VALUING AND CAPTURING THE BENEFITS OF ECOSYSTEM SERVICES OF NYUNGWE WATERSHED, SW RWANDA

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Executive summary

Background

Rwanda's mountain protected areas (PAs) are designed and managed for biodiversity purposes but they also deliver a continued flow of ecosystem goods and services (such as watershed protection, climate regulation, pollination and scenic beauty) in which a large proportion of the rural poor depends on for its survival through subsistence agriculture, collection of safe drinking water and the harvesting of forest products. Not only are the goods and services provided by mountain PAs important for rural livelihoods, they are also crucial to the sustainability of all primary industries (tea production, coffee washing stations, etc.) and the country's economy through the provision of water and hydroelectricity as well as regulation of local and regional climate conditions. Therefore, conserving biodiversity is about much more than just protecting wildlife and their habitats in protected areas. It is about the maintenance of fundamental ecological processes such as hydrological cycles and soil structure and fertility which are central to real progress toward achieving the Vision 2020 and the Millennium Development Goals. This suggests that the search for sustainable development in Rwanda requires an integrated understanding of the relationships among economic activities, ecosystem functioning, and human well-being.

However, despite the contribution of ecosystem services to rural livelihood and national economy as measured by the Gross Domestic Product (GDP), these benefits are often not accounted for, or at best their value is underestimated and setting aside protected areas is still seen as being un-economical or as an opportunity cost by the general public and decision makers rather than an investment in natural capital. Very often the importance of ecosystem services is recognized only upon their loss, such as in the wake of disastrous flooding or loss of power due to sedimentation of hydropower plants as has been the case for Gishwati Forest Reserve.

Because many ecological functions of forests are not directly marketed, they generate an illusion that because their price is zero, so is their economic value. When conservation competes with conversion, conversion wins because its values have markets, whereas conservation values appear to be low or zero. In the absence of markets for carbon dioxide (CO_2) reduction, for example, carbon stored in forests has a zero price. But its economic value is substantial because, released as CO_2; it causes considerable economic damage via the impact of climate change.

Objectives

This study has been commissioned by the USAID-funded Destination Nyungwe Project (DNP) and the GEF-funded UNDP Protected Areas Biodiversity Project and has as objectives to assess the economic value of ecosystem services provided by Nyungwe Forest National Park and to identify mechanisms of capturing these values through Payment for Ecosystem Services (PES). The results of this study will serve two purposes toward decision-making. First, they will reveal the magnitude of the benefits that Nyungwe forest provides for stakeholders and society at large, thus helping to empower decision makers to take a comprehensive approach toward forest management, conservation, and economic development. Second, this study will help to design the required instruments to capture some of the monetary value of benefits and make them available to fund conservation activities and support local communities.

Key results and implications for designing a payment for ecosystem services program in Nyungwe

This study estimated the dollar value of selected ecosystem services (carbon storage and sequestration, watershed protection services, maintenance of biodiversity and opportunity for recreation and tourism) provided by Nyungwe National Park. We used two approaches for this task: market analysis to estimate the economic value of tourism and the avoided costs of the non-market value of ecosystem services. Avoided costs method is used to estimate the costs that could be incurred in the absence of certain services that forests provide such as flood control.

- The value of ecological goods and services provided by Nyungwe forest is estimated at a ***minimum 285 million USD/year***. The major beneficiaries of these services are Electrogaz, REGIDESO_BURUNDI, OCIR THE and COOPTHE, ORTPN and tour operators, rice farmers' cooperative in Bugarama, and the global community.
- The stored carbon is valued at an estimated ***162 million USD/year***.
- The watershed protection services (water supply for irrigation, water for human consumption and industries, flood protection) are valued at an estimated ***117 million USD/year***.
- The maintenance of biodiversity is valued at an estimated ***2 million USD/year***.
- The value of recreation and tourism is estimated at minimum ***3.3 million USD/year***.

Table 1. Total economic value of Nyungwe watershed

Ecosystem services	**Economic Value ($US/year)**	**Beneficiaries**
Watershed protection	117,757,583	Local communities, OCIR THE, Electrogaz, Regideso/Burundi
Biodiversity protection	2,000,000	Global community
Carbon sequestration and storage	162,080,000	Global community
Recreation and tourism	3,372,313	Global community, ORTPN and Tour operators
Total	**285,209,896**	

Many of the benefits identified including carbon sequestration and storage and biodiversity conservation are global and therefore are not realized in terms of financial benefits to the local population and Rwanda, who bear the cost of conservation of Nyungwe forest.

The recognition of above point has encouraged the development of markets around the world in which land users are paid for environmental services that forests provide through conservation and sustainable management. These markets have raised great hope for both protected areas and community development.

Several approaches to payments for ecosystem services (PES) are being tried in different places around the world (developed and developing countries), and these experiences provide key lessons learned and design innovations that may be relevant to Rwanda and Nyungwe, in particular. Moreover, they highlight institutional elements that must be put in place to support and strengthen PES to maximize benefits to conservation and local communities' livelihoods. The following are key elements to consider when designing a PES program.

- First, fundamental institutional and legal reform is often necessary for ecosystem service markets to develop and function effectively and efficiently.
- Second, the long term viability of markets for ecosystem services depends on retaining the support of key local stakeholders, which is related to the benefits they perceive and the sustainability of those benefits in the long term.
- The private sector represents a critical opportunity for PES programs and conservation. However, reducing investment risk by creating a more favorable investment climate – through more secure tenure rights, stricter enforcement of environmental laws, etc. – is essential in any efforts to engage the private sector. Governments need to provide secure legal frameworks for PES contracts, and to find ways of ensuring legal protections for buyers and sellers without overburdening the process and costs with bureaucracy.

Finally the review of international experience suggests a number of promising PES models that could be used for Nyungwe and Rwanda. For success in developing a PES program in Rwanda, the following steps are needed:

- Assess the value of ecosystem services, their beneficiaries and potential markets
- Develop a collaborative framework between different institutions involved to make ecosystem services a national priority. This can be done through an envisioning exercise where all different agencies meet to “envision a sustainable and desirable future of Rwanda”. In the last decade the Government of Rwanda and its development partners have largely been investing in human, social and built capital to achieve its economic development goals. However it is important for key actors to realize that we can not achieve our economic development goals without putting as much investment in our natural capital. All these forms of capital are interdependent and to a large extent complementary in achieving economic development goals and a better quality of life.
- Identify opportunities and risks of using different types of market instruments (public payment schemes, self organized private deals or voluntary markets and ecolabeling or green markets).
- Share experiences, perspectives and lessons about the design and use of ecosystem service market with other countries through study tours
- Design appropriate legal and regulatory framework
- Build the capacity of Rwandans, at both the local and national levels, in designing and implementing ecosystem services markets
- Develop a comprehensive revenue sharing policy that includes not only tourism revenues but all other revenues ecosystem services that are being marketed.

Introduction

Rwanda's mountain protected areas (PAs) are designed and managed for biodiversity purposes, but they also deliver a continued flow of ecosystem goods and services (such as watershed protection, climate regulation, pollination and scenic beauty) in which a large proportion of the rural poor depend on for survival through subsistence agriculture, collection of safe drinking water and the harvesting of forest products. Not only are the goods and services provided by mountain PAs important for rural livelihoods, they are also crucial to the sustainability of all primary industries (tea production, coffee washing stations, etc.) and the country's economy, through the provision of water and hydroelectricity as well as regulation of local and regional climate conditions. Therefore, conserving biodiversity is about much more than just protecting wildlife and their habitats in protected areas. It is about the maintenance of fundamental ecological processes, such as hydrological cycles and soil structure and fertility, which are central to real progress toward achieving the Vision 2020 and the Millennium Development Goals (Box 1). This suggests that the search for sustainable development in Rwanda requires an integrated understanding of the relationships among economic activities, ecosystem functioning, and human well-being.

Box 1. Millennium Development Goals

Goal 1- Eradicate extreme poverty and hunger
Goal 2- Achieve universal primary education
Goal 3- Promote gender equality and empower women
Goal 4- Reduce child mortality
Goal 5- Improve maternal health
Goal 6- Combat HIV-AIDS, malaria and other diseases
Goal 7- Ensure environmental sustainability
Goal 8- Develop a global partnership

However, despite the contribution of ecosystem services to rural livelihoods and the national economy as measured by the Gross Domestic Product (GDP), these benefits are often not accounted for; or at best their value is underestimated. Setting aside protected areas is still seen as being un-economical or as an opportunity cost by the general public and decision makers, rather than an investment in natural capital. Very often the importance of ecosystem services is recognized only upon their loss, such as in the wake of disastrous flooding or loss of power due to siltation of hydropower plants, as has been the case for Gishwati Forest Reserve.

The reason for the continued under-valuation of the benefits of natural ecosystems is that it is still difficult to express the (ecological, socio-cultural and economic) importance of the functions of natural ecosystems in monetary terms, because most of the benefits are not expressed in a currency that is comparable to conventional, market-based prices (Costanza et al., (1997); Balmford et al. (2002)). Due to their nature of “externalities” and “public goods”, ecosystem services are usually undersupplied by the market. In addition to this, markets may fail to reflect the benefits of non-market ecosystem services due to the lack of information about their contribution to human welfare and lack of secure property rights over forest lands (Bishop, 1999).

The United Nations Development Programme (UNDP, 2004) clearly sets out the interlinkages between biodiversity, ecosystem services and the goal of meeting sustainable development; through action on the Millennium Development Goals (MDG) (see Box 1) adopted at the UN Millennium Summit in September 2000, as follows:

- Eradicating hunger (MDG 1) depends on sustainable and productive agriculture, which in turn relies on conserving and maintaining agricultural soils, water, genetic resources and ecological processes;
- The capacity of fisheries to supply hundreds of millions of the world's people with the bulk of their animal protein intake depends on the maintenance of ecosystems (e.g. wetland ecosystems such as mangroves and coral reefs) that provide fish with habitat and sustenance; and
- MDGs aimed at improving health and sanitation (MDGs 4, 5 and 6) require healthy, functioning freshwater ecosystems to provide adequate supplies of clean water; and genetic resources for both modern and traditional medicines.

Worldwide, quantifying the value of ecosystem services has become an important tool for assuring social recognition and acceptance of the public management of ecosystem services (Villa et al., 2002). However, in Rwanda the knowledge of the magnitude and value of forest ecosystems services is still limited, which is likely why they have often been overlooked in policy decisions concerning sustainable management and conservation. At present, we understand neither the true value of our ecosystem services, nor what it would cost to replace them. What we do know, however, is that not understanding these benefits and potential costs is compromising our ability to make meaningful decisions concerning the balance between nature conservation and economic development. In this context, valuation of ecosystem goods and services could be an important contribution to the formulation and evaluation of conservation and development policies.

While the Government of Rwanda has made some considerable progress with respect to biodiversity conservation, funding for protected areas management is reliant on mountain gorilla tourism and donors' support. Given the uncertainties of the global tourism industry—driven by factors such as the state of the global economy, the price of air transport due to fluctuations in oil prices, and the perceived state of international security—revenues from tourism seem to be unpredictable. Also, unpredictable changes in donor's priorities make the donation-driven model unsustainable and harmful to conservation. Therefore it is essential for Rwanda to identify sustainable financing mechanisms for the long term conservation and management of its protected areas.

This study has been commissioned by the USAID-funded Destination Nyungwe Project (DNP) and the GEF-funded UNDP Protected Areas Biodiversity Project and has as objectives to assess the economic value of ecosystem services provided by Nyungwe Forest National Park and to identify mechanisms of capturing these values through Payment for Ecosystem Services (PES).

This report has two main sections. The first section describes key selected ecosystem services provided by Nyungwe watershed (which is composed by Nyungwe Forest National Park and its contiguous forests and buffer zones) provides an analysis of the estimated economic value of these services. The second section provides an overview of current ecosystem services market worldwide and some implications for designing and implementing a payment for ecosystem services (PES) in Rwanda and particularly in Nyungwe.

Definition and classification of ecosystem services

Ecosystem services are the benefits humans receive, directly or indirectly, from ecosystems (Costanza et al. 1997, Daily 1997). They occur at multiple scales, from climate regulation and carbon sequestration at the global scale; to flood protection, soil formation, and nutrient cycling at the local and regional scales. The Millennium Ecosystem Assessment (2005) identifies four types of ecosystem services; supporting services, provisioning services, regulating services, and cultural services. Table 1 reproduces the Millennium Ecosystem Assessment (WRI 2005) categories and illustrates a variety of these services.

Provisioning services comprise the production of basic goods such as crops and livestock, freshwater, fodder, timber and biomass fuels, genetic resources and chemicals.

Regulating services are the benefits obtained as ecosystem processes affect the physical and biological world around them. These services include flood protection and coastal protection, pollination; regulation of water and air quality; the modulation of disease vectors; the absorption of wastes; and the regulation of climate. Many of these services are not priced by the market; nonetheless, they contribute to economic output in two ways.

Some regulating services increase economic output directly. For example, mangrove ecosystems regulate water quality and control erosion, which allows the local ecosystem to support a larger population of fish. Regulating services also increase output indirectly in ways that can be understood via the economic notion of opportunity costs. For example, natural wetlands purify drinking water and provide flood control. If natural wetlands and the services they provide are destroyed, to maintain economic well-being, wetland ecosystem services would be replaced by a water filtration plant and a system of dams and levees. Their construction and operation would consume capital and labor that otherwise would be available to produce other goods and services. The value of these other goods and services, which are lost due to the construction and operation of the filtration plant, dams, and levees, are termed opportunity costs, and represent the economic value of the ecosystem services provided for free by the wetlands.

Cultural services are the nonmaterial benefits people obtain from ecosystems through spiritual enrichment, cognitive development, reflection, recreation, and aesthetic experiences. Cultural services, which are mostly intangible, emerge from individual or collective perceptions, and thus are highly dependent on cultural context. They include spiritual and religious values, aesthetic values, recreation and ecotourism, cultural diversity, education values, sense of a place and cultural heritage.

Supporting services are those that are necessary for the production of all other ecosystem services. Their impacts are indirect or extend over long time-scales. They include primary production of biomass through photosynthesis, soil formation, production of atmospheric oxygen, and nutrient cycling. Supporting services are basic ecological processes that maintain ecosystems without necessarily benefiting people directly. The value of these services is reflected in the other three types of services discussed above (Hein et al, 2005).

Table 1. List of Ecosystem services and their categories.

Ecosystem functions and services	Description	Examples
Supportive functions and structures	Ecological structures and functions that are essential to the delivery of ecosystem services	See below
Nutrient cycling	Storage, processing, and acquisition of nutrients within the biosphere	Nitrogen cycle; phosphorus cycle
Net primary production	Conversion of sunlight into biomass	Plant growth
Pollination and seed dispersal	Movement of plant genes	Insect pollination; seed dispersal by animals
Habitat	The physical place where organisms reside	Refugium for resident and migratory species; spawning and nursery grounds
Hydrological cycle	Movement and storage of water through the biosphere	Evapotransporation; stream runoff; groundwater retention
Regulating services	Maintenance of essential ecological processes and life support systems for human well-being	See below
Gas regulation	Regulation of the chemical composition of the atmosphere and oceans	Biotic sequestration of carbon dioxide and release of oxygen; vegetative absorption of volatile organic compounds
Climate regulation	Regulation of local to global climate processes	Direct influence of land cover on temperature, precipitation, wind, and humidity
Disturbance regulation	Dampening of environmental fluctuations and disturbance	Storm surge protection; flood protection
Biological regulation	Species interactions	Control of pests and diseases; reduction of herbivory (crop damage)
Water regulation	Flow of water across the planet surface	Modulation of the drought–flood cycle; purification of water
Soil retention	Erosion control and sediment retention	Prevention of soil loss by wind and runoff; avoiding buildup of silt in lakes and wetlands
Waste regulation	Removal or breakdown of nonnutrient compounds and materials	Pollution detoxification; abatement of noise pollution
Nutrient regulation	Maintenance of major nutrients within acceptable bounds	Prevention of premature eutrophication in lakes; maintenance of soil fertility
Provisioning services	Provisioning of natural resources and raw materials	See below
Water supply	Filtering, retention, and storage of fresh water	Provision of fresh water for drinking; medium for transportation; irrigation
Food	Provisioning of edible plants and animals for human consumption	Hunting and gathering of fish, game, fruits, and other edible animals and plants; small-scale subsistence farming and aquaculture
Raw materials	Building and manufacturing Fuel and energy Soil and fertilizer	Lumber; skins; plant fibers; oils; dyes Fuelwood; organic matter (e.g., peat) Topsoil; frill; leaves; litter; excrement
Genetic resources	Genetic resources	Genes to improve crop resistance to pathogens and pests and other commercial applications
Medicinal resources	Biological and chemical substances for use in drugs and pharmaceuticals	Quinine; Pacific yew; echinacea
Ornamental resources	Resources for fashion, handicraft, jewelry, pets, worship, decoration, and souvenirs	Feathers used in decorative costumes; shells used as jewelry
Cultural services	Enhancing emotional, psychological, and cognitive well-being	See below
Recreation	Opportunities for rest, refreshment, and recreation	Ecotourism; bird-watching; outdoor sports
Aesthetic	Sensory enjoyment of functioning ecological systems	Proximity of houses to scenery; open space
Science and education	Use of natural areas for scientific and educational enhancement	A "natural field laboratory" and reference area
Spiritual and historic	Spiritual or historic information	Use of nature as national symbols; natural landscapes with significant religious values

Source: Farber et al. 2006

Ecosystem services of the Nyungwe watershed

The Nyungwe watershed located in Southwest Rwanda (figure 1) constitutes the largest forest of mountain rainforest remaining in Rwanda, and provides habitat to a range of wild animals and plants species. It contains 13 primate species, including the owl-faced monkey (*Cercopithecus hamlynii*) and L'Hoest's monkey (*Cercopithecus lhoesti*), both restricted-range species and chimpanzees (Pan troglodytes schweirnifuti). Also 278 bird, 32 amphibian and 38 reptile species have been recorded for the park (Plumptre et al. 2003).

Of 1068 plant species recorded in Nyungwe, approximately 250 are endemic to the Albertine Rift (Troupin 1992). In addition to its biological diversity, Nyungwe forest national park functions as the water catchment for the majority of Rwanda. As such, it protects a major watershed for surrounding communities and communities that live downstream. People living near the forest experience longer periods of rain each year, supporting their farming activities around the forest. Also, streams flowing from Nyungwe feed into the Nile and Congo basins.

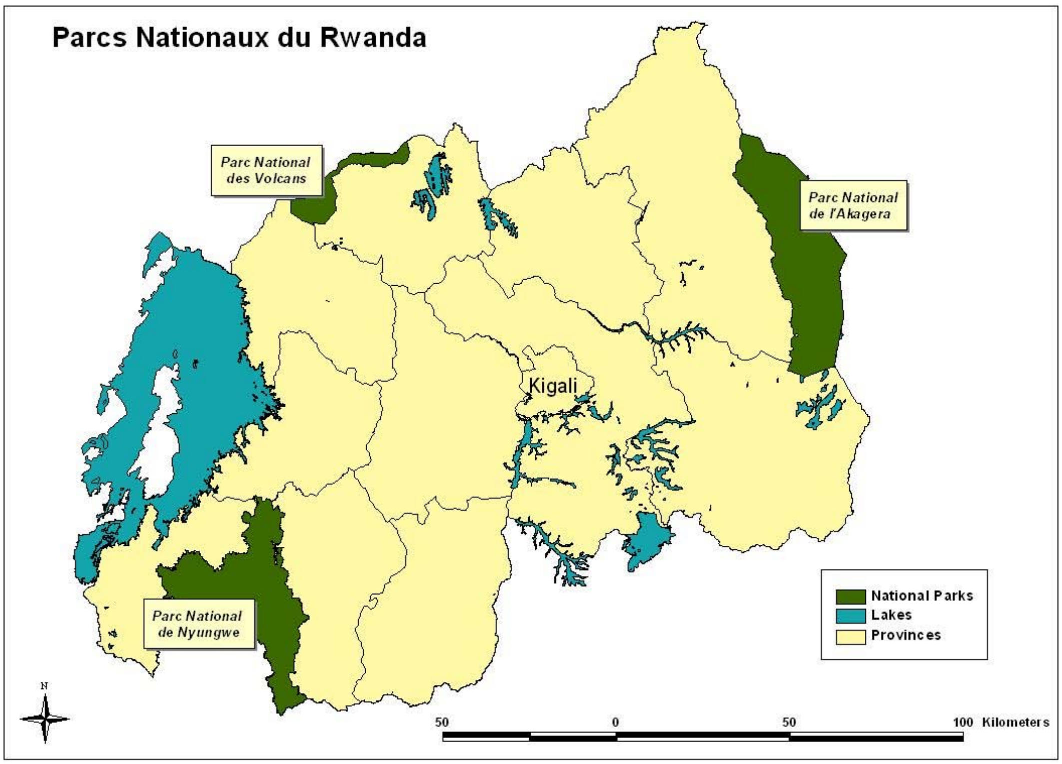

Fig 1. Location of Nyungwe Forest National Park

The ecosystem services that we propose to evaluate in this study are listed below:

1. ***Carbon sequestration and storage****:* On a global level, forest vegetation absorbs atmospheric carbon dioxide and thereby reduces accumulation of greenhouse gases in the atmosphere and the potential for global warming. Tropical deforestation, forest fires and other land use change contribute approximately 20% of the global carbon dioxide emissions. Therefore the importance of tropical forests as a source and a store of carbon

mean they can play a key role in slowing climate change.

2. ***Watershed protection:*** Watershed protection services are among the most valuable of many ecosystem services from forests. The most important services include the regulation of water flow, maintenance of water quality, control of erosion and sedimentation, and maintenance of aquatic productivity. These services are described in Box 2.

3. ***Biological diversity***: Biodiversity is defined as the variability among living organisms in terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part. Protecting biological diversity ensures a wealth of potentially valuable genetic material, such as that used in selective breeding to improve yields of commercial crops and livestock (Pimentel et al. 1997). Genetic diversity also contributes to the development of pharmaceuticals that improve the quality and length of human life and to biotechnology that improves the crop yields and reduces the requirements for chemical pesticides.

4. ***Recreation:*** Mountain forests have an important value as a place where people can come for rest, relaxation and recreation. Through the aesthetic qualities and almost limitless variety of landscapes, Nyungwe National Park provides many opportunities for recreational activities, such as walking, hiking, camping, primate viewing and bird watching. People's willingness to pay for local meals and lodging and to spend time and money on travel to these sites, are economic indicators of the value they place on natural areas.

Box 2 Biophysical relationships that link forests, water and people

The biophysical relationships between forests and water are highly variable from one location to another depending on climate, soils and vegetation types; there is no substitute for site-specific information. The following are a few simplified basic relationships to keep in mind.

Forests can slow the rate of runoff in a watershed: Forest vegetation takes up water and delays the time to soil saturation (after which water pools or runs off the land into the nearest watercourse). Forest soils also usually have a higher water storage capacity than non-forest soils (Falkenmark et al. 1999). The more complex structure of the forest ground surface and underlying soil allows more efficient soil infiltration compared to a deforested watershed. By slowing the rate of runoff, forests may help to minimize flooding in smaller watersheds (although they will not influence large-scale flooding).

Forests can reduce soil erosion and sedimentation of waterways: Interception of rain and snowfall by forest canopies means that less water falls on the ground compared to a deforested watershed. Understorey forest vegetation and leaf litter protects the soil from the impact of rain that does fall through the canopy. Extensive root systems help hold soil more firmly in place and resist shallow-seated landslides compared to clear-cut or heavily disturbed watersheds. Sedimentation levels in forested watersheds are generally lower than in nearby agricultural or urbanized watersheds, but the degree depends on soil types, topography and climate (Falkenmark et al. 1999).

Forest soils filter contaminants and influence water chemistry: Forest soils are more waterlogged than other soils (except wetlands) and contain more nutrients, allowing them to filter out contaminants (Falkenmark et al. 1999). Clearing and cultivating forest soils tends to greatly accelerate decomposition and release large amounts of nutrients that leach into groundwater, surface water runoff, and streams. For example, streams in agricultural areas in temperate regions typically have nitrate levels ten times higher than streams in nearby forested watersheds (which is also partly the result of fertilizer applications).

Forests reduce the total annual water flow in a watershed: Contrary to popular opinion, forests generally reduce the total annual stream flow (Calder 1998). This is because trees consume water for transpiration, which is then evaporated back into the atmosphere. In general, trees consume more water than other types of vegetation, including grasses and annual crops. The degree to which forests reduce stream flow, however, depends on various factors. For example, shallow-rooted trees tend to use less water than deep-rooted trees. Young regenerating forests tend to use much more water than mature and old-growth forests.

Forests can increase or decrease groundwater recharge: Forest cover can lower groundwater recharge because more precipitation is intercepted by vegetation and returned to the atmosphere through evapotranspiration. In some areas, however, removal of forest cover can result in a crusting of the soil surface that reduces or prevents water infiltration and groundwater recharge (Falkenmark et al. 1999).

Forest loss shifts aquatic productivity: Forest cover plays an important and complex role in sustaining aquatic productivity (Revenga et al. 2000). Trees shade waterways and moderate water temperatures. Woody debris provides fish with habitat while leaves and decaying wood provide nutrients to a wide array of aquatic organisms.

Forests may influence precipitation at a large regional scale, but the effect of forest cover on rainfall in most areas is limited: The distribution of forests is a consequence of climate and soil conditions – not the reverse. Some evidence suggests that large-scale deforestation has reduced rainfall in China and some climate models indicate that extensive forest losses in Amazonia and Central Africa could lead to a drier climate (Institute of Hydrology 1994). Still, afforestation is not an effective strategy to increase rainfall (Kaimowitz 2000).

Source: Johnson et al. (2001)

Methods and Results

Measuring Values for Ecosystem Services

Not all easily-identified ecological services can be expressed in monetary terms. In addition, many ecological services may not yet be identified, and the value to future generations is not counted. As a result, monetary estimates of the value produced by natural systems are inherently ‘underestimates’. For example, while we may be able to place a monetary value on the water filtration services provided by a forest, we cannot fully capture in monetary terms the aesthetic pleasure humans gain from looking at the forest, nor every aspect of the forest's role in supporting the intricate web of life. There are always many values we can name but for which we cannot establish prices or costs. Thus, ecological service valuations are not intended to capture all value, but rather to serve as markers below the minimum value of the true social and ecological value of an ecological service (Barclay and Batker, 2004).

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.

Economists have developed several specialized techniques to measure the value of marketed and non-marketed good and services provided by natural ecosystems.

While measuring market values simply requires monitoring market data for observable trades, non-market values of goods and services are much more difficult to measure. When there are no explicit markets for services, more indirect means of assessing values must be used. A range of valuation techniques commonly used to establish values when market values do not exist are identified in Table 2. Each valuation methodology has its own strengths and limitations, often restricting its use to a select range of ecosystem goods and services within a given landscape. In this study, we used market analysis to estimate direct use values and the avoided costs method to generate baseline estimates of other ecosystem service values of Nyungwe watershed.

Table 2: Non-Market Economic Valuation Techniques

Avoided Cost (AC): Services allow society to avoid costs that would have been incurred in the absence of those services; flood control provided by barrier islands avoids property damages along the coast.
Replacement Cost (RC): Services could be replaced with man-made systems; nutrient cycling waste treatment can be replaced with costly treatment systems.
Factor Income (FI): Services provide for the enhancement of incomes; water quality improvements increase commercial fisheries catch and incomes of fishermen.
Travel Cost (TC): Service demand may require travel, whose costs can reflect the implied value of the service; recreation areas attract distant visitors whose value placed

on that area must be at least what they were willing to pay to travel to it, including the imputed value of their time.
Hedonic Pricing (HP): Service demand may be reflected in the prices people will pay for associated goods: For example, housing prices along the coastline tend to exceed the prices of inland homes.
Marginal Product Estimation (MP): Service demand is generated in a dynamic modeling environment using a production function (i.e., Cobb-Douglas) to estimate the change in the value of outputs in response to a change in material inputs.
Contingent Valuation (CV): Service demand may be elicited by posing hypothetical scenarios that involve some valuation of alternatives; e.g., people generally state that they would be willing to pay for increased preservation of beaches and shoreline.
Group Valuation (GV): This approach is based on principles of deliberative democracy and the assumption that public decision making should result, not from the aggregation of separately measured individual preferences, but from *open public debate.*

Carbon sequestration and storage

Forests contain large quantities of carbon that may be released into the atmosphere if they are logged or burned for shifting cultivation, permanent agriculture and pasture resulting in increased carbon dioxide (CO_2) emissions. These various land uses differ in their effect on vegetation and soil, and therefore in the amount of $C0_2$ released in atmosphere when a unit area of forest is converted. In theory, therefore, standing forests are economically valuable if they are at risk of conversion, because preventing conversion also prevents potentially substantial rises in CO_2 emissions. We considered the economic value of forests for the avoided emissions of carbon that is currently stored in aboveground biomass.

According to Frangi & Lugo 1985, Rai & Proctor 1986, Brown & Lugo 1992, Fearnside 2000, Houghton *et al.* 2000, Hughes *et al.* 2000, Nascimento & Laurance 2002, Zheng *et al.* 2006, each hectare of old-growth tropical rainforest typically contains 120–400 tons of carbon in its aboveground vegetation and much more if below ground biomass is considered. In this study we used a conservative figure of 200 tons of carbon per hectare. The current value of a ton of carbon varies between 4 and 12 US Dollars (USD). We used an average value of 8 USD per ton CO_2 to calculate the economic value of carbon contained in the standing biomass in Nyungwe. At current market value, a hectare of Nyungwe forest, if left intact, could be worth 1,600 USD or more. For the total area of 101,300 ha, the economic value of carbon storage is about USD **162,080,000** per year.

Watershed protection services

Watershed protection services include: soil conservation and hence control of siltation and sedimentation; water flow regulation including flood and storm protection; water supply and water quality regulation including nutrient outflow. Forest ecosystems are key determinants of the quantity and quality of water available for human use. Poor water quality and inadequate water quantity affect agricultural production, hydropower production, quality of life and human health. As the human population increases and the availability of high quality water declines, the watershed services of forests will likely become increasingly important.

Forest degradation results in flooding and soil erosion that in turn has tremendous negative impacts, all the way to downstream farmers who experience erosion and flooding. Likewise, forest denudation would negatively impact water supply and hydroelectricity production. Rwanda is experiencing the negative impacts of the deforestation of Gishwati forest that occurred in the last decade. This has resulted in frequent flooding and power shortages due to sedimentation of Gisenyi hydro electrical power plant.

The estimation of the total value of Nyungwe's watershed protection services requires the estimation of each of these individual costs avoided as a result of the forest's presence. To estimate the additional costs which would occur in case of the absence of the Nyungwe forest national park, the avoided cost method was used. The additional production costs represent an approximation of the current benefits of the water supply service of Nyungwe forest. To estimate the additional costs to different users, we used the current economic impacts (costs) of Gishwati deforestation on different users (OCIR THE, Electrogaz and local community) as benefits provided by the Nyungwe forest national park.

a) Erosion and sedimentation control

- Water supply for domestic consumption

To estimate the additional costs which would occur for Electrogaz, the main water supplier, in case there would be a reduction in water quality delivered by Nyungwe National Park, the avoided cost method was used. During the artificial treatment of water, one of the main and most costly steps is the removal of sediments from water with specific reactants so that the parameters of color and turbidity reach the recommended values. Degradation of Nyungwe NP forest ecosystems would increase sediment content in water. To estimate the additional costs for Electrogaz and for the removal of additional sediments, a comparison was made between the average dose of reactants used by water plants (Nyamabuye and Cyunyu) located in Nyungwe watershed; to treat water, and the water coming from the Sebeya River, which comes from a watershed (Gishwati forest) which is almost without forest cover due to previous deforestation and expansion of pasture, agriculture and settlements. Nyamabuye and Cyunyu water plants treat respectively 291,979 m^3 and 500,720 m^3 of water annually. The most costly reactant mainly used to remove sediments is aluminum sulphate ($US 0,65/ kg). The average doses of aluminum sulphate used to remove sediments from water plants located in the Nyungwe watershed varies between 0 and 40 g/m^3. For Sebeya River in Gisenyi the maximum dose of aluminum sulfate used is 143 g/m^3, which is a difference varying between 103 and 143 g/m^3.

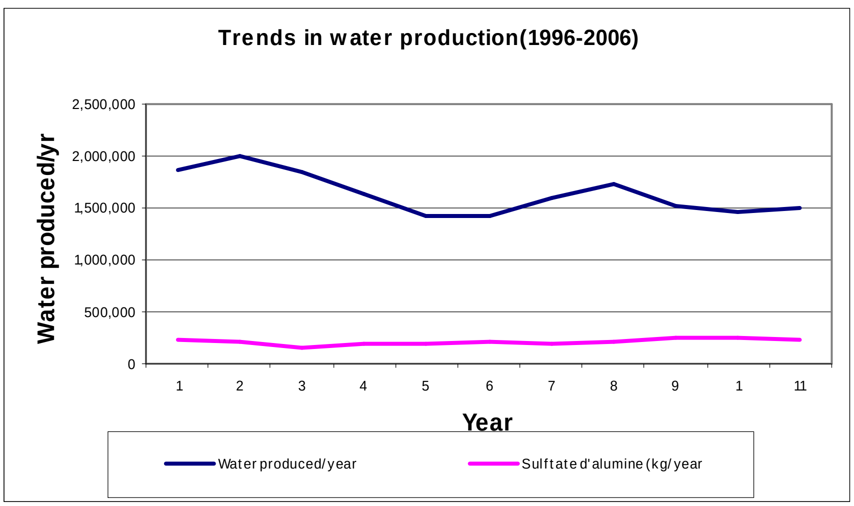

Figure 2. Trends in water production and quantity of aluminum sulfate used by Electrogaz in Sebeya River

If forest cover from Nyugwe NP was degraded, it can be assumed that the quantities of sediments in water delivered from Nyungwe NP would augment to levels at least similar to the ones of Sebeya, and it would be necessary to use a similar dose of aluminum sulphate to remove sediments. Based on these considerations, it has been estimated that the annual avoided costs for Electrogaz by using the Nyungwe forest water supply service is between US$ **27, 329** and **33, 758**. We used US$ **30,000** as the average annual avoided cost for Electrogaz.

– **Water supply for energy production**

Currently there is one hydroelectric power facility in Burundi (Rwegura) benefiting from the presence of Nyungwe National Park. This hydroelectric power facility produces on average 48,887,261 kWh per year. There is also a potential for micro hydropower facilities in the districts around Nyungwe that could potentially produce 78,651,648 kWh/year (MININFRA, 2006). The accumulation of sediments in the dam reservoirs leads to a loss of dam capacity, with associated costs due to reduction of electricity production, dredging of the reservoirs to remove sediments, and economic losses while power generation is halted to make reparations. For example, the annual costs associated with sediment problems at the Gihira power plant located in the Gishwati watershed amount to $US **1,143,543**. The energy loss represents at least 38% of the total production. We used this estimate (proportion) to extrapolate the benefits of Nyungwe to the Rwegura hydro electrical power plants in Burundi.

We assumed that 38% of the total costs that Electrogaz faces because of sedimentation of Gihira power plant is directly associated with the deforestation of Gishwati forest reserve. Based on this assumption, the avoided costs for Rwegura power plant was proportionally calculated from having their drainage area with forest cover in Nyungwe NP. Currently Rwegura power plant produces 48,887,261 kWh per year and generates $US 9,777, 452 per year. Therefore the benefit of erosion and sedimentation control provided by Nyungwe to the REGIDESO (Burundian power supplier) represent about 38% of the current annual production, which is $US **3,715,432** per year.

- **Potential for hydropower supply**

Aside from the hydropower facility in Burundi, there are a number of planned micro hydropower facilities in the Nyungwe watershed that will utilize water being protected by the forests:

Table 3. Planned hydropower facilities around Nyungwe forest national park and its economic value

Planned Dams around Nyungwe NP	Installed capacity (KW)	Total energy (KWh)	Total value/yr ($US/year)	Construction costs/yr (for 50 years) ($US/year)	Maintenance cost/yr (20%/yr)	Total costs ($US/yr)	Net revenue ($US/year)
Ruhwa/Bweyeye	200	1,382,400	301,615	24,567	4,913	29,481	272,134
Kabingo/Gasumo	300	2,073,600	452,422	16,830	3,366	20,196	432,226
Nyirabuhombohombo	500	3,456,000	754,036	33,843	6,769	40,612	713,424
Mazimeru/Nyaruguru	479	3,310,848	722,367	31,680	6,336	38,016	684,351
Rukarara/Nyamagabe	9500	65,664,000	14,326,691	320,000	64,000	384,000	13,942,691
Runyombye/Nyaruguru	400	2,764,800	603,229	19,208	3,842	23,050	580,179
Total	**11,379**	**78,651,648**	**17,160,360**	**446,129**	**89,226**	**535,355**	**16,625,005**

Source: MININFRA, 2001

Total maximum energy that is estimated from the planned dams is 78,651,648 kWh per year, which if valued (at consumer prices of electricity in Rwanda (120 RwF)) falls in the range of US$ **16,625,005** per year. This represents a huge value in terms of potential hydropower supply being provided by the watershed protection services of the Nyungwe Forest. However these figures should be interpreted with caution for several reasons:

a) We assumed the price of a kWh produced by the micro hydropower facilities has the same price as a kWh produced by Electrogaz at national level. However, given the fact that some of these micro hydropower facilities projects could be funded under the clean development mechanisms (CDM) the investment cost for Rwanda will be almost null and therefore the price per kWh will be small compared to the current price of electricity in the country. The **Clean Development Mechanism** (**CDM**) is an arrangement under the Kyoto Protocol allowing industrialized countries with a greenhouse gas reduction commitment (called Annex 1 countries) to invest in projects that reduce emissions in developing countries as an alternative to more expensive emission reductions in their own countries. For example an investment in microhydropower facilities could help reduce local communities' dependency on fuel wood as source of energy and at the same time reduce $C0_2$ emissions from deforestation.

b) The costs of micro hydropower facilities used in this report were estimated few years ago and therefore we assume these costs overestimate the current costs of building the microhydropower facilities. Given the current advances of technology in this area especially in Asia there could be some new technologies that are less expensive.

c) We assumed fifty years lifetime of hydropower facilities and the annual costs of maintenance and operations representing 20 % of the costs of micro hydropower facilities. Given the fact that there are no private power producers and sellers in the country we did not have a clear baseline, therefore our figure of 20% could be an overestimation of annual costs of running the micro hydropower facilities.

- **Water supply for agriculture production**

The production of rice has been given a high priority and the government is seeking to increase productivity from the flood-prone valley bottoms that are conducive for rice growing. The Bugarama rice producing scheme plays a critical role in supplying rice to urban areas because it ranks high in terms of productivity per ha, due to a regular and permanent water flow from Nyungwe.

Bugarama rice farmers benefit from the watershed protection services of Nyungwe because it protects against erosion and floods, which can cause heavy damage on crops during rainy seasons. To estimate the economic value of watershed protection services for rice production we used the avoided cost method. We compared the production costs of 1 kg of paddy in the rice producing scheme of Butare and CODERVAM, located respectively in Southern and Eastern provinces, with the BUGARAMA perimeters located in the Western Province (around Nyungwe forest). Butare and CODERVAM are located in the regions that have been deforested and therefore soil erosion and flooding are likely to occur frequently as a result. Because of this, the production cost of 1 kg of rice paddy is higher than Bugarama because of the additional costs of maintenance of irrigation canals and other costs related to water uses. Deforestation is assumed to result in a reduction of output volumes and an increase in the production costs.

Yield decline in rice production can be ascribed mainly to a deterioration of nutrients in the soil, along with soil erosion, drought and floods, and an increase in weeds. But clearly, these causes of decline are linked to the deforestation occurring in many developing countries.

Table 4. Erosion and sedimentation retention value estimate

Sites	Average production cost (RwF/kg)	Total production (kg/year)	Total production cost /year (RwF/year)
Butare	151	13,428,000	2,020,963,733
CODERVAM/Mutara	125	2,913,000	364,751,295
Bugarama	80	18,373,000	1,468,199,554

Source: MINAGRI, 2006

If forest cover from Nyugwe NP was degraded, it can be assumed that the production costs of 1 kg of rice paddy will be the same as in Mutara and Butare. We calculated the average production cost based on the costs of Mutara and Butare rice and then multiplied it by the annual production of rice paddy in Bugarama to get an estimate of the average annual avoided costs for rice production in Bugarama. Therefore, the average annual avoided cost for rice farmers in Bugarama is estimated at US$ **1,935,801/year.** This amount represents the benefits Nyungwe provides to Bugarama rice farmers.

- **Tea production**

The Rwanda Tea Authority (OCIR THE) owns three major tea estates (Kitabi, Gisakura and Gisovu) around Nyungwe forest, and is one of the major beneficiaries of Nyungwe's watershed protection services. These factories use water from the forest to process the green tea leaves into black tea. During the post harvest processes (withering, rolling, oxidation and firing), the factories use steam from boilers to dry tea. This process requires a regular supply of clean water to boilers. Because the water that is used comes from the Nyungwe forest for free, no attention has been paid to determining the volume of water needed to produce black tea. To estimate the economic value of water supply for tea production, we used the virtual water content of tea. Virtual water content is the volume of water required to produce one unit of tea (m^3/ton of tea) (Chapagain and Hoekstra, 2008).

According to Chapagain and Hoekstra (2008), the global average virtual water for producing 1kg of black tea is 10.4 m^3. We used this figure to calculate the quantity of water used per year in each tea factory for the production of black tea (Gisakura, Gisovu and Kitabi). We estimated that on annual basis OCIR THE uses 58, 240,000 m^3 to produce 5,600,000 kg of black tea and this water comes from Nyungwe free of charge. However if this water is valued at the current price of water utilization by industries or factories in Rwanda (US $1.4/$m^3$) it would represent an annual avoided cost of US $**81,536,000** for OCIR THE .

Table 5. Annual virtual water content of tea

Sites	Annual production (kg black tea/year)	Average virtual water content (m3/kg)	Total virtual water content (m3/year)
Gisakura	2,220,000	10.4	22,880,000
Kitabi	1,700,000	10.4	17,680,000
Gisovu	1,700,000	10.4	17,680,000
Total	**5,600,000**		**58,240,000**

b) Flood prevention

The flood control functions of Nyungwe forest national park have been estimated using the costs of flooding that occurred in 2007 in the western region, as a result of deforestation of Gishwati forest. Estimates from the consultant's field visit and from the Disaster Management Unit in Prime Minister's Office showed that flooding that has occurred in 2007 has damaged 94 ha of tea (30 ha of Pfunda Tea estate and 60 ha of Nyabihu tea estate) and destroyed 1091 houses.

Table 6. Economic impact of flooding in the Western Province (Nyabihu and Rubavu)

	Cost ($US)	Cost ($US/ha/year)
[a] Opportunity costs to Tea Estate	501,333	
[b] Cost of replacing the houses destroyed (1091)	3,334,961	
Total economic impact	**3,846,294**	**137**

Source: [a] Pfunda and Nyabihu tea Estates

[b] Disaster Management Unit, Prime Minister's Office

It should be noted that the figures representing the impacts of flooding on local population are underestimations of reality, because they don't take into account the humanitarian and government assistances provided to displaced populations during and after the disaster. Also, due to the lack of reliable data, some information is missing on the full cost of natural disasters.

To estimate the flood protection benefits of Nyungwe Forest National, we first divided the total cost of flooding by the area of Gishwati forest (28,000 ha) to obtain the cost per hectare per year. We then multiplied the cost per unit area by the current size of Nyungwe Forest national park (101,300 ha) to obtain the annual avoided costs of flooding due to the presence of the forest. This was estimated to be around **$US 13,915,345** per year.

In sum, total watershed protection functions are made up of the following values:

Table 7. Watershed protection value estimates, Nyungwe Forest National park

Watershed Protection Components	**Total Annual Value (US$/year)**	**Annual value (US$/ha/year)**
Water for domestic consumption	30,000	0.30
Water for hydropower production	3,715,432	36.68
Potential micro-hydro power supply	17,160,360	164.11
Tea production	81,536,000	804.9
Agriculture production	1,935,801	19.11
Flood prevention	13,915,345	137.37

Total	**117,757,583**	**1,116**

Biological diversity

People living in areas with a high biodiversity value tend to be relatively poor. Hence, the highest economic values for biodiversity are likely to be found within institutions and people in wealthy countries (Blamfold, 2002). The non-use value associated with nature conservation services is normally analyzed using contingent valuation methods (CVM) (Hailu et al., 2000). Although CVM has increasingly been applied to analyze the non material benefits derived from ecosystems, some authors have questioned the validity of CVM (e.g. Carson, 1998). One of the problems associated with CVM is that respondents do not actually have to pay the amount they express to be willing to pay for a service, which may lead to an overestimation of its value (Diamond and Hausman, 1994; Carson, 1998). Instead, in order to obtain a crude approximation of the monetary value of the biodiversity conservation service, it is assumed that the amount of money contributed to the NGOs that support ORTPN in the management of Nyungwe National park provides an indication of the willingness-to-pay (WTP) of the international community for maintenance of biodiversity in Nyungwe. Although such expenditures do not represent economic value per se, they do indicate a minimum WTP to take advantage of the park resources (IIED, 1994) and recognition of the global benefits derived from keeping the country’s forests and resulting biodiversity intact. However, it is assumed that donors will be interested in continuing funding these activities only if the forest remains in good condition. Therefore, we estimated the amount of money different partners donate for the conservation of Nyungwe National Park per year as an estimation of the biodiversity conservation value, which is about **$ US 2,000,000** per year.

Recreation and tourism

Recreation and tourism value is often determined using the Travel Cost Method (Bockstael, 1995). This is a data intensive technique requiring surveys of tourists as well as comprehensive data on visitation rates. No primary data could be collected during this study, and thus estimation of the tourism value of the Nyungwe National Park relied entirely on existing information and informal discussions with tour operators. This meant that tourism turnover was estimated, but consumer surplus was not considered. Based on their answers and existing information, an estimation of the economic impact in relation to the presence of Nyungwe National Park was calculated.

Economic impact = **Number of Visitors * Average Spending per Visitor * Regional Multipliers**

Multipliers are used to capture the secondary effects of visitor spending in a region. There are two basic kinds of secondary effects:

Indirect effects are the changes in sales, jobs and income within backward-linked industries in the region, (i.e., businesses that supply goods and services to tourism-related firms). For example, hotels/guest houses in the Nyungwe area purchase a variety of goods and services locally in order to produce a night of lodging. Each business that provides goods or services to hotels/guest houses benefits indirectly from visitor spending in hotels. These indirect effects are captured by Type I multipliers.

Induced effects are the changes in sales, jobs and income in the region resulting from household spending of income earned either directly or indirectly from visitor spending. Employees in tourism firms and backward linked industries spend their income in the local region, creating additional sales and economic activity. These impacts are most readily seen when there is a significant drop in tourism activity. Reduced income in the area results in reduced spending that will affect retail stores and other businesses that depend on household spending. Type II multipliers capture both indirect and induced effects.

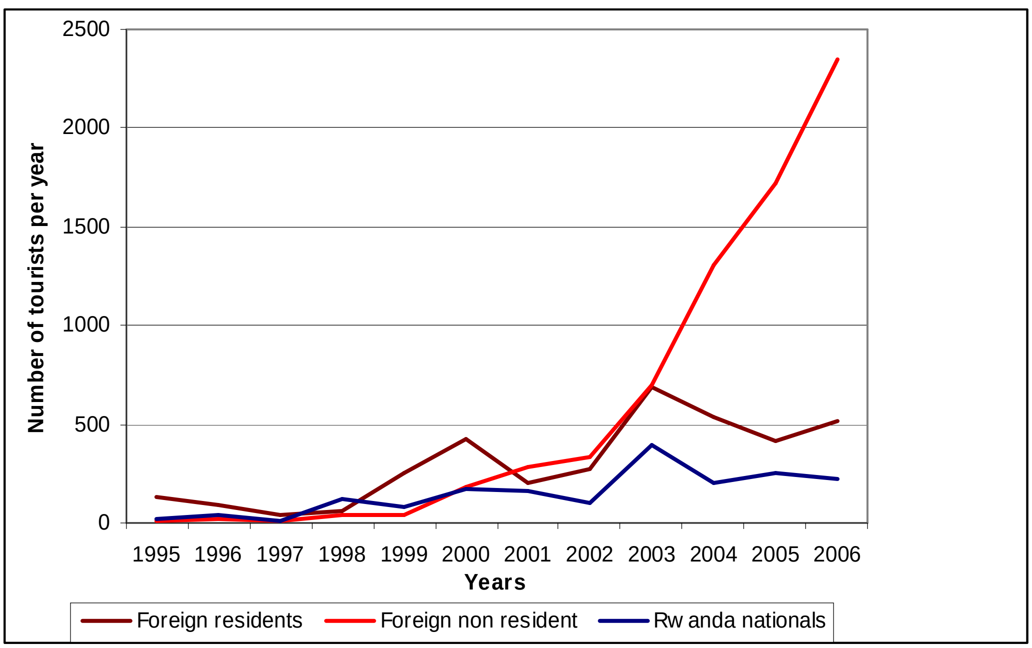

Figure 3: Trend in tourist arrivals in Nyungwe Forest National park (1995-2006)

For a total number 3,089 tourists who visited Nyungwe in 2006, 76% were foreigners living outside the country, 17% were foreigners resident in Rwanda and 16% nationals. We assumed that none of the nationals spend a night in Gisakura guesthouses, and they use their own vehicles to get to Nyungwe. Similarly, we assumed that foreigners living in the country own vehicles and therefore they do not have to rent cars, but they spend nights in the Gisakura guest house or Cyangugu. Finally, based on our observations and discussions with local field staff, we concluded that all foreign non residents tourists rent cars or arrive in Nyungwe with a tour operator and spend at 2 to 3 days in Nyungwe forest.

The total collected entrance and visitation fees in 2006 were estimated at $US 133,753. Based on our assumptions above, the average expenditure per tourist per day was estimated at $US 160 ($US60 for food and accommodation and $US80 for car rental. Also we considered the type I multiplier to estimate the economic impact of tourism in Nyungwe due to data constraints. The results are summarized below:

Table 8. Economic impact of tourism in Nyungwe Forest National Park

Economic measure	Direct effects ($US/year)	Indirect effects ($US/year)	Total effects ($US/year)
Entrance and visitation fees	133,753		133,753
Food, accommodation and transportation	1,079,520	2,159,040	3,238,560
Total economic impact			**3,372,313**

The tourism and recreation value of Nyungwe is estimated at $ US **3,372,313**/year**.** These results represent the minimum economic impact of tourism in Nyungwe and should be interpreted with caution for two reasons: first, the current tourism database at ORTPN is not designed to conduct this type of analysis because it confuses the number of visits and visitors. Second, tour operators were not willing to share their financial information.

Summary of results

Table 9. Total economic value of Nyungwe Forest National Park

Ecosystem services	**Economic Value ($US/year)**	**Beneficiaries**
Watershed protection	117,757,583	Local communities, OCIR THE, Electrogaz, Regideso/Burundi
Biodiversity protection	2,000,000	Global community
Carbon sequestration and storage	162,080,000	Global community
Recreation and tourism	3,372,313	Global community, ORTPN and Tour operators
Total	**285,209,896**	

The total value of ecosystem services provided Nyungwe Forest National Park is estimated to be $US 285 million USD/year. For example, for the total value ($ 285 million), 56.82% is attributed to carbon storage, followed by watershed protection (41.28%), recreation (1.18%) and biodiversity conservation/protection (0.70%).

Although the carbon storage value represents the largest benefits provided by Nyungwe, a number of assumptions regarding the policy context of carbon emissions are needed in order for these economic values to be viable. First, we assumed that avoided deforestation (which is not currently part of the Clean Development Mechanism of the Kyoto Protocol), is a valid means of reducing CO_2 emissions. At least some groups, such as the newly formed Coalition of Rainforest Nations, are pushing strongly to include avoided deforestation in any deal that extends past the current Kyoto Protocol lifespan; avoided deforestation would then join reforestation and afforestation as legitimate means to reduce CO2 emissions (Santilli et al. 2005 and Laurence, 2007). Second, we assumed as a baseline that the whole Nyungwe forest is facing imminent deforestation without an intervention project that invests in the carbon content of its forest. This assumption is necessary to satisfy the “additionality” criterion (Greiner et al. 2003) of the Kyoto Protocol, and given the high rates of population growth in the region and the high demand for agriculture land, is realistic. Third, we assumed the existence of a willing buyer who would invest in Nyungwe forest for its carbon value, and we did not consider the often high transaction costs that can reduce the viability of small CDM projects (Michaelowa et al. 2003).

Conclusion

In this study, we estimated the total value of ecosystem services provided by Nyungwe to be approximately $290 million/year, with carbon storage and watershed services values representing the large share of these benefits. However many of the benefits identified including carbon storage are global and therefore are not realized in terms of financial benefits to the local population and Rwanda, who bear the cost of conservation of this landscape.

Unlike the carbon sequestration and biodiversity conservation services—which benefit the global community, watershed protection benefits accrue to local and regional users and therefore they contribute directly or indirectly to the local and regional economic development.

Although valuing ecosystem services is important to inform decision makers and help planning efforts, it is not sufficient to motivate conservation. There is little point in demonstrating the value of ecosystem services if those values cannot be converted into flows of real resources. Without such mechanisms, many economic values associated with natural habitat habitats will remain outside the calculus of agents who actually make land use decisions (Naidoo and Ricketts, 2006). Therefore it is essential to create markets for ecosystem services for the benefit of the many vulnerable communities that rely on forests for their well-being, and to secure sustainable funding for conservation and management of protected natural ecosystems.

The recognition of above points has encouraged the development of markets around the world in which land users are paid for environmental services that forests provide through conservation and sustainable management. These markets have raised great hope for both protected areas and community development. The following section provides an overview of current markets and the implications for designing a PES program in Rwanda.

Capturing the benefits of ecosystem services in Nyungwe Forest National Park

The past decade has seen the widespread emergence of markets and other systems of financial payments schemes for ecosystem services (Landell-Mills & Porras, 2002 and Mayrand and Paquin, 2004). Payments for ecosystem services seek to capture part of the benefits derived from environmental services and channel them to natural resources managers who generate these services, therefore increasing incentives for their conservation. The many different types of market and payment schemes can be organized into four broad categories (Landell-Mills & Porras 2002):

1) Public payments to private land and forest owners/managers to maintain or enhance ecosystem services

In this system, governments determine what ecosystem services are priorities for protection, and pay landowners or managers directly to manage their land and forest for this purpose. Examples of public payment instruments include: permanent conservation easements (guarantees that such land will not be logged or farmed); contract farmland set-asides for conservation (such as North American and European set-aside programs); programs to co-finance investments in afforestation or sustainable forest management (SFM); and payments for the confirmed presence of endangered wildlife species. Generally, payments are made to individual landholders, but may also be made to common-property forest owner groups or organized watershed users. Payments can also be made to government agencies that manage the forest. These payments may be standardized or negotiated individually.

2) Open trading under a regulatory cap or floor

In this system, a government defines a mandatory level of a specific ecosystem service to be provided, but to achieve this level the regulated party can choose either to comply directly with the requirement or to pay others – who are in a position to supply the service more cheaply – to do so. Essentially, government regulation creates demand, but independent buyers and sellers can respond flexibly by trading with one another. A typical example is carbon emission offset trading, whereby carbon polluters face a regulatory cap on emissions that they can meet either by reducing their own emissions, by paying other parties to do so, or to sequester an equivalent amount of carbon.

3) Self-organized private deals

This approach involves direct, usually closed, transactions between offsite beneficiaries of forest services and forest landholders responsible for the services. Instruments include the purchase of development rights to land and direct payment schemes for ecosystem services. For example, a company selling bottled water may pay upstream landowners to use best management practices on their land to ensure their supply of quality water. A conservation NGO may pay the owners of high-biodiversity-value forest for a long-term ‘conservation concession,’ analogous to a logging concession, to be managed explicitly for conservation. Government agencies may play a minor role in facilitating such deals through appropriate contract law.

4) Ecolabelling of forest or farm products

This fourth approach is also handled by private actors, but the payment for ecosystem services is embedded in a traded product. Producers sell forest or farm products produced under management systems certified to enhance forest ecosystem services. Products are sold to consumers who prefer to support suppliers who are good environmental managers. But there need be no direct transaction between the consumer and the producer of ecosystem services; rather, third-party certification or marketing agents are involved. This approach enables consumers to choose to pay a price premium for products produced in a way that is certified by an independent third party, according to standard criteria, to be ecologically friendly. A typical example for this is the Forest Stewardship Council wood and non-wood product certification.

There are many examples of each type of the market in both developed and developing countries (especially Latin American countries) and for each type of ecosystem services. The section below is organized by the type of ecosystem service markets; and provides an overview of each market, the types of payments mechanisms used in the world, and some legal and policy frameworks used.

Watershed protection services

Unlike carbon sequestration and many biodiversity conservation services—which benefit the global community, watershed protection services are typically primarily of interest to local and regional users (Landell-Mills & Porras 2002). Markets for watershed services are site and user specific and therefore it may be easy to identify beneficiaries.

Payments for watershed protection services can be grouped into several categories including water quality, water quantity, and flood control. The main groups of beneficiaries include hydroelectric power generators, municipal water supply systems, irrigation systems, industrial users, and populations in flood prone areas (Pagiola et al. 2002).

The payment schemes for watershed services are shaped by the nature of the services provided, who supplies it, who receives it, how economically important it is and what the legal and regulatory systems are in place. There are a variety of institutional mechanisms and economic tools, including markets and other financial mechanisms that are being used to encourage higher level of protection of watershed services on forest lands, which are reflected in examples Boxes 3 and 4. Public payment schemes and self-organized private deals are most predominant worldwide and especially in developing countries. Open trading schemes are limited to developed countries where governments have stronger environmental regulation. We will not discuss this type of payment as there are few case studies relevant to developing countries.

Box 3. *Example of self-organized private deals for watershed services*

In France, Perrier-Vittel, the world's largest bottler of natural mineral water found that reforesting sensitive infiltration zones, assisting farmers with financing to build modern facilities, and switching to organic farming practices are cheaper than building infiltration plants.

In Costa Rica, there is an example of a voluntary agreement in place since 1998 between a hydroelectric power company and the conservation organization "Monteverde Conservation League", where the company pays 10 US$/ha per year to the NGO for maintenance of forest hydrological services in the Peñas Blancas watershed (Reyes et al., 2002).

In Colombia, water users' associations charge fees on the large agricultural producers in the Cauca Valley, to finance watershed management practices (reforestation, erosion control etc.) in upland areas (Perrot-Maître & Davis, 2001).

In public payment schemes, government or a public-sector institution pays for the watershed service. Financing 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.

Box 4. Examples of public payment schemes

Mexico has created the Payment for Hydrological Environmental Services program which pays for the conservation of forests in hydrologically critical watersheds, using revenue from water charges (Bulas, 2004).

In Ecuador, the cities of Quito and Pimampiro have created water funds (FONAG) by charging levies on drinking water and electricity (Echevarria, 2002 and Hofstede & Alban, 2002). In the case of Quito, the revenues of the water tax are planned to be complemented by the voluntary payments of major agricultural and industrial water consumers, which will be invested into conservation of protected areas from which Quito draws its water. In Pimampiro, the municipal water fund was set up with the help of an environmental NGO and results in direct payments to forest owners.

In Brazil, the state of Paraná has an ecological tax to finance payments to those municipalities that take action either on their own or in cooperation with private landowners to protect watersheds (Perrot-Maître & Davis 2001). This public redistribution mechanism rewards those municipalities protecting more watershed areas than others, as they receive a larger allocation of tax funds.

New York City’s (NYC) watershed management program is an alliance between federal, state and municipal governments to protect water quality in the Croton and Catskills watersheds, which together supply the city’s nine million residents with some of the highest quality drinking water in the United States. NYC is the largest city in the United States to choose watershed protection instead of a filtration plant Faced with estimated capital costs of $6-billion and annual operation cost and maintenance costs of at least $30-billion for the filtration plant, the city opted to seek a waiver of the filtration requirement by investing in a comprehensive watershed protection program (Postel and Thompson, 2005).

In both the private and public cases, intensive negotiations between downstream and upstream governments, businesses and citizens’ groups were necessary to establish these mechanisms. Significant changes in the regulatory environment were also needed to enable downstream beneficiaries to pay for watershed improvements in upper watersheds.

Carbon sequestration and storage values

Of all the forest ecosystem services, carbon sequestration has drawn the greatest attention and enthusiasm in recent years. Forests play an important role in the carbon cycle by absorbing carbon dioxide and releasing oxygen to the atmosphere through the natural process of photosynthesis. Because tropical deforestation, forest fires and other land-use change contribute approximately 20% of global carbon dioxide emissions, forestry activities – to sequester carbon by promoting forest establishment and growth, or to avert the loss of standing forest resources from land-clearing, disease or fire – could potentially be an important strategy for slowing climate change.

The market for carbon sequestration and storage from tropical forests has three major segments: the Clean Development Mechanism of the Kyoto Protocol; non-Kyoto trading schemes intended for eventual crediting; and voluntary carbon emission offsets for green organizations and companies.

The Kyoto Protocol: at the Earth Summit in Rio de Janeiro in 1992, the United Nations Framework Convention on Climate Change was signed and the issue of climate change came to the forefront of international environmental discourse. In 1997, the convention produced the Kyoto Protocol, requiring industrialized nations to reduce their greenhouse gas emissions by 5% below 1990 levels by 2012. These countries (referred to in the Protocol as 'Annex I' countries) thereby set national standards to place caps on company emissions and establish a framework by which they may trade their emission credits. In order to reduce emissions at least cost, the Protocol provides three flexibility mechanisms:

• 'International Emission Trading' mechanism; that allows Annex B countries to trade emission permits, known as Assigned Amount Units (Article 17 of Protocol);

•'Joint Implementation' (JI) mechanism; that allows countries to earn Emission Reduction Units through projects in other Annex B countries (Article 6); and

• 'Clean Development Mechanism' (CDM); allowing for the generation of Certified Emission Reductions from projects in non-Annex B countries (i.e. developing countries that are outside the capping regime) (Article 12).

The CDM provides an opportunity for industrialized nations to meet part of their obligation for emission reductions (up to a maximum of 1% of their 1990 emission level for each of five years). Companies and agencies obliged to meet national greenhouse gas emissions' reduction requirements can do so at a lower cost than domestic abatement, while providing host countries with an additional source of investment finance.

According to the Protocol, emission reductions may be achieved in one of two ways: (1) by reducing emissions; and (2) by increasing carbon sequestration and storage. The importance of forests as a source (about one-quarter of global emissions come from burning forests, land clearance, and soil erosion) and a store (forests account for two-thirds of terrestrial carbon) of carbon means they can play a key role in generating carbon offsets through four approaches:

- Reforestation/ afforestation (including agroforestry) to increase carbon sequestration,
- improved forest management (e.g. reduced impact logging) both to increase sequestration and reduce emissions,
- Conservation and protection against deforestation to cut emissions, and
- Substitution of sustainably produced biomass for fossil fuels to cut emissions.

While all these approaches can achieve carbon offsets, practitioners distinguish between activities to reflect risks of “leakage” and future forest conversion. Forest protection and management are viewed to be most risky, and have thus been subject to the greatest restrictions under the Protocol – neither conservation or protection is permitted under the CDM.

Non-Kyoto market trading: Although the US did not sign the Kyoto Protocol, Americans largely support its fundamental cap-and-trade structure. Voluntary systems have developed in the *Valuation_Nyungwe_Final_Masozera.doc*shadow of Kyoto, encouraging US businesses, municipalities and universities to make verifiable reductions in their greenhouse gas emissions while developing trading partnerships. Such programs have emerged as an alternative market for domestic carbon trading, such as the Partnership for Climate Action, the Chicago Climate Exchange (CCX), and the Environmental Resources Trust (ERT). They have encouraged investment in projects that grow and conserve forests, creating carbon offsets for companies.

Retail ‘green’ markets: a third component of the carbon market is in voluntary payments by companies, individuals and organizations who wish to be environmentally responsible by making their activities ‘carbon-neutral’. Such buyers undertake an internal ‘carbon accounting’ to then reduce emissions or purchase emission offsets. A number of companies and NGOs (such as the NGO, Sustainable Management Forestry - SFM) have set up forest carbon projects in developing countries to serve this market by producing carbon offsets.

The carbon market has given rise to a series of ancillary services such as investments funds, advisory services; insurance and legal counsel to reducing transaction costs, demonstrating the sophisticated nature of carbon market. The private sector dominates the market as a buyer of carbon credits, and its role is growing as supplier and intermediary. Most trades are internationally brokered (Scherr et al. 2004).

According to Landell-Mills and Porras (2002), payments for carbon offsets are closely intertwined with supporting cooperative and hierarchical arrangements. At the highest level, markets for carbon offsets are rooted in the cooperative agreement between nations to cut back GHG emissions i.e. the Kyoto Protocol. Market boundaries and structures are defined by this overarching agreement. Even for companies that have sought to embed markets in their hierarchical structures (e.g. Shell and BP Amoco), markets are designed to fit with Kyoto requirements. It is also clear that market success depends on support from a range of local hierarchical and cooperative institutions. The establishment of national offices for regulatory agencies, trust funds to channel funds for individual deals, trading platforms such as exchanges, and ancillary service providers such as brokers, certifiers and insurers all contribute to market infrastructure. Cooperation between private and non-governmental entities has been critical in spreading risks and transaction costs associated with market development.

Biodiversity protection services

Traditionally, the market for forest biodiversity services has been dominated by the public sector. Donor funds channeled through bilateral and multilateral agencies has helped to finance protected areas and conservation by government forestry, natural resources, national wildlife and environmental authorities. However, the growing awareness of the important role of forests in maintaining the earth's life support functions, as well as increased scrutiny of corporate activities and pressure for improved social and environmental performance, have all contributed to the creation of market for biodiversity services (Landell-Mills and Porras, 2002).

Many approaches to biodiversity payment schemes are emerging to financially remunerate the owners and managers of tropical forest resources for their good stewardship of biodiversity (Table 3). These market mechanisms include land markets for high biodiversity value habitat, payments for non-consumptive uses such as ecotourism; tradable rights and credits within a regulatory cap and trade on habitat conversion; and ecolabelled products such as shade-grown coffee, herbal medicines and other botanicals from natural forests.

Table 3. Types of Payments for Biodiversity Protection

Purchase of high-value habitat
• Private land acquisition (purchase by private buyers or NGOs explicitly for biodiversity conservation) • Public land acquisition (purchase by government agency explicitly for biodiversity conservation)
Payment for access to species or habitat
• Bioprospecting rights (rights to collect, test and use genetic material from a designated area) • Research permits (right to collect specimens, take measurements in area) • Hunting, fishing or gathering permits for wild species • Ecotourism use (rights to enter area, observe wildlife, camp or hike)
Payment for Biodiversity-Conserving Management
• Conservation easements (owner paid to use and manage defined piece of land only for conservation purposes; restrictions are usually in perpetuity and transferable upon sale of the land) • Conservation land lease (owner paid to use and manage defined piece of land for conservation purposes, for defined period of time) • Conservation concession (public forest agency is paid to maintain a defined area under conservation uses only; comparable to a forest logging concession) • Community concession in public protected areas (individuals or communities are allocated use rights to a defined area of forest or grassland, in return for commitment to protect the area from practices that harm biodiversity) • Management contracts for habitat or species conservation on private farms, forests, grazing lands (contract that details biodiversity management activities, and payments linked to the achievement of specified objectives)
Tradable Rights under Cap & Trade Regulations
• Tradable wetland mitigation credits (credits from wetland conservation or restoration that can be used to offset obligations of developers to maintain a minimum area of natural wetlands in a defined region) • Tradable development rights (rights allocated to develop only a limited total area of natural habitat within a defined region) • Tradable biodiversity credits (credits representing areas of biodiversity protection or enhancement, that can be purchased by developers to ensure they meet a minimum standard of biodiversity protection)
Support Biodiversity-Conserving Businesses
• Business shares in enterprises that manage for biodiversity conservation • Biodiversity-friendly products (eco-labelling)

Source: Scherr et al. 2004

An assessment of 72 cases of markets for forest biodiversity protection services in 33 countries by Landell-Mills and Porras (2002) found that the main buyers of biodiversity services were private corporations, international NGOs and research institutes, donors, governments and private individuals. Of these, 73 percent were international, and the rest were distributed among regional, national and local buyers. International and many national actors demanding biodiversity protection services tend to focus on the most biodiverse habitats (in terms of species numbers), or those perceived to be under the greatest threat globally (high number of endemic species where habitat area has greatly declined) (Chomitz et al. 1999, Rice et al. 2001).

The fastest-growing component of future market demand for biodiversity services from tropical forests is likely to be in eco-labeling of crop, livestock, timber and fish products for export and for urban consumers in middle-income tropical countries. Pressures continue to increase on major international trading and food processing companies to source from suppliers who are not degrading ecosystem services (Clay 2002). Demand for organic farm products is increasing at 20 percent per year, and the international organic movement is strengthening standards for biodiversity conservation (IFOAM 2002). For example, the Rainforest Alliance has initiated a labeling program with explicit biodiversity criteria.

Voluntary biodiversity offsets are also a promising source of future demand, as many large companies are seeking ways to maintain their “license to operate” in environmentally sensitive areas, and offsets are of increasing interest to them. Biodiversity offsets not only rehabilitate sites, but also address the company's full impact on biodiversity at the landscape scale and assist companies in managing their risks, liabilities and costs.

Tourism and Recreation

PES for recreational uses of natural areas holds significant promise for conservation and for benefiting poor local communities worldwide. This category encompasses a variety of services including the conservation of wildlife for consumptive use (hunting) or non-consumptive use (viewing) and the protection of landscape beauty. Although these services often overlap with biodiversity services, the commodity being purchased by tourists is access rights to scenic beauty, not biodiversity per se.

In reviewing recreation payments, the most commonly employed payment mechanisms to capture willingness to pay for landscape beauty include entrance fees, community based tourism operations, trust funds, retail-based payments, and joint venture between local communities and tour operators (Landell-Mills and Porras, 2002). These payment mechanisms are not mutually exclusive and in many cases are combined. A common combination is that of entrance fees with an intermediary arrangement whereby revenue from entrance fees is pooled in a central fund for allocation to predetermined projects or to local communities.

Although payments for recreational use are perhaps the oldest ecosystem service markets, in many respects they are poorly developed (Landell-Mills & Porras 2002). A major reason is that, historically, the ecotourism 'supply chain' has disfavored land stewards while allowing tour operators, concessionaires, and hospitality businesses to capture tourists' willingness to pay for recreational and aesthetic amenities.

Finally, given the uncertainties of the global tourism industry—driven by factors such as the state of the global economy, the price of air transport due to fluctuation of oil market, and the perceived state of international security—markets for tourism and recreation services may prove to be the most unpredictable of any of the major ecosystem service markets (Scherr et al. 2006).

Lessons Learned from International Case Studies and Implication to Rwanda

Several approaches to PES are being tried in different places, and these experiences provide key lessons learned and design innovations that may be relevant to Rwanda and Nyungwe, in particular. Moreover, they highlight institutional elements that must be put in place to support and strengthen PES to maximize benefits to conservation and local communities' livelihoods.

This section focuses particularly on lessons learned regarding policy and institutional frameworks, approaches to engage the private sector as buyers and local community participation in the process.

- **Policy and Institutional frameworks**

For the majority of ecosystem services that are "public goods," the creation of PES requires proactive efforts on the part of governments and non-government actors. **It is believed that lack of policy frameworks and market information are two critical barriers to the successful development of PES.** Therefore it is the responsibility of policymakers and regulators to provide a supportive legal framework for PES markets.

For public payments and cap-and-trade systems, governments are directly responsible for developing the “rules of the game.” Such rules define what services are to be purchased, who is eligible to be a supplier, terms of payment, performance standards and monitoring procedures, and procedures in case of breach of contract. While self-organized private deals or private ecosystem payment schemes and eco-certification do not rely on government to set up implementation, policies still need to establish rights to buy and sell ecosystem services, and establish legal safeguards needed for buyers, sellers and investors.

PES programs involve a large number of different actors at different spatial scales (local, national and international). Therefore a major challenge of ecosystem services market development is to ensure that critical institutions are established to reduce transactions costs and to provide intermediation between buyers, sellers, investors, certifiers and other key groups in the value chain (Scherr et al. 2004). Transaction costs include costs of attracting potential buyers, costs of working with project partners (such as negotiating with project participants and capacity building), and costs of ensuring that parties fulfill their obligations (such as contract development and enforcement, legal costs and insurance, etc). In order to grow these ecosystem markets and to engage the private sector, the necessary stakeholders and institutions must be identified or developed if they do not exist. For instance, Costa Rica has the most elaborate PES program operated by the National Fund for Forest Financing (FONAFIFO) (Pagiola, 2002).

The international case studies above on payment for watershed services, for instance, show that significant changes in the regulatory environment were needed to enable downstream beneficiaries to pay for watershed improvements in upper watersheds. In cases where legal or regulatory reform was not needed, public sector institutions played critical supporting role in negotiations between buyers and sellers. This indicates that fundamental institutional and legal reform is often necessary for ecosystem service markets to develop and function effectively and efficiently.

In Rwanda, ecosystem services cut across all economic sectors and fall under different ministries. For instance, Nyungwe national park and the ecosystem services provided by it fall under the control of no less than 3 government agencies (not to mention provincial- level entities); the National Forest Authority (NFA) for its buffer zone, the Rwanda national park services (ORTPN) which is in charge of protected areas management and the Rwanda Environment Management

(REMA) which is the focal point for the conventions on biodiversity and climate change. The ORTPN falls under the Ministry of Commerce, Industry, Investment Promotion, Tourism and Cooperatives (MINICOM); while REMA and NFA fall under the Ministry of Lands, Environment, Forests, Water and Mines (MINITERE).

There are some opportunities under the current environmental law and different sectoral policies (forest, energy and water policies) that could be explored and used as a basis to initiate a PES. First, these laws and policies recognize the need to engage private sector and decentralized entities in environmental management. Second, the water policy specifically puts emphasis on improvement of water resources through reforestation of hillsides and water catchments areas. Third, the environmental law, under Chapter III Article 65 establishes the National Fund for Environment in Rwanda (FONERWA); which is responsible for soliciting and managing financial resources. Also its Title IV Articles 71, 72 and 73 provide some incentives (such as tax reduction) to individuals, associations and companies that invest in environmental protection.

Also, ORTPN has initiated a revenue sharing scheme that aims at increasing the effectiveness of national parks in attaining conservation objectives and contributing to the improvement of communities' livelihoods around the parks. The revenue sharing policy earmarks 5% of the total gross revenue earned in each park to be combined into a national pool from which funds are distributed to the parks in the following proportion: 40% PNV, 30% PNA, and 30% PNN. In addition, given the limitations of annual revenue sharing pool, a community or sector within the target area are expected to have one project funded at least every 5 years.

This existing legal framework could serve as a basis for initiating the PES that fits the context of Rwanda and then adjusted as the market grows and becomes more complex. Payment for ecosystem services could be made to the National Fund for Environment (FONERWA), and in return FONERWA will allocate the money to agencies that manage natural resources and support local communities' projects.

As a step towards more efficient environmental management, cross-agency frameworks could be developed and strengthened to facilitate the pooling of resources and expertise, the coordination of effort and the sharing of responsibility. REMA or ORTPN could play a leadership role as the agency with the overall responsibility of environmental management and protected areas in the country. At the same time, FONERWA should be used as an agency to mobilize resources and to negotiate contracts with different actors (local, national and international) interested in investing and marketing ecosystem services.

More clearly demarcated responsibilities, combined with well-developed platforms for cross-agency cooperation, would also reduce incentives for individual agencies to use PES programs as a means to expand their power, responsibilities and budgetary allocations, which can adversely impact program effectiveness.

The most challenging tasks in developing a PES in Rwanda would be to design effective institutional arrangements that could ensure fair distribution of benefits to local communities. This will require some innovations based on the unique context of Rwanda, where there is high population density and limited on-farm opportunities for the current and future generations. Most importantly, it will be important to design a flexible and adaptive institutional framework that could change over time as the markets for ecosystem services grow.

- **Local communities' participation**

The long term viability of markets for ecosystem services depends on retaining the support of key local stakeholders, which is related to the benefits they perceive and the sustainability of those benefits in the long term. Therefore it is important to make sure that new markets include low income stakeholders and reduce potential livelihood threats. Pagiola et al. (2005) have outlined some critical factors that could affect a household's decision to participate in PES programs. These include the profitability of PES practices, the ability to participate given the land tenure issues and investments costs needed to satisfy the requirements of the program, and the technical capacity to adopt PES promoted practices. Finally, the most obvious and significant potential constraints to the poor's participation in PES are transaction costs.

Participation in ecosystem markets requires a fairly high level of production, marketing or information management skills. Local communities need business skills to negotiate private deals effectively and to understand their rights and responsibilities. In order for low-income communities to participate equitably in PES, there will need to be much greater investment in human and institutional capacity-building.

In Rwanda, the decentralization policy coupled with existing community associations provides a great opportunity for local participation in PES design and implementation. This could potentially reduce bureaucracy and transaction costs.

- **Engagement of private sector in PES programs**

The private sector represents a critical opportunity for PES programs and conservation. However, a meaningful level of private sector involvement will not materialize unless the institutional conditions outlined in the above sections are met. Reducing investment risk by creating a more favorable investment climate – through more secure tenure rights, stricter enforcement of environmental laws, etc. – is essential in any efforts to engage the private sector. Governments need to provide secure legal frameworks for PES contracts, and to find ways of ensuring legal protections for buyers and sellers without overburdening the process and costs with bureaucracy. In Rwanda, the need to stimulate private sector investment in water and energy production, highlighted in environmental law and sectoral policies, presents a great avenue for private sector participation.

Specific Recommendations for Nyungwe Forest National Park

A review of international experience suggests a number of promising PES models that could be used for Nyungwe and Rwanda. These are:

Watershed Services

Case studies from other tropical developing countries indicate that these types of schemes are straightforward to set up due to the relative ease in identifying beneficiaries, and the clear linkages between land management practices and outcomes. Two types of payment schemes are possible for Nyungwe, including self organized private deals and public payment schemes.
The main beneficiaries of watershed protection services of Nyungwe are OCIR THE, ELECTROGAZ, REGIDESO/BURUNDI, Tea farmers associations and rice farmers' association of BUGARAMA. These beneficiaries avoid important costs due the quality of the water supply and flood prevention services of Nyungwe, but there is currently no obligation for water and energy users to pay or contribute to the conservation of watersheds where their waters come from. Not all the beneficiaries are capable of paying for watershed services, but by initiating

discussions with key stakeholders/beneficiaries, one of these two types of payments could be feasible.

Carbon Sequestration and Storage

Though markets for carbon sequestration can in some cases be very profitable, international experience indicates that potential sellers often find it difficult to enter the market due to insufficient internal capacity. This suggests that Rwanda can work with both private companies and NGOs like WCS, to help them assess opportunities to engage in PES for carbon sequestration and to develop a business case for them to become sellers. Under the current Kyoto Protocol, forest conservation and management are not part of the deal. Therefore Nyungwe, as a standing forest, is not eligible but the carbon sequestered under a regeneration project of 13,000 ha of burned areas could be sold in either voluntary or Kyoto compliant markets. The second option would be the development of an avoided deforestation project based on historical rates of deforestation, and the verified emission reduction (VER) credits could be sold in the voluntary market.

Biodiversity conservation

Two types of payments for biodiversity protection are currently in use in Rwanda, and Nyungwe in particular, including research permits fees to collect samples and filming fees. However, due to the war and genocide of 1994 and the security situation that followed in the region, the fees were kept low to attract researchers. One possibility would be for ORTPN to establish contracts with major universities for research in Nyungwe, and in return these institutions would pay a certain amount agreed on per year instead of dealing with individual researchers. This could substantially increase the revenue for biodiversity protection services. Bioprospecting is not well developed in Rwanda but it has potential; and Nyungwe, with its biodiversity richness, could be used as a case study or model.

Similar to international trends, eco-labeling shows significant promise for Nyungwe and could also be promoted through market research of international opportunities for ecological value-added products. For example, Nyungwe produces good quality honey that could potentially be marketed as organic honey; “Nyungwe Honey”. There are already some associations of beekeepers that are being supported by WCS and ORTPN in different aspects of honey production. The existence of functioning communities would be a great opportunity to initiate eco-labeling projects. However, more effort will be needed to enhance the quality and support these organizations to improve their managerial skills.

Tourism and recreation

While ecotourism has pioneered in Rwanda's protected areas, there are some areas that need to be improved and international experiences can indicate where adjustments are needed.
Despite the fact that Nyungwe is the most attractive forest in Rwanda, with primates, birds and hiking trails; ecotourism in Nyungwe is characterized by low number of visits but with high willingness to pay considering that the majority of tourists coming to visit mountain gorillas end up spending two to three days in Nyungwe. There are some obstacles to increasing the number of visitors and revenue. First, the current pricing policy is not well designed to attract many visitors. Very often tourists return unhappy due to the fact that every day they are charged differently for different activities in forest. The best approach would to revise the price system based on the assessment or survey of visitor's willingness to pay. Second, there is an issue of accommodation in Nyungwe forest national park. The current accommodations at Gisakura are not designed to house the increasing number of visitors in Nyungwe. While this issue is being addressed through development of ecolodges by private investors, it is important to make sure that some revenues go to the communities either through joint venture or taxing a certain percentage on bed nights, as it is the case in some Eastern African countries.

Some companies are interested in buying concessions around Nyungwe; but to get the right price on the land, ORTPN will need to assess the value of the lands near and around its protected areas. Also, to be successful, ORTPN will need to develop an effective concession or contracting policy, as well as the standards for obtaining desired quality through appropriate contract monitoring and enforcement of all contract provisions.

Finally, for success in developing a PES program in Rwanda, the following steps are needed:

- Assess the value of ecosystem services, their beneficiaries and potential markets
- Develop a collaborative framework between different institutions involved to make ecosystem services a national priority. This can be done through an envisioning exercise where all different agencies meet to "envision a sustainable and desirable future of Rwanda". In the last decade the Government of Rwanda

and its development partners have largely been investing in human, social and built capital to achieve its economic development goals. However it is important for key actors to realize that we can not achieve our economic development goals without putting as much investment in our natural capital. All these forms of capital are interdependent and to a large extent complementary in achieving economic development goals and a better quality of life.

- Identify opportunities and risks of using different types of market instruments
- Share experiences, perspectives and lessons about the design and use of ecosystem service market with other countries through study tours
- Design appropriate legal and regulatory framework
- Build the capacity of Rwandans, at both the local and national levels, in designing and implementing ecosystem services markets
- Develop a comprehensive revenue sharing policy that includes not only tourism revenues but all other revenues ecosystem services that are being marketed.

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