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Conventional vs. Ecological Economics Perspectives in Valuation of Ecosystem Services in East Africa

Gladys Nthenya Kivati and Joel O. Onyango

Series Editors
Dr. Joël Houdet
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African Centre for Technology Studies (ACTS)
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Table of Contents

List of Figures

List of Tables

Abstract

Ecosystems provide a range of services that are of fundamental importance to human wellbeing, health, livelihoods, and survival. In the last two decades, environmental science and policy have made increasing efforts to value ecosystem services in monetary terms, and to articulate such values through markets in order to create economic incentives for conservation. This issue paper describes conventional and ecological economics in the context of ecosystem valuation. It analyzes and reviews the current valuation systems in East Africa Region, in a comparative context, highlighting their strengths and weakness by examining the natural benefits of the ecosystem services through the use of case studies (Eastern Arc Mountains in Tanzania; Nyungwe National Park Rwanda; Kakamega Forest in Kenya). Finally, it assesses the implication of conventional and ecological economic approach in ecosystem valuation in East Africa. The hypothesis is that current ecosystem valuation processes and tools take a conventional economics approach which leads to poor environmental and social outcomes. Ecological economics represents the best hope for estimating the value of ecosystem services within the East Africa region as it encompasses a more holistic approach that regards the economic subsystem as a part of the larger ecological life-support system.

1. Introduction

1.1 Background information

Biodiversity is a major component of ecosystems and a fundamental unit for life support on Earth. Furthermore, functioning ecosystems, which rely on healthy biodiversity, play a critical role in providing goods and services needed to sustain human life (MEA, 2005). Until recently, ecosystem services have systematically been ignored or undervalued in decision-making (Heal, 2000). Natural capital resources were thought to be endless (Daly, 1992), used directly by humans without passing into the economic sphere (Constanza et al., 1997). As explained by Daly (1997), ecosystem processes have historically been assigned little or no value at all, as decisions were centered exclusively on financial values, typically that of labor and capital. This has resulted in policy choices and human activities which did not take into account their impacts on biodiversity and ecosystem services, thus leading to widespread resource overexploitation, pollution and ecosystem degradation. As biodiversity loss increases dramatically, the sustainable supply of ecosystem services is increasingly threatened in many regions. In this context, the valuation of ecosystem services has been argued to be critical tool for better decision-making. Valuation can help stakeholders understand and quantify the role of ecosystem services in human development and wellbeing, including the cost of changing landscapes (UNEP, 2005). Through the concept of valuing ecosystem services in economic terms is not new (Freeman 1993; Hartwick 1994; Costanza et al. 1997), efforts to apply this approach to a wide range of habitats, ecosystems and social settings have proliferated dramatically following the release of the Millennium Ecosystem Assessment report (MEA ,2005).

Economics, conventionally, is considered a social science that examines allocation among various potential uses that are in competition of scarce resources (NetIndustries 2012). Economics attempts to predict and understand patterns of consumption of goods and services by individuals and society. This view forms the basis of conventional economics, with the core assumption that individuals and corporations seek to maximize their profit within the marketplace and an ever-increasing GDP is desirable, possible, and that everyone benefits out of it (Gund Institute for Ecological Economics 2008). In conventional economics, the worth of goods or services is valued on the basis of their direct or indirect utility to humans.

Ecological economics takes a broader perspective and recognizes that there are more things that contribute to human well-being than just the amount of tradable entities, such as health and education (human capital), friends and family (social capital) and the contribution of the earth and its biological and physical systems (natural capital) (Gund Institute for Ecological Economics 2008).

Ecological economics differs from conventional economics in attempting to value goods and services in ways that are not only based on their usefulness to humans, that is, in a non-anthropocentric fashion. This means that ecological economics attempts to take into account the many environmental and social costs associated with the depletion of natural resources, as well as the degradation of ecological systems through pollution, extinction, and other environmental damages (NetIndustries 2012). Many of these important problems are associated with the diverse economic activities of humans, but the degradation is often not accounted for by conventional economics. From the environmental perspective, the most important problem with conventional economics has been that the marketplace has not recognized the value of important ecological goods and services. Therefore, their degradation has not been considered a cost of doing business. Ecological economics attempts to find ways to consider and account for the real costs of environmental damage. The goal of ecological economics, different from conventional economics, is to develop a deeper scientific understanding of the complex linkages between human and natural systems, and to use that understanding to develop effective policies that will lead to a world which is ecologically sustainable, has a fair distribution of resources (both between groups and generations of humans and between humans and other species), and efficiently allocates scarce resources including "natural" and "social" capital.

On the other hand, ecosystem goods and services represent the benefits human populations derive, directly or indirectly, from ecosystem functions (Costanza *et al.,* 1997). MEA (2005) categorizes ecosystem services as provisioning, regulating, cultural, and supporting services (Table 1). Humans obtain goods and products (such as food, genetic resource, medicine amongst other) necessary to support life from ecosystems. Such benefits can be viewed as the market values of ecosystems as they can be assigned a 'price' value in the market place and are readily attached to the economy. At the same time, ecosystems have nonmarket values which are expressed as existence, aesthetic and knowledge amongst other values (Table 2).

Table 1: Ecosystem services (Modified from MEA, 2005)

Provisional Services	***Regulating services***	***Cultural Services***
Products obtained from the Ecosystem	*Benefits obtained from regulation of ecosystem*	*Non-material benefits from ecosystem*
Food Freshwater Fuel wood Fiber Biochemicals Genetic resources	Climate regulation Disease regulation Water regulation Water pollution	Recreation Spiritual and Religious Educational Sense of place Cultural heritage
Supporting Ecosystem Services *Services necessary for production of all other ecosystem services* .Soil Formation .Nutrient Cycling .Primary Production		

Table 2: Use and non-use ecosystem values (TEEB, 2010)

Value type	**Value sub-type**	**Meaning**
Use values	Direct use value	Results from direct human use of biodiversity (consumptive or non consumptive).
	Indirect use value	Derived from the regulation services provided by species and ecosystems
	Option value	Relates to the importance that people give to the future availability of ecosystem services for personal benefit (option value in a strict sense).
Non-use values	Bequest value	Value attached by individuals to the fact that future generations will also have access to the benefits from species and ecosystems (intergenerational equity concerns).
	Altruist value	Value attached by individuals to the fact that other people of the present generation have access to the benefits provided by species and ecosystems (inter-generational equity concerns).
	Existence value	Value related to the satisfaction that individuals derive from the mere knowledge that species and ecosystems continue to exist

These non-market values are complex to quantify, but are adequate justification to preserving ecosystem autonomous of market values. Organisms that live, grow, reproduce, and interact within ecosystems help to arbitrate local and regional flows of energy and materials. This contributes to various ecological or life support services that benefit human welfare including plant growth, greenhouse gas regulation, water treatment, and soil quality control. The concept of valuing ecosystem services focuses on the contribution of ecosystems to human welfare which is deemed relevant to policy-making. Valuation is about assessing trade-offs towards achieving a goal in environmental decision making for instance on information on costs and benefits of different options regarding the protection, management and exploitation of environmental resources. The value of ecosystem services is therefore the relative contribution of ecosystems to that goal. There are multiple ways to assess this contribution, some of which are based on individual's perceptions of the benefits they derive individual's perceptions are limited and often biased.

1.2 Rationale and components for ecological economics approaches

Economic valuation of ecosystem services traditionally make use of conventional economics with high uncertainty due to limitation in scientific understanding since ecosystem services are not assigned their true economic values hindering informed policies. The monetization methods that have been developed contain various difficulties and controversial issues. The monetary evaluations are based on phenomena such as consumer surpluses, market failures, demand curves, which are just one partial point of view and connected to one institution: markets. Conventional economists believe that there are very few things that are truly unique, in the sense that they have no substitutes, including nature (Simpson, 1998). Some authors (e.g. Goodland, 1995; Norton, 1991; Dasgupta *et al.*, 2000) further reinstates that natural resources and processes have substitutes and are freely interchangeable with another of like nature or kind. This fundamental ideological and paradigmatic shift in development thinking from a state-centered to a market-driven perspective has a significant impact on the prospects of ecosystem and biodiversity preservation. The perspective of conventional economists have the advantage of presenting a seemingly coherent and practical vision of environmental and development issues. They offer analytical tools which in theory are useful in decision-making. However, a number of questions remain unanswered. These are mostly questions of social power. According to Atlee (2008), social power is the basic, common element in politics, economics, and all other social relationships possessed by all individuals and social groups and arises out of their connections to each other. The chain of reasoning in cost–benefit analysis (CBA) goes from 'human preferences' to 'choices made in a market context' to the 'market value of these choices'. The assumption is that ecosystem services can be desirable and made compatible with market goods.

Ecological economics is a trans-disciplinary field of study that address the relation between ecosystem and economic systems in the broadest sense. By trans-disciplinary, ecological economics goes beyond conception of scientific discipline and tries to integrate and synthesis many disciplinary perspectives. As such, it focuses more directly on the problems rather than the particular intellectual tools and models used to solve them, ignoring the arbitrary intellectual boundaries. While the intellectual tools we use are of importance they are secondary to solving critical problems and managing planet resources. It recognizes that practical solutions to pressing social and environmental problems require new interdisciplinary approaches that focus on the links between economic, social and ecological systems. Neither the traditional practice of economics nor the natural sciences alone are held to be sufficient to address these issues. Ecological economists have a 'natural view' of the world, thereby emphasizing natural laws, interdependencies between sectors and systems, and limits to the material growth of the human economy.

Ecological economics differs from conventional economics in terms of breadth of its perception on the problem, and the importance it attaches to environment-economy interaction. It takes a wider and longer view in terms of space, time and parts of the system to be situated. It sees human economy as part of the whole and its domain is the entire web of interactions between economies and ecological sectors. As illustrated in Table 3, in conventional economics the basic world view is one in which individual human consumers is the central figure. Their tastes and preference are taken as given and are dominant determining force. The resource base is viewed as essentially limitless due to technical progress and infinite substitutability. Ecological economics on the other hand takes a more holistic view with human as one component in the overall system. Human preferences, understanding, technology and cultural organizations all co-evolve to reflect broad ecological opportunities and constraints. Human have a special place in the system because they are responsible for understanding their own role in the larger system.

Table 3: Comparison of Conventional economics and Ecological Economics (Constanza , 1989)

Characteristics	Conventional Economics	Ecological Economics
Basic World View	Mechanistic and Static Individual tastes an Preferences taken as given and the dominant force The resource base viewed as essentially limitless due to technical progress and infinite substitutability.	Dynamic , systems Human preference, understanding, technology and organization co-evolve to reflect broad ecological opportunities and constrains. Humans are responsible for understanding their role in the system and managing it sustainably
Time frame	Short 50 yrs max	Multi scale Multi scale synthesis
Space frame	Local to international Framework invariant at increasing spatial scale , basic units change from individuals to firms to countries	Local to global Hierarchical of scale
Species frame	Human only Plants and animals only rarely included for contributory value	Whole ecosystem including humans Acknowledgement interconnections between humans and rest of nature
Primary Macro goal	Growth of national economy	Ecological system sustainability
Primary Micro goal	Max Profits (firms) Maximum Utility (Individuals) All agents following micro goals leads to macro goal being fulfilled. External costs and benefits given lip service but usually ignored	Must be adjusted to reflect system goals Social organization and cultural institutions at higher levels of space / time hierarchy Conflicts produced by myopic pursuit of micro goals
Assumptions about technical progress	Very optimistic	Prudently sceptical
Academic stance	Disciplinary Focus on mathematical tools	Transdisciplinary Pluralistic, focus on problems

To understand the concept of ecological economics, Table 4 provides some of the components of ecological economics that justifies its preference over conventional economics in ecosystem services valuation.

Table 4: Components of ecological economics compared to conventional economics

Component	Description
Sustainable Scale	Ecological economic broadens the definition of capital. It incorporates natural, social and human capital. According to Constanza et al, 1993 the approach incorporates human values including fairness, respect for future generations, and justice as well as views human as part of the world. Its emphasis switches from resources to systems, arguing that ecological thresholds exist, and when breached, systems fail and collapse. It asserts that there is often no "substitute" for the services provided by the system. Daly (1992) argues for a steady-state economy, which recognizes the appropriate scale of the economy in relation to the capacities of the natural environment. As the economy uses up more and more land, fossil fuels, and degrades or exhausts populations of fish and land animals, then the risks increase that the some vital support for human life will be damaged and destroyed. Economic growth will eventually come up against the carrying capacity of the atmosphere in terms of safe concentrations of greenhouse gases, the global warming problem, or will entail irreversible damage to some vital ecosystem service involving the land and water resources, so that the price mechanism can no longer work to provide the service. He argues that "scale is not determined by prices, but by a social decision reflecting ecological limits. Distribution is not determined by prices, but by a social decision reflecting a just distribution of the newly created assets." (Daly, 1992)
Ecosystem-economics interrelation	Ecological economics studies how ecosystems interrelate with economic systems and how the economy is constrained by the natural environment. Linking biophysical aspects of ecosystems with human benefits through the notion of ecosystem services is essential to assess the trade-offs (ecological, socio-cultural, economic and monetary) involved in the loss of ecosystems and biodiversity in a clear and consistent manner. The effort to integrate ecology and economics to improve environmental and economic management and to ensure long-term sustainability has and permits a deeper understanding of the ecological functions and values. This is important in ecosystem valuation as ecological economics estimates the long-term social and ecological costs and benefits of various human activities for comparison with the private short-term costs and benefits that are too often the only consideration in decision making.
Uncertainty in conventional economics	Chee (2002) states that "ecosystems are complex, highly interconnected, and feature nonlinear interactions between variables at a range of spatial and temporal scales." Additionally, "these characteristics and complexities make it impossible to predict ecosystem dynamics in any detail" (Harwood and Stokes, 2003). Ecological economics reminds us of the complexity of the many interacting systems that make up the biosphere and the uncertainty that is a fundamental characteristic of all complex systems. It calls for a structural approach where technical descriptions of particular economies are used for scenario analysis (Duchin, 1998). In terms of policy, one ecological economics alternative to assuming that uncertainty can be reduced to risk is the precautionary principle (Ciriacy-Wantrup, 1952), which suggests that we should err on the side of caution in the face of uncertainty.
Inter-generational equity	Conventional economics is focused on a model of utility maximisation and the allocation of resources via the price mechanism (Bergh, 2000). It crucially assumes that all natural services can be converted to money and back again at any time, i.e. that there are no irreversible effects (Ackerman and Heinzerling, 2004). This is not the case, so future generations face the risk that they will be deprived of vital resources if economic growth continues without constraints. In contrast, ecological economics encompasses a more general view of values, including intrinsic rights of ecosystems to exist. It emphasizes uncertainty in effects and the major intergeneration problems associated with irreversible damage to natural systems caused by human activity.
Improved scientific understanding	Ecological economics attempts to improve scientific understanding of the natural and social processes relating to human interactions with the environment and at the same time providing information useful to decision-making on sustainable development (Shi, 2003). While many environmental economists would accept the relevance of considerations outside their analysis, they claim to leave these to the mythical 'decision-maker'. The potential of ecological economics is to include these as essential aspects of analysis. The difference between pure science and ecological economics is that research in ecological economics is issue driven, and therefore the components of a synthetic framework will be prescriptive rather than descriptive or explanatory (Smith, 1997).

True economic efficiency	Ecological economics also seeks true economic efficiency. Economic efficiency and good economic decision making are not possible if all of the costs and benefits are not considered or included in prices. Often current market prices do not capture the full costs of an economic activity that depletes resources or damages natural systems (natural capital); or inflicts costs to human health and well-being (social and human capitals) caused by pollution or other side effects of the activity. These excluded costs are called "externalities", defined as costs that are not included in the price of the product but are shouldered by a third party, outside the producer/seller and buyer/consumer. Capture of these costs in the market would provide a powerful incentive to move towards sustainability. An emerging ecological economics alternative to CBA—and value monism in general—is multi-criteria decision aide (MCDA), which is based on diverse criteria such as efficiency, equity or sustainability, allowing for a more realistic assessment of substitutability and complementarity between criteria. MCDA allows for ethical considerations, incongruities and concern for the distant future in a democratic decision-making framework. Numerous case studies (e.g. O'Neill and Spash, 2000) employing MCDA methods also highlight the strength of incorporating qualitative information into an economic valuation framework. However it is important to note, true economic efficiency is made exponentially more difficult by the fact that conventional economics thinking still tends to dominate the discourse, with its tropes of substitutability and focus on efficiency without considering natural capital as the basis for all economic activity. Equally, because the conventional economics perspective rarely takes the medium or long term under consideration, especially intergenerational factors, embedding ecological economics into the discourse, with all of its indirect and intangible factors, faces many obstacles as conventional economics attention to free markets and self interest marches on.
Policy roles; from theory to practice	Ecological economics tends to deal with policy issues not only in theory but also in practice. A key policy role of ecological economics is to provide the intellectual background of concepts, orientations and intellectual generalisations that inform policy. In particular, it focuses on clarifying distribution issues and identifying trade-offs in policy development. Ecological economics proposes to integrate the ecological and social externalities of the dominant economic rationality into the paradigms of political economy, and to insert the ecological dimension into the planning practices of governments (see, for example, O'Hara et al., 2000; Erickson and O'Hara, 2000). In placing environmental management and policy issues in a broad context that integrates human behaviour within ecological and economic systems, ecological economics promotes an alternative conceptualisation of economic development that takes account of resource and environmental limits.
Decision making for sustainability	Ecological economics provides a new way of thinking that scientific consideration and ethical and political judgements necessarily bear on each other in the evaluation of possible policies and courses of action. Decision-making for sustainability in this way can be understood as a collective argumentative process, with different questions and possible priorities put forward, evidence gathered and arguments built for and against different positions (Faucheux and O'Connor, 1998). "The decision process would thus conform to a sort of procedural rationality, taking place through an iterative process of trade-offs and compromises with the aim of ending up with a solution that is satisfactory in terms of economic, social and ecological imperatives" (Funtowicz *et al.*, 1997). Key to this process is to make sure that diverse groups of actors are engaged in the assessment process, particularly those voices that are commonly unheard have a place at the table.

2. Ecosystem services, human development and economics

2.1 Ecosystem services for human development

Functioning ecosystems are essential to human well-being (MEA, 2005). When ecological concerns are connected to economics; the challenge is to meet human needs without degrading the environment. As indicated by Heal (2000), ‘ecosystem services are scarce, material contributions to economic welfare cannot be taken for granted, and can be affected by conscious choices. These features place them within the purview of economic analysis (Figure 1).

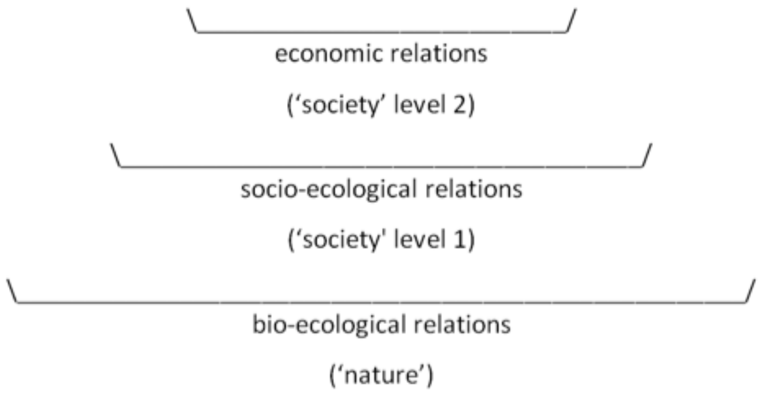

Figure 1: The existence of economy depends on society depends on bio-ecological nature (in Maiteny, 2002, adapted from Wilden, 1987)

The illustration according to Maiteny (2002), emphasizes that the existence of human beings and society depends on the physical life-support systems. Human society is ultimately dependant on and physically sustained by bio geological process (nature). Nature however, can continue indefinitely without society. Nature would continue to sustain itself if human became extinct (Figure 2). On the other hand, if nature became extinct, or degenerate beyond a certain point human would also die. In other words nature constitutes the outer environment of humans, and Wilden (1987) states in his ‘inevitable rule’, ‘the system that destroys its environment destroys itself’.

Ecosystems are prone to depreciate if they are misused or overused since depreciation of natural capital may be irreversible, or the systems may take a long time to recover. This could cause the ecosystem to collapse without prior warning as ecosystems cannot be replaced once depleted or degraded (Dasgupta, 2008). As ecosystems are threatened by human activities, it is important to take better account of long-term ecosystem health and its role in enabling human habitation and economic activity. The economic importance of ecosystems to human development justifies the need to understand their value.

The most obvious danger of ignoring the role of nature in economics is that nature is the economy’s life support system, and by ignoring it we may inadvertently damage it beyond its ability to repair itself. In economic terms, ecosystems may be regarded as a special form of capital assets (van der Heide, 2013). The services of ecological systems and the natural capital stocks that produce them are critical to the functioning of the earth’s life support system. They contribute significantly to human welfare, both directly and indirectly, and therefore represent a significant portion of the total economic value of the planet. Because these services are not fully captured in markets or adequately quantified in terms comparable with economic services and manufactured capital, they are often given too little weight in policy decisions.

Most economists view natural and manmade capital as substitutes rather than complimentary, consequently neither factors can be limiting, since only in complimentary factors either may be limiting. Ecological economists contrary, see manmade and natural capital as complimentary, and therefore emphasises the importance of limiting factors and changes in the patterns of scarcity. To understand the connection between ecosystem services and human development, as a factor of decision support for policy, various valuation techniques can be applied.

2.2 Ecosystem valuation for human development

The issue of valuation is inseparable from the choices and decisions we have to make about ecological systems. Some argue that valuation of ecosystems is either impossible or unwise, that we cannot place a value on such “intangibles” as human life, environmental aesthetics, or long-term ecological benefits. Various methods have been used to estimate both the market and non-market components of the value of ecosystem services. The method of ecosystem services valuation depends on the type of benefit attached to the ecosystem service, the characteristics of the case, and data availability. The challenges in valuation of ecosystem services are attributed to the valuation methods and the difficulties embedded in these methods (Table 5).

Direct use valuation

Provisioning services may be described as direct use values. These are relatively straightforward to monetize as most of the products of provisioning services are traded on markets. However, this method of valuation contains key limitations since the ‘true’ economic value of goods and services may not be fully reflected in market transactions (Smith, 1997). Goulder and Kennedy (1997),explain that this approach indicates the minimum amount that people who buy the good are willing to pay for it in comparison with the market price which may not be considered to be a higher value to warrant protection of the ecosystem service.

Table 5: Valuation methods for ecosystem services (TEEB, 2010)

Valuation method	**Element of TEV captured**	**Ecosystem service(s) valued**	**Benefits of approach**	**Limitations of approach**
Market prices		Those that contribute to marketed products e.g. timber, fish, genetic information	Market data readily available and robust	Limited to those ecosystem services for which a market exists
Cost-based approaches	Direct and indirect use	Depends on the existence of relevant markets for the ecosystem service in question. Examples include man-made defences being used as proxy for wetlands storm protection; expenditure on water filtration as proxy for value of water pollution damages.	Market data readily available and robust	Can potentially overestimate actual value
Production function approach	Indirect use	Environmental services that serve as input to market products e.g. effects of air or water quality on agricultural production and forestry output	Market data readily available and robust	Data-intensive and data on changes in services and the impact on production often missing
Hedonic pricing	Direct and indirect use	Ecosystem services that contribute to air quality, visual amenity, landscape, quiet i.e. attributes that can be appreciated by potential buyers	Based on market data, so relatively robust figures	Very data-intensive and limited mainly to services related to property
Travel cost	Direct and indirect use	All ecosystems services that contribute to recreational activities	Based on observed behaviour	Generally limited to recreational benefits. Difficulties arise when trips are made to multiple destinations
Random utility	Direct and indirect use	All ecosystems services that contribute to recreational activities	Based on observed behaviour	Limited to use values
Contingent valuation	Use and non-use	All ecosystem services	Able to capture use and non-use values	Bias in responses, resource-intensive method, hypothetical nature of the market
Choice modelling	Use and non-use	All ecosystem services	Able to capture use and non-use values	Similar to contingent valuation above

Replacement cost

This economic valuation technique estimate economic values based on costs of avoided damages resulting from lost ecosystem services, costs of replacing ecosystem services, or costs of providing substitute services. This is not an effective approach as only partial, or a lower estimate of the value of the services of the ecosystem is reached (Heal, 2009).

Travel cost method

This method estimates economics values associated with ecosystem or sites that are used for recreation. It assumes that the value of a site is reflected in how much people are willing to pay to travel to visit the site. It is used as an effective method of valuation to capture the values of cultural services. This valuation is applied to determine value parks, rivers, recreation areas which are a reflection of how much people are willing to pay to access the service. This has in most cases contributed to underestimation of the value of the area (Chavas, 2000).

Hedonic price method,

This method is used in assessing non-marketed services where demand of services may be reflected in the prices people will pay for change in market prices for goods due to access of a particular service. Issues of consideration include aesthetic value, air quality as well as environmental amenities which causes an increase in land value if desirable and vice versa (Husein, 2004). The limitation in this method is that the value of service calculated is limited to the attributes related to market goods as well the method required high scientific expertise and analysis which is time consuming.

Contingent Valuation

This method makes use of surveys and hypothetical scenario to assess individual values for estimating non-use values, existence values, option values, and bequest values (Heal, 2009). A major advantage of these survey methods is their potential as general procedures for assessing the total economic value (use values plus non-use values) of any type of ecosystem. However, it remains the case that even the most sophisticated design of contingent valuation instruments cannot fully capture the total value of ecosystems (Hussen, 2004).

Benefit transfer

This method of valuation estimates economic values by transferring existing benefit estimates from ecosystem studies already completed for another location or issue. There are challenges in implementing this approach, such as potential lack of accuracy and appropriate information about similar values in other comparable situations.

Application of conventional economic valuation techniques to ecosystem services, as discussed, can provide valuable information for conceptualizing decision choices and evaluating management options. However they have serious limitations when applied to decision-making since they are centered on commercial solutions and exchanges, hence undermining the functions of ecosystem. Ecological economics, as an alternative approach advocated for in this paper, emphasizes participation, explicit treatment of uncertainty and transparent decision-making processes.

3. Application of ecosystem valuation in East Africa: conventional or ecological economics based?

3.1 Case for Eastern Arc Mountains in Tanzania

The significance of ecosystem services research has been demonstrated to be key in linking conservation efforts and human development (Fisher *et al.*, 2011). As such, systematic approaches used to measure, model and map these services and their values are important (Burgess, 2011). This has been demonstrated by the Natural Capital Project (NCP) when attempting to value the Eastern Arc Mountains in Tanzania and analyze threatened ecosystem services and develop measures to conserve their value to people in the Arc (Fisher *et al.*, 2011). The NCP valued ecosystem services using GIS-based models as a tool to attach economic value to various ecosystem services.

Hydrological services related to the regulation of water flow was difficult even though the Eastern Arc Mountains are the source of a significant proportion of Tanzania's water, providing drinking water for all the major coastal cities, irrigation water for most of eastern Tanzania, and the water used to generate 50-70% of the country's electricity (Lopa, 2012). This hurdle was attributed to limited availability of information on rainfall, water flows and soils data (Lopa, 2012; Fisher *et al.*, 2011). The value of carbon storage and sequestration results indicated that the Eastern Arc stores a total of around 6.3 Pg C (Shirima, 2011). Around 35% of the carbon is stored within protected areas, with the highest density of carbon found in forest reserves and nature reserves, while, the largest unprotected carbon stores are found in wetlands, and in unprotected woodlands (Marshall, 2012). According to the NCP incorporating costs of sustainable management of forests and woodlands into analyses of the net economic consequences of alternative courses of action, as well as the design of any interventions are required (Fisher *et al.*, 2011). The NCP model approach indicated that current management expenditure is $2.3/ha/y, but that $8.3/ha/y is needed for effective protection. The efforts of the NCP evaluation approach led to the economic valuation methodology which is currently applied in the development for Payment for Ecosystem Services (PES) programs across the Eastern Arc Region, provided by the systematic basis for implementing PES, compensating local residents for maintaining natural assets (Fisher *et al.*, 2011; Lopa, 2012).

3.2 Case for Nyungwe National Park Rwanda

Globally, 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). In Rwanda however, the knowledge of the magnitude and value of forest ecosystems services is still limited. 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. 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). In this context, valuation of ecosystem goods and services could be an important contribution to the formulation and evaluation of conservation and development policies. A 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, Rwanda (Masozera, 2008). The study used market analysis to estimate the economic value of tourism and the avoided costs of the nonmarket value of ecosystem services as approaches of valuation. Avoided costs method was applied to estimate the costs that could be incurred in the absence of certain services that Nyungwe forest provide for instance flood control. As such the value of ecological goods and services provided by Nyungwe forest is estimated at a minimum 285 million USD/year. The value of carbon storage and sequestration was valued at an estimated 162 million USD/year, while the watershed protection services (water supply for irrigation, water for human consumption and industries, flood protection) were valued at an estimated 117 million USD/year. The maintenance of biodiversity was valued at an estimated 2 million USD/year, and the value of recreation and tourism was estimated at minimum 3.3 million USD/year. The total economic value of the Nyungwe watershed was estimated at 285,209,896 USD/year.

3.3 Case for Estimation of the Tourism Benefits of Kakamega Forest, Kenya

Kakamega forest is a famous tourist destination which is visited both by local and international tourists as a result of its biodiversity. The forest has two distinct parts which are differently managed by Kenya Wildlife Services and Kenya Forest Service. Kenya Wildlife Services is in charge of Kakamega Forest National Reserve while Kenya Forest Service is in charge of Kakamega Forest Reserve. However, despite the forest being a key recreational site, it has been faced by threats like encroachment and degradation, hence affecting the biodiversity status of the forest.

Kenya Wildlife Service generates revenue from the entry fees and camping charges. International tourists are usually charged 10 USD for both entrance fee and camping respectively per day, while local tourists pay 1.3 USD and 4 USD for entrance fee and camping (Mugambi & Mburu, 2013). Kenya Forest Service, on other hand, generates revenue by charging guest houses (4 USD) and loyalties from grazing. Grazing usually attracts a small income. Although Kenya Forest Service charges no access fee, its section attracts fewer tourists than the KWS-managed area. The variation in management of Kakamega forest has led to accelerated degradation and destruction of forest biodiversity, especially in the section under Kenya Forest Service. As the local communities can freely access this area, there is continuous extraction of non-timber forest products for local consumption and sale. The major concern is however grazing, as often livestock animals destroy indigenous grass and shrub species which have now become endemic

According to a research carried out by Mugambi & Mburu, 2013, it is estimated (generated from averages for three years) recreational benefits from Kenya Wildlife Services and Kenya Forest Service were US$ 3.7 Million and US$ 2.6 Million per year for, respectively. The area managed by Kenya Wildlife Service (KWS) had a higher recreational potential benefits than that of the Kenya Forest Service. This is due to difference in management regimes applied by the two institutions, whereby the segment under KWS is mainly protected as tourist destination. The segment under Kenya Forest Service is managed for multiple uses like grazing, recreational use, source of medicinal plant among others.

The report concluded that the realization of huge economic benefits depends on effective management and protection of forest biodiversity. The degradation and encroachment of the forest from Kenya Forest service segment could lead to substantial loss of biodiversity which eventually would be reflected in the reduced number of visitors. This implies that recreational benefits of the forest can be considered when persuading development partners and donors to make financial contributions for the conservation of the forest.

3.4 Analytics of the valuation approaches in East Africa

Country	**Project**	**Primary valuation approach**	**Secondary valuation approach**	**Implications**
Tanzania	Natural Capital Project (NCP) Eastern Arc Mountains	Cost-based approaches	Hedonic pricing	The valuation system for The Eastern Arc Mountains is based on payment for ecosystem services (PES) system with reference to an economic value that is attributed to conventional economics perspective. Although the PES initiative was recommended in 2011 (Fisher *et* al., 2011), the success was greatly uncertain (Lopa, 2012). This could be attributed to question of whether the community would continue conserving the ecosystem if they are not paid. Similar challenges have been experienced by PES initiatives, such as in Naivasha Kenya (Chiramba *et al.,* 2011), essentially in the sustainability of the process. This would potentially lead to a collapse in the natural resources management in the Eastern Arc Mountains, Tanzania.
Rwanda	Nyungwe National Park	Market prices; Cost-based approaches	Hedonic pricing; Travel cost	The project gave a definitive figure of the national park, essentially putting an economic value, understood by the policy makers and the community. The downside here is the values that would be deemed inconsequential, would easily be disregarded. The result of this would be a poorly managed ecosystem. This might result in an under valuation of the park.
Kenya	Estimation of the Tourism Benefits of Kakamega Forest, Kenya	Travel Cost		The tourism sector is well endeared by the national government in Kenya. The county (local) government of Kakamega is heavily investing in making the forest a tourist destination. This valuation greatly helps the policy makers and influencers make decisions on the way forward. Nonetheless, the valuation is centred towards maximizing benefits to the economy of the county (and national) government and not so much on the nature and ecosystem as a whole.

Reflection into the implications of applying conventional economics in valuing ecosystem services is apparent for the east Africa natural ecosystems, as in the case studies. This manifests in the need to consider applying ecological economics in valuing the ecosystem services. Would ecological economics valuation approaches result to better conservation measures for nature-based ecosystems in the East Africa areas? To understand this, it could be useful for some effort to be put in valuing ecosystem services in alternative and less anthropocentric approaches.

4. Conclusion and recommendations

Ecosystems and the benefits they provide are essential for human well being and viable communities. Yet, humans are exploiting and threatening those resources at increasing rates. As resources become scarce their values will increase and become more apparent. Human societies face important choices in how they manage ecosystems, affecting their conditions and the services they provide and thus ultimately human well-being. How decisions are made will depend on the systems of value endorsed in each society, the conceptual tools and methods at their disposal, and the information available. Making the appropriate choices requires, among other things, reliable information on actual conditions and trends of ecosystems and on the economic, political, social, and cultural consequences of alternative courses of action. Notably, "environmental issues are often undetectable to 'human senses' and often become visible when the damage is obvious and tend to be reported as 'catastrophes' "(White, 2007). The issue of valuation is inseparable from the choices and decisions we have to make about ecological systems. However, the incomplete state of scientific understanding of ecosystem function in many systems limits our ability to quantify all of their associated ecosystem services, which consequently impedes decisions about how best to manage for the long-term return and sustainability of these services.

Ecological economic approach derives a set of techniques are founded 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 a consensus. It encompasses a more holistic approach and emphasizes long-term effects and intergenerational issues which are important consideration when valuing ecosystems. The paper advocates for inclusion of Ecological Economics approach in ecosystem services valuation policy development and implementation, since it represents a viable option in creating sustainable global condition for human well being. Further, this paper shows that the ecological economics approach can work, with specific reference to valuation of ecosystems services, including the intangible services. The paper does not propose to have provided a complete picture but rather a snapshot of the current situation in East Africa. Gains have been small and inconsistent, and yet they form the only viable option for the way forward. More work must be done, more successes must be documented, and more positive news must be shared through ecological economics ecosystem valuation approach in order for it to take root as the dominant tool for generating sustainable human well being.

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