is lower than the 20-25% reported in literature and acceptable for the developing world where WTP has not been extensively implemented (Whittington 1998).

However, the almost 90% WTP bid is considerable reasonable taking into account the high recognition of the effect of human activities on water provision. Additionally it has been observed in some studies in participation of watershed management that, most people only participate on personally critical issues (Irvin and Stansbury 2004) such as a dependency on the subject matter resources (e.g., access to drinking water). And so respondents' dependence on watershed services without any alternative and the perception that decision-making benefits from participating in the process positively influence their willingness to pay. The mean WTP bid is 5.8% and is influenced by mainly three key variables namely, income, effect of human activities and number of times water runs per week. An increase in respondents income level yielded an increased WTP bid for watershed services which is consistent with the economy demand theory explained by (Urama and Hodge 2006) and confirmed by (Ojeda, Mayer et al. 2007).

7. Conclusion

7.1. What changes have occurred in land use in the study area between 1990 and 2007?

- Seven (7) dominant land use / cover types namely, riverline, dense active, shrub herbaceous, grass herbaceous, built up/bare, water and swampy exist in the study area.
- Riverline and dense active vegetation covers decreased whereas built up/bare, grass and shrub herbaceous cover areas increased during the period studied.
- Dense active vegetation and built up/bare areas experienced the most negative and positive changes respectively.
- Shrub herbaceous cover increased by about 10% of the total area from 1990 – 2007.
- Built up/ bare area increased from 4% to 17% of the total area during the period.
- A total of 2197 ha of riverline vegetation was lost from 1990 – 2007.
- Grass increased by 1215.6 ha over the period.
- Water body gained in size by about 2% from 1990 – 2007.
- Swampy area also gained by 3% from 1990 – 2007.

7.2. How much economic value do users assign to watershed services and how willing are they to pay for watershed services?

- Total WTP bid for watershed services is ¢ 512 per month representing 15.95% of WTP/income ratio were recorded.
- Mean WTP per month was recorded as 5.8%
- 52 males and 37 female representing 58% and 41.6% respectively bid for WTP
- 91% of respondents accepted to commit to WTP whereas 9% rejected shifting responsibility to government and Water Company.

7.3. To what extent does the existing water management plan addresses the possibility of incorporating PES around the weija catchments?

With regards to the feasibility, Ghana has the potential for a successful PES design. Policy wise, the country has wide range of policies and regulations on water and natural resources which provide the institutional and political structures in place for PES design which will support the design and implementation of a PES scheme thereby complimenting environmental and economic policies considering the role PES can play in preserving healthy ecosystem whiles providing an economic stimulus for local livelihood. The potential for the design and implementation of a PES scheme for watershed can be seen.

7.4. Who are the stakeholders

Producers of watershed service in this case will include people living upstream in communities in and along the Densu Basin who use the Densu River and the forest for farming, fish farming, domestic,

recreational, and the washing of vehicles as they depend on farming practices and forest products for their subsistence.

Beneficiaries will include demand from both direct and indirect downstream users of water from the Weija. They are the indirect users or beneficiaries: the Ghana Water Company (GWCL) whereas the direct users of watershed services in this case would include individuals or organised groups who depend on Weija for direct consumption and are directly affected by land management activities upstream. In the case of Weija, communities located within the Ga district and some part of the Accra Metropolitan Area, firms and industries whose operations have the potential to damage the environment. Government institutions will include Water Resources Commission (WRC), Public Utilities Regulatory Commission (PURC) and the Environmental Protection Agency (EPA), Forestry Commission whiles intermediaries and supporting institutions will local NGOs (Water Aid, Friends of Rivers and Water Bodies, Ghana Coalition of non-governmental organizations in Water and Sanitation (CONIWAS). Sectors involved in water resources such as hydrological services, irrigation development, water research, environmental protection, customary authorities, the NGO community and women interests are also seen as potential stakeholders. From the above, the stakeholders identified with regards to potential producers, beneficiaries, supporting and intermediary actors and structures could form a PES scheme. Figure 7-1 gives a brief illustration of stakeholders and features of a framework for a local PES scheme.

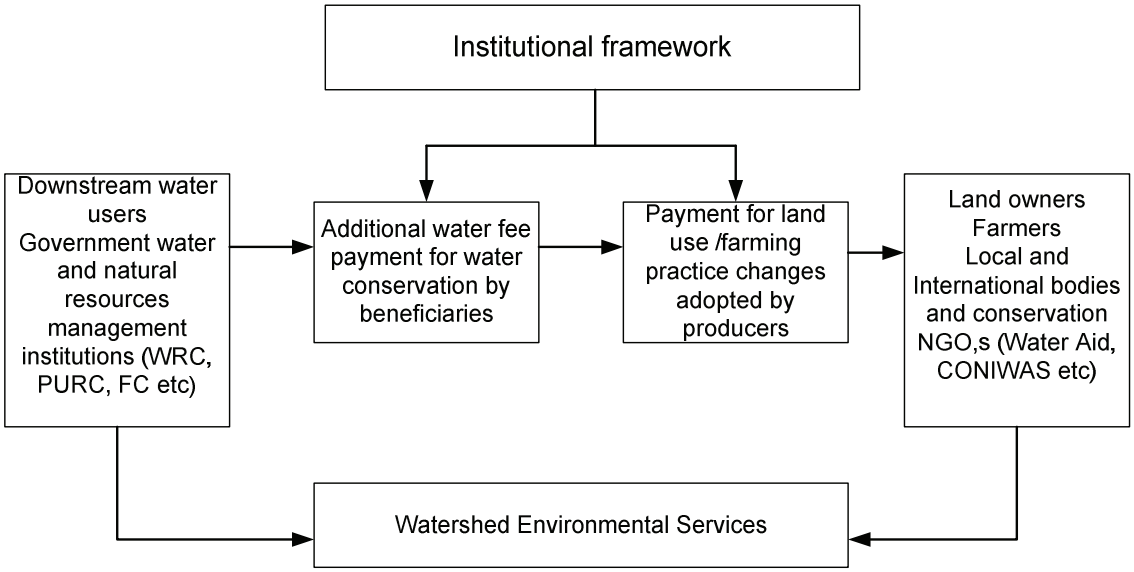


Figure 7-1: Sketch Map of potential stakeholders for the Weija PES scheme

Recommendation

It is recommended that further studies could consider areas of livelihood patterns, resource use, access and right and an assessment of their implication for and on PES design and the local poor.

Further studies in WTP surveys in Ghana could also consider an assessment of the extent to which valuables such as knowledge and environmental perception of respondents can influence their WTP bids for environmental goods and services.

Epilogue

Organizing PES under the broad concept of governance.

Karl (2005) looks at good governance among others as a normative concept involving legitimacy, participation, accountability and transparency, an assumed norm regarded as the standard of correctness in behaviour, speech and activities. Governance structures can take root into existing local institutions and communities in order to build trust, institutions supporting. Research into public participation in governance has asserted that participatory governance processes may be successful if users see net potential gains of taking part in decision-making activities (Ostrom 1990). To improve the quality of governance at all levels, there is the need for institutions and the citizens to be brought more closely together, bridging the gap between them. This enhances the level of participation as it broadens the base of decision making. Participation creates representation which is a key indicator of empowerment hence the level of voice of the people on issues that touches on their future (Blair 2000). Stenseke (2009) make reference to Zachrisson (2004) of the associating benefits of participation such as reduction of conflicts, a more flexibility and efficient management, increased legitimacy, an implied better use of place-specific knowledge etc. Ecological sustainability as identified by (Charles 1994) is that component of sustainability which focuses on socio -economic welfare, measured at the level of individuals, and aggregated across the resource system. The World Development Report, (2004) highlighted the importance of accountability in the provision of public services as a condition for greater efficiency as an instrument for greater program efficiency and emphasizes how breakdowns in the relationships between the key actors policymakers, service providers, and clients can result in the failure to provide key services to the poor. This requires strong external leadership as well as confidence-building strategies to make sure that land users and beneficiaries buy into the new system.

PES schemes should have a governance structure to strengthen the leadership, oversees their functioning, specifies eligible activities and payments levels, monitors impacts of land use changes and the provision of services, and adjusts eligible activities and payments, as appropriate. Ensuring equity requires the establishment of fair systems for access to resources, decision-making and revenue flows for landowners and the ability to institute this within policy and legal frameworks especially the recognition of customary rights, which are rights derived from ownership and their reintroduction into the natural management and planning process. Fairness is achieved through development of processes that ensure that those who own the resources are recognised as holding the property rights. Local and international organizations involved in PES scheme should help to ensure that beneficiary rights of people to access natural resources for maintaining a basic standard of living and their associated responsibility to ensure the sustainable use of such resources enhanced. It could also help in the identification of producers with rights to access and use land to be paid for the service they render under a PES scheme through community participation and public awareness at all levels in sustainable land management and development practices to ensure the highest and best use of land as well as guarantee optimum returns to land. There is therefore need to ensure that the involvement of communities in natural resource management result in their ability to assert their right and influence over matters that affect their lives so as to achieve equity and greater efficiency in natural resource

management. According to Hobley and Events, (1997) such an approach will ensure collaborative natural resource management underpinned by the requirement that management is equitable and more efficient. Monitoring is also important under PES schemes to ensure that services are generated and payments adjusted to provide technical assistance which allow payments and contributions to optimize the system where necessary. The financial mechanism should be fair and equitable to ensure that revenue from PES scheme payments flow back to the land owners from whose land environmental services are provided. Also, charges need to be agreed and acceptable to landowners according to the extent of their production and protection areas. PES schemes also have simultaneous goals of effectiveness, efficiency and equity. In order to be effective, payments need to be optimized and targeted to higher value land and a reduction in transaction costs.

A PES scheme for watershed could help to facilitate equitable access to and security of tenure of land based on registered titles and prevents situations where farmers are often distant from landowners and remain without secure property rights in order to enable forest resources to be protected in the interest of landowners as well as farmers (Kotey, Francois et al. 1998). Further, Kotey et al., 1998 (1998) noted that there is the need to develop arrangements which enable forest resources to be protected in the interest of landowners as well as farmers. Mechanisms for ensuring fairness or equity in rights of access and use to forest and land resources must ensure that domestic use rights of farming communities and tenant farmers for example are respected and formalised by the chiefs and the elders of landowning stools. Since, farmers are often distant from landowners and remain without secure property rights Tenant farmers and leaseholders' right to land need to be enhanced through the granting of permanent leaseholds to ensure equity. This could be achieved through direct pressure on providers to act in accordance with agreed contracts and also through lobbying and voting to influence policy making to regulate the operation of actors. Kasanga and Kotey (2001) testifies that customary tenure systems and institutions are more able to ensure accountability to local communities and villagers than the state land management machinery and that Community land secretariats backed by their own hired professionals are better placed to promote positive land management and community participation. of the land administration system is to ensure equal level of access to services as well as exhibit equal service standards to the public irrespective of their political or economic status (Zakout, B. Wehrmann et al. 2006). Additionally various land management and administration institutions which previously worked separately have now been brought together under LAP to facilitate ease, cost effective and efficient processing of titles and rights to land by owner for ease implementation of payment schemes under PES. The Project has enabled the creation and maintenance of effective institutional capacity and capability at the national, regional, district and at community levels for land service delivery which could be adopted for PES scheme implementation.

Brown and Corbera (2003) views equity as fairness of outcomes both now and in the future with respect to who benefits or is included in the process of decision-making for development action. Studies of participatory development suggest that women may be less likely to participate in environmental decision making where male dominated social structures are in place (Agarwal 2001), for which reason, gender may be a key variable worth investigating. Additionally, the UNDP noted in its Human Development Report (UNDP 2000) that women, as a social category, are poorer than men in sub-Saharan Africa as a whole, where the GDP per capita figures in 1998 were US$1142 per woman and US$2079 per man. Women's weak economic and social position hinders their independent access to private freehold land and very little land is owned directly by them. Situations

where women are not allowed to own land create gender inequalities. This can be improved through gender integration into the implementation of PES activities at various levels, sensitization and consultation with the Ministry of Women and Children Affairs and other women's groups engaged in land administration with a focus on poor and the deprived.

The successful implementation of a PES scheme for watershed services also requires the trust and faith of all actors. According to Webler and Tuler, (2001) communities with watershed administrations perceived as trustworthy positively influence local beneficiaries' willingness to participate for which reason there should be a strong feeling among the participants that they can trust administrative and institutional structures and its positive effect on the scheme (Smith and McDonough 2001). Some studies in participation of watershed management have found that most people only participate on personally critical issues such as a dependency on watershed such as water for drinking (Irvin and Stansbury 2004). Therefore, dependence of watershed services and the perception that decision-making benefits from participating in the process will positively influence their willingness to participate is thus critical for a PES scheme design and implementation. Public participation has been recognized, within the context of natural resources management, as an effective means for giving local populations a voice in the use of and access to resources, thereby helping with the development of appropriate institutions for sustainable management (Beierle and Cayford 2002). As argued by the World Bank (2000) participatory approaches devolve decision-making rights, benefits, and responsibilities to local populations. Literature also suggests that community-based approaches receive special attention when the resource problems require solutions that: i) concern the management of local resources; and ii) demand action at the community level (Agrawal and Gupta 2005; Engel, Iskandarani et al. 2005). If such resource management regimes are based on local context and support of local participatory governance structures, they are more likely to enhance system performance (Ostrom 1992).

Also of relevance to PES scheme is the issue of transparency which is a key element to ensure trust of participants in the monitoring system and highlighted in literature as the effect PES can be on social capital of poor people thereby promote internal organization (Pagiola, Arcenas et al. 2005). Institutions that are transparent and empower the people to voice their discomfort are particularly necessary in order to tackle corruption which is at the core of governance problems in water sector world wide (Stålgren 2006). This is closely linked to effective local participation in decision making and implementation of forest programs is the need to ensure that the actions of local government officers are transparent and that the officers themselves remain accountable to local populations for their actions. A review by the World Bank's Operations Evaluation Department of the performance of the World Bank's 1991 Forests Strategy (Lele 2006) pointed to the failure to address governance issues as a serious gap in the World Bank's work in forestry and thus need to promote and improve governance and enforcement of laws and regulations of natural resources. Likewise, the World Bank's 2001 environment strategy emphasizes the comparative advantage of the World Bank in supporting better governance, increased transparency, access to environmental information, and public participation in client countries (World Bank 2001).

In the design and implementation of PES, the transfer of power to local institutions must be accompanied by accountability structures else the benefits of decentralization may not be realized thereby providing local communities with an opportunity to have their views and voice heard as well

as be able to influence policy design and implementation. According to (Ribot 1998) local forest institutions are at risk of becoming simple extensions of the central government, which naturally tends to use them for promoting central agendas, thus defeating many of the opportunities of decentralization. Forest decentralization should include adequate measures to improve community participation and to respect indigenous and traditional rights and make room for local communities to have their views heard and the ability to influence policies. Monitoring of equity could thus become one of monitoring the quality of the processes to ensure that the outcomes are fair and this is important at all levels including design, implementation, and monitoring to ensure compliance of obligations by stakeholders for a continued production and supply of services and impacts on local users. Effective monitoring is essential to prove beneficiaries that their investments are generating land use changes.

This is a contribution to the few of governance issues that need to be consider in the design and implementation of PES schemes.

References

Agarwal, B. (2001). "Participatory exclusions, community forestry and gender: an analysis for South Asia and a conceptual framework " World Development **29** (10): 1623–1648.

Agrawal, A. and C. C. Gibson (1999). "Enchantment and disenchantment: The role of community in natural resource conservation." World Development **27**(4): 629-649.

Agrawal, A. and K. Gupta (2005). "Decentralization and Participation: the governance of commonpool resources in Nepal's Terai." World Development **33** (7): 1101-1114.

Agyarko, T. (2001). "Country Report Ghana - Ministry of Lands and Forestry."

Amirnejad, H., S. Khalilian, et al. (2006). "Estimating the existence value of north forests of Iran by sing a Contingent Valuation Method." Ecological Economics **58**: 665-675.

Arocena-Francisco, H. (2003). "Environmental service payments": experiences, constraints and potential in the Philippines.World Agroforestry Centre (ICRAF) Bogor, Indonesia."

Attua, E. M. and E. Laing (2001). "Land-cover mapping of the Densu Basin: Interpretations from multi-spectral imagery." Bulletin of Ghana Geographical Association **33**.

Aylward, B. and A. Fernández González (1998). "Institutional Arrangements for Watershed Management: A Case Study of Arenal, Costa Rica. London, International Institute for Environment and Development."

Baland, J.-M. and J.-P. Platteau (1996). "Coordination Problems in Local Level Resource Management " Development Economics **53**: 197-210.

Barraclough, S. L. and K. B. Ghimire (2000). "Agricultural Expansion and Tropical Deforestation: Poverty, International Trade and Land Use. Earthscan, Sterling, Virginia, USA." Conservation Ecology **5**(2): 7.

Becht, R. and D. M. Harper (2002). "Towards an understanding of human impact upon the hydrology of Lake Naivasha, Kenya." In: Hydrobiologia, 488(2002)1-3.

Beierle, T. C. and J. Cayford (2002). "Democracy in Practice: Public Par-ticipation in Environmental Decisions. Washington, D.C.: Resources for the Future.".

Bektas, F. and C. Goksel (2003). "REMOTE SENSING AND GIS INTEGRATION FOR LAND COVER ANALYSIS, A CASE STUDY: GOKCEADA ISLAND." (Unpublished).

Benneh, G. (1975). "Traditional Political Systems, titles to land and tenures in Ghana." Bulletia of Ghana Geographical Association **17**.

Bentsi-Enchil, Ed. (1975). The Traditional Legal Systems of Africa, In Lawson F.H. (Ed.) Property and Trust, Chapter 2, Section 4, Vol. 6. International Encyclopaedia of Comparative Law, The Hague, Pp. 68-101.

Bishop, J. and N. Landell-Mills (2002). "Forests Environmental Services: An Overview."

Blair, H. (2000). "Participation and Accountability at the Periphery: Democratic Local Governance in Six Countries." World Development **28**(1): 21-39.

Boggess, W., R. Lacewell, et al. (1993). Economics of Water use in Agriculture. Agricultural and Environmental Resource Economics. G. Carlson, D. Zilberman and J. A. Miranowski. New York, Oxford University Press Inc.

Boyd, J. and S. Banzhaf (2006). "What are ecosystem services? The need for standardized environmental accounting units." Ecological Economics **63**(2-3).

Braimoh, A. K. (2006). "Random and Systematic Land-cover Transitions in Northern Ghana." Agriculture, Ecosystems and Environment **113**: 254-263.

Brandon, K., K. H. Redford, et al. (1998.). "Parks in Peril. People, politics and protected areas. Edited by T. N. Conservancy. Washington DC: Island Press.".

Brown, K. and E. Corbera (2003). "Exploring equity and sustainable development in the new carbon economy." Climate Policy **3**(S1): s41-s56.

Brundtland. (1987). "Our Common Future. Report of the Brundtland Commission on Environment and Development. Oxford: Oxford University Press.".

Bucknall, J., C. Kraus, et al. (2000). "Poverty/Environment Background Paper. World Bank, Washington, DC."

Calder, I. (2000). "Land use impacts on water resources. Prepared for eworkshop on Land-Water Linkages in Rural Watersheds." Food and Agriculture Organization of the United Nations (FAO), Rome.

Campbell, J. B. (2002). "Introduction to Remote Sensing. Taylor and Francis, London." 621.

Carson, R. (2000). "Contingent valuation: A user's guide " Environmental Science and Technology **38**(4): 1413-1418.

Carson, R. and T. Groves (2007). "Incentive and informational properties of preference questions." Environmental and Resource Economics **37**(1): 181-210.

Charles, A. (1994). "Towards Sustainability: The Fishery Experience." Ecological Economics **11**(3).

Chilton, S. M. and W. G. Hutchinson (1999). "Do focus groups contribute anything to the contingent valuation process?" Journal of Economic Psychology **20**(4): 465-483.

Cho, S.-H., D. H. Newman, et al. (2005). "Measuring rural homeowners' willingness to pay for land conservation easements " Forest Policy and Economics **7**(5): 757-770

Choe, K., D. Whittington, et al. (1996). "The Economic Benefits of Surface Water Quality Improvements in Developing Countries: A Case Study of Davao, Philippines." Land Economics **72**: 107-126.

Chomitz, K. and K. Kumari (1998). "The Domestic Benefits of Tropical Forests: A Critical Review." World Bank Research Observer **13**(1): 13-35.

Chomitz, K. M., E. Brenes, et al. (1998). "Financing Environmental Services: The Costa Rican Experience and its Implications, World Bank, Washington DC."

Constanza, R., R. d'Arge, et al. (1997). "The Value of the World's Ecosystem Services and Natural Capital." Nature **387**: 253-260.

Costanza, R., R. d'Arge, et al. (1997). "The value of the world's ecosystem services and natural capital " Nature **387**: 253-260.

Cummings, R. G., D. S. Brookshire, et al., Eds. (1986). Comparison studies: What is accuracy? Valuing environmental goods: An assessment of the contingent valuation method. Totowa, NJ, Rowman and Allanheld.

Daily, G. C. (1997). "Nature's Services: Societal Dependence on Natural Ecosystems. Island Press, Washington, DC, USA."

DANIDA (2003). "Water and Sanitation Sector Program Support, Phase II, Ministry of Foreign Affairs, Government of Ghana."

Day, B. and S. Mourato (2002). Valuing River Water Quality in China. Case Studies: Valuing the Environment in Developing Countries. D. Pearce, C. Pearce and C. Palmer. Cheltenham, Edward Elgar**:** 25 - 66, ISBN: .

de Groot, R., M. Wilson, et al. (2002). "A typology for the classification, descriptions and valuation of ecosystem functions, goods and services." Ecological Economics **41**: 393–408.

de Groot, R. S. (1994). "Environmental functions and the economic value of natural ecosystems', in A. Janson (ed.), Investing in natural capital: the ecological economics approach to sustainability." International Society for Ecological Economics, Island Press: 151–168.

de Groot, R. S. (2002). "A Topology for the Classification, Description and Valuation of Ecosystem Functions, Goods and Services." Ecological Economics **41**: 393-408.

De, L., Angeles. (2007). "Personal communication, Environmental Economic Consultant, World Bank Institute, Washington DC."

Desjardins, J. R. (1993). "Environmental Ethics -- An Introduction to Environmental Philosophy. Belmont, CA: Wadsworth PublishingCompany."

Doe, H. W. (2007). "Assessing the Challenges of Water Supply in. Urban Ghana: The case of North Teshie. (EESI Master Thesis), Stockholm: Department of Land and Water Resources Engineering, Royal Institute of Technology (KTH)."

Dudley, N. and S. Stolton (2003). "Running Pure: The Importanceof Forest Protected Areas to Drinking Water." World Bank/WWF Alliance for Forest Conservation and Sustainable Use, Gland.

Echavarría, M., J. Vogel, et al. (2004). "The impacts of payments for watershed services in Ecuador. Emerging lessons from Pimampiro and Cuenca. Markets for Environmental Services." International Institute for Environment and Development, London, UK **4**.

EMM. (2006). "Ecosystem Marketplace Matrix

" Retrieved 29 November 2008, 2008, from www.forest-trends.org/trendlines/1205/emailer1.htm.

Engel, S., M. Iskandarani, et al. (2005). Improved Water Supply in the Ghanaian Volta Basin:Who Uses It and Who Participates in Community Decision-Making? Washington DC. EPT Discussion Paper 129. International Food Policy Research Institute.

Enneking, U. (2004). "Willingness-to-pay for safety improvements in the German meat sector: the case of the Q&S label." European Review of Agricultural Economics **31**: 205-223.

FAO (1996). Forest Resources Assessment 1990 - Survey of tropical forest cover and study of change processess. FAO Forestry Paper No. 130. Rome.

FAO (2001). Global Forest Resources Assessment FRA 2000 – Main report

Rome.

FAO (2004). Payment schemes for environmental services in watersheds. Proceedings of a Regional Forum, Arequipa, Peru, June 9–12, 2003. Land and Water Discussion Paper 3. Food and Agriculture Organization of the United Nations, Rome Proceedings of a Regional Forum.

Farrington, J. and C. Lobo (1997). "Scaling Up Participatory Watershed Development in India: Lessons from the Indo- German Watershed Development Programme. London: Overseas Development Institute." Natural Resource Perspectives Report(17).

Ferraro, P. and A. Kiss (2002). "Direct payments to conserve biodiversity." Science 1718-1719.

Freeman, A. M. (1993). "The Measurement of Environmental Values and Resources: Theory and Methods " Resources for the Future, Washington, DC: 516.

Gelderblom, C. and B. van Wilgen (2000.). "South Africa's Working for Water Program. Paper prepared for World Resources Institute's Critical Flows Project by Council for Scientific and industrial Research. Capetown, South Africa.".

GOG (2003). "Ghana Population and Housing Census, 2000."

Goodland, R. and H. E. Daly (1996). "Environmental Sustainability: Universal and Non-negotiable." Ecological Applications **6**: 1002-1017.

Gouyon, A. (2003). "Rewarding the upland poor for environmental services: a review of initiatives from developed countries. World Agroforestry Centre (ICRAF), Bogor, Indonesia ".

GPRS (2003). "Ghana Poverty Reduction Strategy - An agenda for growth and prosperity."

Gürlük, S. (2006). "The Estimation of Ecosystem Services' Value in the Region of Misi Rural Development Project: Result from a Contigent Valuation Survey." Forest Policy and Economics **9**: 209-218.

Hadker, N., S. Sharma, et al. (1997). "Willingness-to-pay for Borivli National Park: evidence from a Contingent Valuation." Ecological Economics **21**: 105-122.

Hanemann, W. M. (1994). "Valuing the Environment through Contingent Valuation Method." Journal of Economic Perspectives **8**(4): 19-43.

Hanemann, W. M., J. Loomis, et al. (1991). "Statistical Efficiency of Double-bounded Dichotomous Choice Contingent." American Journal of Agricultural Economics **73**(4): 1255-1263.

Hardner, J., and Rice, R (2002). " Rethinking green consumerism." Scientific American 89-95.

Heal, G., C. D. Gretchen, et al. (2001). "Protecting natural capital through ecosystem service districts." Stanford Environmental Law Journal **20**: 333-364.

Heilig, G. K. (1994). "Neglected Dimension of Global Land use Change: Reflections and Data " Population and Development Review **20**(4): 831-859.

Hein, L., K. V. Koppen, et al. (2006). "Spatial Scales, Stakeholders and the Valuation of Ecosystem Services." Ecological Economics **57**: 209-228.

Hinchcliffe, F., J. Thompson, et al. (eds.1999). "Fertile Ground: The impacts of participatory watershed management. London: IT Publications."

Hobley, M. and B. Everts (1997). "Technical Review of Forest Management Systems. Ghana Forestry Sector Development Project. MLF Accra."

Iftikhar, U. A., K. Mikkel, et al. (2007). Exploring the inter-linkages among and between Compensation and Rewards for Ecosystem Services (CRES) and human well-being: CES Scoping Study Issue Paper no1 ICRAF Working Paper no 36 Nariobi World Agroforestry centre. Physical description :
Publisher : World Agroforestry Centre ICRAF
43.

Irvin, R. A. and J. Stansbury (2004). "Citizen participation in decision mak-ing: Is it worth the effort? ." Public Administration Review **64** 55-65.

Irvin, R. A. and J. Stansbury (2004). "Citizen Participation in Decision Making: Is it worth theeffort?" Public Administration Review **64**: 55-65.

Johnson, C. (2004). "Uncommon ground: The 'Poverty of history' in common property discourse." Development and Change **35**(3): 407-433.

Kaimowitz, D. (2000). "Forestry assistance and tropical deforestation: why the public doesn't get what it pays for." International Forestry Review **2**: 225–231.

Karl (2005). "Good Governance and Economic Development in Africa."

Kasanga, K. (2002). "Land Tenure, Resources Acess and Decentralisation in Ghana, In Toulmin, C. Delvinille, P. H., Traore, S (Eds), The Dynamics of Resource Tenure in West Africa, Oxford, James Currey/IIED/GRET."

Kasanga, K. and N. A. Kotey (2001). "Land Management in Ghana: Building on Tradition and Modernity." IIED/University of Ghana/ILMAD.

Kerr, J. (2002). "Watershed Development, Environmental Services, and Poverty Alleviation in India." World Development **30**(8).

King, R. (1966). "Wildlife and man." New York Conservationist **20** 8–11.

Kjellén, M. (2003). "From Public Pipes to Private Hands – Water provisioning in Dar Es Salaam, Tanzania, Licentiate Thesis, Dept. of Human Geography, Stockholm University."

Komives, K., B. Akanbang, et al. (2008). "Post-construction Support and the Sustainability of Rural Water Projects in Ghan. Paper presented at the 33rd WEDC International Conference - Access to Sanitation and Safe Water: Global Partnerships and Local Actions (Accra)." 2.

Konarska, K. M., P. C. Sutton, et al. (2002). "Evaluating Scale Dependence of Ecosystem Valuation: A comparison of NOAA-AVHRR and Landsat TM datasets." Ecological Economics **41**: 491-507.

Kopp, R. J. and V. K. Smith, Eds. (1993). Valuing Natural Assets. Resource for the Future. Washington-DC.

Kosoy, N., M. Martinez-Tuna, et al. (2007). "Payments for environmental services in watersheds: Insights from a comparative study of three cases in Central America." Ecological Economics **61**(2-3): 446-455.

Kotey, E. N. A., J. Francois, et al. (1998). "Fallinging to Place. Policy that works for forest and people No 4. International Institute for Environment and Development, London."

Lambin, E. F. and D. Ehrlich (1997). "Identification of tropical deforestation fronts at broad spatial scales." International Journal of Remote Sensing **18**(17): 3551-3568.

Lambin, E. F., H. J. Geist, et al. (2003). "Dynamics of land-use and land-cover change in tropical regions." ANNUAL REVIEW OF ENVIRONMENT AND RESOURCES **28**: 205-241.

Lambin, E. F., B. L. Turner, et al. (2001). "The causes of land-use and land-cover change: moving beyond the myths " Global and Environmental Change **11**: 261-269.

Landell-Mills, N. and I. Porras (2002). "Silver Bullet or Fool's Gold? Markets for Forest Environmental Services and their impact on the poor:." International Institute for Environment and Development, London, UK.

Lele, S. (2006). Payment for forest Ecosystem Services: Conceptual and empirical issues in the Indian context. South Asia regional workshop on compensating for ecosystem services, Institute for social and economic change, Bangalore.

Lillesand, T. M. and R. W. Keifer (1994). "Remote Sensing and image interpretation (4th ed). New York: Wiley."

Limburg, K. E., R. V. O'Neill, et al. (2002). "Complex systems and valuation." Ecological Economics **41**(3): 409-420.

Lins, K. S. and R. L. Kleckner (1996). "Land cover mapping: An overview and history of the concepts." In: J.M. Scott, T.H. Tear and F. Davis, Editors, *Gap analysis: A landscape approach to biodiversity planning*, American Society for Photogrammetry and Remote Sensing, Bethesda, MD: 57-65.

Loomis, J. (2005). "Economic Values without prices: The Importance of Nonmarket values and Valuation for Informing Public Policy Debates." Choices **20**(3): 179-182.

Lu, D. and Q. Wend (2005). "A Survey of Image Classification Methods and Techniques for Improving Classification Performance." International Journal of Remote Sensing **28**(5): 823-870.

Mas, J. F. (1999). "Monitoring land-cover changes: a comparison of change detection techniques." International Journal of Remote Sensing **20**(1): 139-152.

Maveneke, T. N. (1998). Local participation as an instrument for natural resource management under communal area management programme for indigenous resorces in Zimbabwe. Proceeding of an international workshop on community-based natural resourc management. Wahington, D. C., May 10-14, 1998.

Mayrand, K. and M. Paquin (2004). "Payments for environmental services: a survey and assessment of current schemes. Unisfera International Centre for the Commission for Environmental Cooperation of North America, Montreal ".

Meyer, W. B. and B. L. Turner II (1992). "Human Population Growth and Global Land-Use/Cover Change." Ecology and Systematics **23**: 39-61.

Michael, J., S. J. Scherr, et al. (2004). "Markets for Biodiversity Services : POTENTIAL ROLES AND CHALLENGES." Environment **46**(6): 32-42.

Mikitin, K. (1995). Issues and Options in the Design of GEF-Supported Trust Funds for Biodiversity Conservation. Washington, DC, World Bank, Global Environment Division.

Millennium Ecosystem Assessment (2005). "Millennium Ecosystems and Human Well-Being: Synthesis."

Millennium Ecosystem Assessment (2003). Ecosystems and human well-being. A Framework for Assessment.

Mitchell, R. C. and R. T. Carson (1989). "Using Surveys to Value Public Goods. The Contingent Valuation Method." Resources for the Future, Washington, DC.

Muñoz-Piñaa, C., Alejandro Guevarab, et al. (2005). "Paying for the hydrological services of Mexico's forests: Analysis, negotiations and results " Ecological Economics.

Mutunga, C. and M. Samuel (2006). "Inventory for Ecosystem Service Payment in Kenya." Katoomba Group in conjunction with BEA International and Kenya Resource Centre for Indigenous Knowledge

Nature, W. W. F. f. (2006). "Payments for Environmental Services An equitable approach for reducing poverty and conserving nature ".

Niesten, E. and R. Rice (2004). "Sustainable forest management and conservation incentice agreements." International Forestry Review **6**: 56-60.

Odum, E., and Odum, H. (1972). "Natural areas as necessary components of man's total environment', in Transactions of the 37th North American Wildlife and Natural Resources Conference." Wildlife Management Institute **37** 178–189.

Ojeda, M. I., A. S. Mayer, et al. (2007). "Economic valuation of environmental services sustained by water flows in the Yaqui River Delta." Ecological Economics: 1-12.

Osei, E. M. J. and Y. X. Zhou (2004). "Land cover change detection in West Jilin using ETM + images." Journal of Geoscientific Research in N. E. Asia **7(1)**: 74-84.

Ostrom, E. (1990). "Governing the Commons: The Evolution of Institutions for Collective Action. New York: Cambridge University Press."

Ostrom, E. (1992). "Crafting Institutions for Self-Governing Irrigation Systems. San Francisco: ICS Press. (A Publication of the Center for Self-Governance.) ".

OTTO (2006). "Status of tropical forest management 2005: Intergovernmental Organization Promoting the Conservation and Sustainable management, use and Trade of Tropical forest resources."

Pagiola, S. (2002). "Paying for Water Services in Central America: Learning from Costa Rica."

Pagiola, S. (2003). Paying for the Environmental Services of Protected Areas: Involving the Private Sector. Fifth World Parks Congress: Sustainable Finance Stream. Durban, South Africa.

Pagiola, S., P. Agostini, et al. (2004). "Paying for biodiversity conservation services in agricultural landscapes. Environment Dept Paper , Washington DC " (96).

Pagiola, S., A. Arcenas, et al. (2005). "Can payments for environmental services help reduce poverty? An exploration of the issues and the evidence to date from Latin America:The World Bank, Washington DC." World Development **33**(2): 237-253.

Pagiola, S., J. Bishop, et al. (2002). "Selling Forest Environmental Services: Market-based Mechanisms for Conservation and Development." Earthscan Publications, London, UK.

Pagiola, S. and G. Platais (2007). "Payments for Environmental Services: From Theory to Practice." Washington: World Bank.

Pagiola., S., A. Arcenas., et al. (2005). "Can payments for environmental services help reduce poverty? An exploration of the issues and evidence to date from Latin America. ." World Development: 33, 2, 237-253

Pattanayak, S. K. (2004). "Valuing Watershed Services: Concepts and Empirics from Southeast Asia." Agriculture, Ecosystem and Environment **104.1**: 171-184.

Pearce, Özdemiroglu, et al. (2002). "The stages of analysis in a stated preference study ".

Pearce, D. (1993). "Economic Values and the Natural World. London Earthscan."

Pearce, D., and Moran, D (1994). "The Economic Value of Biodiversity." The World Conservation Union London: 50.

Pearce, D., A. Markandya, et al. (1989). "Blueprint for a Green Economy, London, Earthscan ".

Pearce, D., F. Putz, et al. (2003). "Sustainable forestry in the tropics: panacea or folly?" Forest Ecology and Management **172**((2-3)): 229-247.

Pearce, D. and R. k. Turner (1990). "Economics of Natural Resources and the Environment."

Perrot-Maître, D. and Patsy Davis Esq (2001). "Case Studies of Markets and Innovative Financial Mechanisms for Water Services from Forests." Forest Trends and the Katoomba Group.

Pimentel, D. and C. Wilson (1997). "Economic and environmental benefits of biodiversity." Bioscience **47**: 747–758.

Postel, S., and Richter, B., (2003). "Rivers for Life: Managing Water for Peopleand Nature." Island Press, Washington, D.C.

Postel, S. L. and B. J. Thompson (2005). "Watershed Protection:Capturing the benefits of nature's water supply services." Natural Resource Forum(29).

Powell, I. and A. White (2001). A conceptual framework for developing markets and market-based instruments for environmental services of forests Paper prepared for Developing Markets for Environmental Services of Forests. October 4, Vancouver, British Columbia. 2000.

Powell, I., A. White, et al. (2002). "Developing Markets for the Ecosystem Services of Forests, Forest Trends, Washington DC."

Reid, W. V. (2001). "Capturing the value of ecosystem services to protect biodiversity."

Ribot, J. C. (1998). Decentralization and Participation in Sahelian Forestry: Legal Instruments of Central Political-Administrative Control. Presented at "Crossing Boundaries," the seventh annual conference of the International Association for the Study of Common Property. Vancouver, British Columbia, Canada, .

Rosa, H., D. Barry, et al. (2004). "Compensation for environmental services and rural communities: Lessons from the Americas. Political Economy Research Institute Working Paper Series 96, University of Massachusetts, Amherst ".

Rosa, H., S. Kandel, et al. (2003). Payments for environmental services and rural communities: Lessons from the Americas. International Conference on Natural Assets. Tagaytay City - The Phillipines. **14**.

Ruhl, J. B., C. L. Lant, et al. (2003). "Proposal for a Model State Watershed Management Act, Environmental Law (Lewis and Clark Law School) 929."

RUPES (2002). Primer on Developing Mechanisms for Rewarding the Upland Poor in Asia for Environmental Services They Provide Los Baños, Laguna, the Philippines, World Agroforestry Centre.

Sachs JD, R. (2006). "Environment: Investments toward sustainable development." Science **312**: 1002.

Sagoff, M. (1997). "Do We Consume Too Much? Ruffin Lectures in Business Ethics, University of Virginia, Charlottesville, VA."

Salafsky, N. and E. Wollenberg (2000). "Linking livelihoods and conservation: A conceptual framework and scale for assessing the integration of human needs and biodiversity." World Development **28** (8): 1421-1438.

Salzman, J. (2005). "The promise and perils of payment for Ecosystem Services." International Journal of Innovation and Sustainable Development(1): 1 - 2.

Sandra, L. P. and H. T. Barton, Jr (2005). "Watershed protection: Capturaing the benefits of nature's water supply services." Natural Resources Forum **29**: 98-108.

Scherr, S., A. White, et al. (2004). "Tropical forests provide the planet with many valuable services. Are benefi ciaries prepared to pay for them?" ITTO Tropical Forest Update **14** (2): 11-14.

Schlager, E. and E. Ostrom (1992). "Property-Rights Regimes and Natural Resources: A Conceptual Analysis." Land Economics **68**(3): 249-262.

Sela, O. E. (2000). "Biodiversity: Global Biodiversity Scenarios for the year 2100." Science **287**: 1770-1774.

Shalaby, A. and R. Tateishi (2007). "Remote sensing and GIS for mapping and monitoring land cover and land-use changes in the Northwestern coastal zone of Egypt." Applied Geography **27**(1): 28-41.

Singh, A. (1989). "Digital change detection techniques using remotely sensed data." **10**: 989-1003.

Smith, P. D. and M. H. McDonough (2001). "Beyond public participation:Fairness in natural resource decision making." Society and NaturalResources **14** 239-249.

Stålgren, P. (2006). "Worlds of Water: Worlds Apart. How Targeted Domestic Actors Transform International Regimes. Göteborg, Göteborg University."

Stenseke, M. (2009). "Local participation in cultural landscape maintenance: Lessons from Sweden." Land Use Policy **26**(2): 214-223.

Steven, S. T. H. (2005). "Can Stated Preference Valuation Help Improve Environmental Decision Making." Choices **20**(3): 189-193.

Suleymanova, M. (2002). "Access to Water in Developing Countries : State of the World Population. New York: United Nations."

Suyanto, S. L., P. Beria, et al. (2005). " Review of the Development Environmental Services Market in Indonesia." ICRAF. RUPES.

Swallow, B., R. Meinzen-Dick, et al. (2005). "Localizing demand and supply of environmental services: interactions with property rights, collective action and the welfare of the poor. CAPRi Working Paper 42, IFPRI, Washington DC ".

Tognetti, S. (2001.). "Creating Incentives for River Basin Management as a Conservation Strategy: A Survey of the Literature and Existing Intiatives. World Wildlife Fund, Ecoregion Conservation Strategies Unit, Washington, DC, USA.
."

Troeng, S. and C. Drews (2004). "Money talks: Economic aspect of Marine Turtle use and Conservation, WWF - International Gland Switzerland."

Trust for Public Lands. (1997). "Protecting the Source. Strategies for Watershed Protection. Trust for Public Lands, New York, USA.".

Turner, R. K., J. Paavola, et al. (2003). "Valuing nature: lessons learned and future research directions." Ecological Economics **46**(3): 493 - 510.

Turpie, J. K., B. J. Heydenrych, et al. (2003). "Economic value of terrestrial and marine biodiversity in the Cape Floristic Region: implications for defining effective and socially optimal conservation strategies " Biological Conservation 112, 233-251.

Turpie, J. K., H. Winkler, et al. (2004). "Economic impacts of climate change in South Africa: a preliminary analysis of unmitigated damage costs: In Blignaut, J., de Wit, M. (Eds) Sustainable Options.UCT Press."

UN (1992). International Conference on Water and the Environment. The Dublin Statement on Water and Sustainable Development, Dublin, Ireland.

UN (2002). "Economic and Social Council Article 11 and 12 of the International Covenant on Economic, Social and Cultural Rights."

UN (2005). "Development Programme's Human Development Report."

UNDP (2000). Human Development Report 2000, United Nations Development Programme Oxford University Press, Oxford and New York.

Urama, K. C. and I. Hodge (2006). "Deliberative monetary valuation and the evidence for a new value theory, Land. Economics 84 (3): 469-488." Land. Economics **84** (3): 469-488.

Van Noordwijk, M. (2007). Avoided Deforestation with Sustainable Benefits (ADSB) in Indonesia-research brief. Indonesia-SEA Regional Office, World Agroforestry Centre - ICRAF.

Venkatachalam, L. (2003). "The Contingent valuation method: A Review." Environmental Impact Review **24**: 89-124.

Verburg, P. H., K. P. Overmars, et al. (2006). "Analysis of the effects of land use change on protected areas in the Philippines." Applied Geography **26**(2): 153-173.

Vitousek, P. (1994). "Global Warming: Ecology and Global Change." Ecology **75**(7): 1861 - 1876.

Waage and et al (2005). "A Guide to Conducting Country-Level Inventories of Current Ecosystem Service Payments, Markets, and Capacity Building." Forest Trends.

Waage, S., Mulder I, et al. (2007). "Investing in the Future: An Assessment of Private Sector Demand for Ecosystem Service Business Agreements: A Synthesis of Current Research. Washington, DC: Forest Trends."

Waage, S. S., S. Jenkins, et al. (2006). "A scoping assessment of current work on payments for ecosystem services in Asia, Latin America and East & Southern Africa: A research summary adapted from the full report submitted to the UNDP-GEF project:."

Wagner, M. R. and J. R. Cobbinah (1993). "Deforestation and Sustainability in Ghana - the Role of Tropical Forests." Journal of Forestry **91**(6): 35-39.

Webler, T. and S. Tuler (2001). "Public Participation in Watershed Management Planning: Views on Process from People in the Field." Human Ecology Review **8**(2): 29-39.

Whittington, D. (1998). "Administering Contingent Valuation Surveys in Developing Countries." World Development **26**(1): 21 - 30.

Wilson, E. (1992). "The Diversity of Life. Harvard University Press, Harvard, USA."

Wise, R. M. and J. K. Musango (2006). " A Framework for decision-making using a cost-effectiveness approach: a case study of the Ga-Selati River. ." CSIR, Stellenbosch, RSA and IIED, London, UK.

Wolf, A. T. (1998). "Conflict and cooperation along international waterways." Water Policy **1**(2): 251-265.

World Bank (2000). "World Development Report 2000/2001: Attacking Poverty. Oxford:Oxford University Press."

World Bank and WWF (2003). "World Bank and World Wildlife Fund Alliance for Forest Conservation and Sustainable Use. 2003. Running Pure: The Importance of Forest Protected Areas to Drinking Water Washington, DC: ." 20–21.

World Bank Report (2004). Project Appraisal Document on a proposed credit in the ammount of SDR 71 million (USD 103 million eqivalent) to the republic of Ghana for an urban water project report, World Bank.

World Development Report (2004). "Making Services Work for poor people - World Development Report, World Bank, Washington DC."

Wright, S. J. (2005). "Tropical Forest in a changing environment." Trends in ecology and evolution **20**(10).

Wunder, S. (2001). "Poverty alleviation and tropical forests - what scope for synergies?" World Development **29**(11): 1817-1833.

Wunder, S. (2005). "Payment for enviornmental services: some nuts and bollts. CIFOR Occasional Paper." (40).

Wunder, S. (2006). "Are Direct Payments for Environmental Services Spelling Doom for Sustainable Forest Management in the Tropics." Ecology and Society **11**(2): 23.

Wunder, S. (2007). "The efficiency of payments for environmental services in tropical conservation." Conservation Biology **21**: 48–58.

Wunder, S. and M. Alban (2005). "Decentralized payments for environmental services: Comparing the cases of Pimampiro and PROFAFOR in Ecuador. Special issue on Payments for environmental services: Methods and design in developing and developed countries." Ecological Economics.

WWF (2006). "Ecosystem Services and Payments for Ecosystem Services: Why Should Businesses Care ?" WWF Forum to Promote Ecosystem Services and Payments for Ecosystem Services.

Yuan, F., K. E. Sawaya, et al. (2005). "Land cover classification and change analysis of the Twin Cities (Minnesota) Metropolitan Area by multitemporal Landsat remote sensing." Remote Sensing of Environment **98**(2-3): 317-328.

Zachrisson, A. and FjÃ¤llMistra (2004). Co-management of natural resources : paradigm shifts, key concepts and cases. UmeÃ¥, Mountain mistra.

Zakout, W., B. Wehrmann, et al. (2006). Good Governance in Land Administration: Principles and Good Practices. Washington D.C., World Bank, FAO.

Zilberman, D., M. Wetzstein, et al., Eds. (1993). Renewable and Nonrenewable Resources. Agricultural and Environmental Resource Economics. New York, Oxford University Press.

Appendix

Appendix 1 Questionnaire on WTP survey

STRUCTURED QUESTIONNAIRE FOR OPEN-ENDED WILLINGNESS TO PAY– FACE TO FACE SURVEY

1.1 General Information
1.2 Field Enumerator……..Date……
1.3 Community / Residence……...
2.0 **Respondent's Personal Information**
2.1 Respondent's Name…….
2.2 Age……Gender……..F / M……
2.3 Occupation……...
2.4 Education Level Illiterate ( ) Literate ( ) Primary ( ) Secondary ( ) Tertiary ( )
2.5 Household Size……
2.6 No. of Children / Dependents / Family Size……
2.7 Income Level……
2.8 Daily ( ) Weekly ( ) Monthly ( ) Annually ( )
3.0 **Ecosystem (watershed) Service Value Elicitation Scenario**

Two scenarios about the trend of land use/cover conversion and degradation

Scenario 1 Current trend of land cover conversion continued
Scenario 2 Current trend halted and a hypothetical PES project introduced

3.1 Are you aware of these changes Yes ( ) No ( )
3.2 Do you know what the causes of these changes are Yes ( ) No ( )

If yes, mention them

……
……
……
……

3.3 Can you mention some effects of the changes you know?
4.0 **Watershed Services**
4.1 Do you know of how nature helps to produce water? Yes ( ) No ( )
If yes, indicate what you know and how……
4.2 Are you connected to the public water line? Yes ( ) No ( )
4.3 What is your type of use Domestic Industrial Commercial/Business
4.4 How often do you have water running through your taps in a week.....
4.5 How much is your average water consumption……..
4.6 How much do you pay as average water bill per month……
4.7 Are you satisfied with service condition…….
4.8 If no, where do you get water from Well ( ) Tanker (…) River (…) Bottled (…)
4.9 What is the quality of water you receive…….

5.0 How much do you spend averagely on other water sources per month……...

5.1 Are you willing to pay for a project that will help maintain and sustain water provision? Yes ( ) No ( )

5.2 If yes, why

……

……

If no, why

……

……

5.3 What is the maximum amount you are willing to pay in cedis?

¢1-5 (…) ¢5-10 (…) ¢Above 10 (…)

5.4 Why do you want to contribute such an amount?

……

……

……

Enumerator's Comments

……

……

……

Signature

……

Appendix 2 Accuracy Assessment

Class Name	Reference Totals	Classified Totals	Number Correct	Producer Accuracy	User Accuracy
Riverline vegetation	5	4	4	80%	100%
Dense active bushes	5	7	4	80%	57.14%
Shrub Herbaceous cover	5	5	3	60%	60%
Grass herbs	5	5	4	80%	80%
Built up / bare areas	5	5	5	100%	100%
Water body	5	5	5	100%	100%
Swampy areas	5	4	4	80%	100%
Totals	35	35	29	…..	……
Overall Accuracy			**82.86%**		