

Consilience: The Journal of Sustainable Development
Vol. 9, Iss. 1 (2012), Pp. 16 – 32

A Review of Economic Instruments Employed for Biodiversity Conservation

Edem Kodzo Ekpe
Department of Biology
University of Central Florida 4000 Central Florida Boulevard, Orlando Florida, USA
email: edemekpe@knights.ucf.edu

Abstract

Globally, the use of economic instruments for biodiversity conservation has gained a lot of support. This is because of the concern for the economic well being of people living in and near biodiversity-rich areas. Also, economic drivers are the main threats to biodiversity. This policy of using economic instruments is being used on a case-by-case basis worldwide. A review of their use from a global perspective is important to facilitate learning from issues resulting from their implementation. This article documents and reviews the specific economic instruments being used in different parts of the world for biodiversity conservation. An analysis of the economic instruments using a demand or supply classification suggests that more instruments are targeted at increasing supply of biological resources for human use. A review of literature and field documents was also employed to determine trends in the use of economic instruments for conservation. A major trend observed is the relatively low investments in economic instruments used for biodiversity conservation in developing countries, even though such countries tend to be rich in biodiversity.

Author's Note

Edem Kodzo Ekpe is Research Associate at the University of Central Florida, Orlando, FL, USA, where he graduated with a PhD in Conservation Biology. He also works in Ghana, where he has had extensive professional experience in socio-ecological research and management of biodiversity conservation projects.

Keywords: economic instruments, biodiversity conservation and development, conservation strategy.

1. Introduction

Biological diversity (or biodiversity) is the basic support for life on earth. Therefore, its importance to the survival of humans and their needs and wants cannot be overemphasized. However, global biodiversity is declining, thereby threatening the future survival of humanity. Without ambitious policies, biodiversity is projected to decline by a further 10% globally by 2050 (Organisation for Economic Cooperation and Development (OECD) 2012).

This decline of biodiversity and the biological resources they provide worldwide has been of increasing concern such that many tools and strategies are being used to address the threats (Groom et al. 2006). Among these strategies are economic instruments, such as policies, strategies and activities. These economic instruments are used to influence how people conduct their economic activities in

order to reduce the rate of biodiversity loss in various parts of the world. Some examples include market-oriented tools such as fees and ecotourism, and financial incentives such as compensations and tax incentives. In developing countries, development interventions such as alternative livelihood programs near protected areas are also implemented. Investments in local economic livelihood activities are therefore used to influence how people's actions affect biodiversity. It is important to determine whether and how effective all these different economic instruments are for biodiversity conservation. However, since they are employed on a case-by-case basis, information on them is scattered in several books and papers. A global perspective that documents their use and lessons from their successes and failures is necessary.

This study aims at presenting a consolidated global perspective of experiences of the use of economic tools for biodiversity conservation. The objectives of the study are to determine and describe the following:

- The role of economics in biodiversity conservation.
- The economic instruments being used for biodiversity conservation and the justification for their use.
- Some global trends and results from the use of economic instruments for biodiversity conservation.

2. Biodiversity and Economics

The Convention on Biological Diversity (CBD) defines biodiversity as the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems (CBD, 2008). By this definition, biodiversity is the “variability among” instead of the “full extent or scale” (Bennet, 2003) of all living organisms at various organizational levels including genetic, species and ecosystem levels, and the functions that maintain the biological organisms and their habitats. Biodiversity therefore captures two dimensions: number of biological organisms and their variability (Perman et al. 2003). This technical definition makes biodiversity a very complex concept and its absolute empirical assessment or measurement cumbersome. However, since scale and variability are linked, it is often understood in terms of the wide variety of plants, animals and microorganisms. For many reasons, the most common unit of measurement is in terms of the number and diversity of species. Estimates range from 3 to 100 million species but an estimate by Dobson (1996) claims 6 million is more realistic.

In economics, biodiversity is usually valued in terms of the biological resources that are generated from it. It is therefore perceived in terms of biological resources that humans use directly and indirectly and also perceived to be important for maintaining the environment in which they live. These biological resources include genetic resources, organisms and/or their parts, populations, or any other biotic component of ecosystems with actual or potential use or value for humanity. Therefore, though economics is also concerned about biodiversity conservation, it acknowledges that individuals and/or organizations do not decide directly upon how

much diversity to preserve, but rather make decisions about the way in which biological resources and their habitat are used (van Kooten and Bulte, 2000). The overriding goal of economics is to deliver choice solutions that make society better off. Therefore, economists view biodiversity as a scarce and valuable resource which humans use to improve their well-being through both present and future potential values. This makes biodiversity anthropocentric and utilitarian from an economic point of view. It has the peculiar attribute of a renewable resource which “grows” even when it is used for the different values humans place on it.

Biodiversity has many values of importance to humans. Groom et al. (2006) classify them into instrumental and intrinsic values. The instrumental values include their use as goods such as food, fuel, fiber and medicine; for ecosystem services such as nutrient recycling, air and water purification, climate regulation, and the generation of moisture and oxygen; information values such as genetic storehouse for biotechnology, genetic engineering and other life sciences research; and psycho-spiritual uses such as aesthetic beauty, religious awe and cultural identity (Ibid.). The intrinsic value, as seen in terms of its existence, means it is important and that satisfies some humans. Apart from the values outlined above, biodiversity also has future potential uses, which may be difficult to foresee. All these values can be assigned economic values, but with limitations. Many attempts to put dollar values on the present and future potential values of biodiversity have been inadequate but still resulted in values which are many times the world’s total Gross National Product, which humans cannot afford to substitute. From the different values that humans generate from biodiversity, it can be said that we need it for both our economic survival and existence.

2.1 Threats to Biodiversity and Approaches to Biodiversity Conservation

Both biodiversity and sustainable development are currently threatened by human action. Direct threats include habitat degradation and loss, habitat fragmentation, overexploitation of resources, species invasion and climate change (Groom et al, 2006). High losses driven by land-use change and management (e.g. for pasture, food crops and bioenergy crops), commercial forestry, infrastructure development, habitat encroachment and fragmentation, pollution (e.g. nitrogen deposition) and climate change are projected in parts of Asia, Europe and Southern Africa (OECD, 2012).

Habitat degradation and loss (as well as fragmentation) are largely caused by conversion, modification, and fragmentation of natural ecosystems for alternative uses such as agriculture and infrastructural development, which do not maintain species diversity or which undermine the provision of vital ecological services. These changes in land use are often driven by the perception that employing land for alternative use would generate higher economic returns (Norton-Griffiths and Southey, 1995). Land use changes often result in irreversible changes to the habitat whose natural systems and component species are destroyed and replaced (Ehrlich and Kremen, 2001). Overexploitation is largely due to the increasing demand for natural resources because of increasing human population. Due to human migration and other factors, several species are introduced in new areas where they invade and

dominate native species. Climate change - which is being observed globally - is making the results of these threats worse. Scientific information now indicates that though climate change is a natural process, human consumption patterns contribute to its increase. These threats are resulting in many more species becoming endangered. The 2008 update of The International Union for Conservation of Nature (IUCN) Red List includes 44,838 species, of which 869 (2%) are Extinct or Extinct the Wild; 16,928 (38%) are threatened with extinction (with 3,246 Critically Endangered, 4,770 Endangered and 8,912 Vulnerable); 3,513 (8%) are Near Threatened; while 5,570 (12%) have insufficient information to determine their threat status (Data Deficient). The number of extinctions might well exceed 1,100 if the 257 Critically Endangered species tagged as 'Possibly Extinct' are considered (IUCN 2008^a). A review of the trends in the numbers of endangered species by Ayoo (2008) indicates an increasing number of endangered species. European Commission (2008) indicates that the current decline in biodiversity and the related loss of ecosystem services will continue and in some cases even accelerate – some ecosystems are likely to be damaged beyond repair. It estimates that if human development continues in a “business-as usual” scenario, 11% of natural areas in 2000, 40% of the land currently under low-impact forms of agriculture and 60% of coral reefs could be lost by 2050. These studies indicate that human actions play a big role in the decline of biodiversity.

As a result of these anthropogenic threats and the consequent biodiversity decline, different biodiversity conservation approaches are used. These include establishment of protected areas on public lands, educational programs, government acquisition of private lands, regulatory prohibitions and requirements and economic instruments. These strategies are largely used complementarily. The major direct threats to biodiversity loss outlined above are to a large extent driven by economic factors.

2.2 Underlying Economic Causes of Biodiversity Decline

The major direct threats to biodiversity loss outlined above are to a large extent driven by economic factors because of the close links that exist between economic policies and the actions of humans as economic agents. Economic factors such as markets, policies and institutional arrangements tend to undervalue many goods and services associated with biological resources, ecosystems and their diversity and the premium attached to conserving them (Emerton, 2000). This results in biodiversity being underpriced, over-consumed and under-conserved because it is treated as a free good, which can be mined, converted, depleted or otherwise degraded at no social cost. Therefore, activities that lead to biodiversity degradation are permitted or even encouraged to occur because of failures and distortions in policies and laws, markets, institutions and livelihoods (UNEP, 2004; Ayoo, 2008) that govern the use of biological resources. Swanson (1995) as cited by van Kooten and Bulte (2000) adds portfolio choice and development as other underlying causes of biodiversity decline. I argue that these are similar to the institutional and livelihood failures respectively of Ayoo (2008) because portfolio choice is usually influenced by institutional arrangements. Also, development is largely concerned about different dimensions of human livelihoods.

Policy and legal failures occur when governments formulate and implement policies that are backed by legislations aimed at increasing economic activities. These could be in the form of agricultural subsidies or land re-distribution programs or increasing producer prices for certain crops. These may in turn encourage the use of more environmental amenities such as land and water for those activities and thus result in reduced biodiversity.

In economics, markets allocate resources and so influence choice decisions about production and consumption of goods by economic agents. Economic activities therefore depend on markets and prices. This is because markets determine the marginal profitability of different production options and the marginal economic desirability of different consumption options. However, markets are imperfect and can give wrong information about the value of renewable natural resources that are generated from biodiversity. Together, these phenomena result in the depletion of biodiversity because of increased land conversion.

Institutional failures occur when organizations fail to coordinate their development in order to reduce its impact on biodiversity. Portfolio choice by these institutions occurs because biodiversity decline is an outcome of society's own free will and this comes into play when developing countries copy the route taken by industrialized countries – the route of exploiting natural capital (van Kooten and Bulte, 2000).

Livelihood failures occur when people are forced to engage in economic activities that degrade biodiversity. This occurs because people's livelihoods, constraints and opportunities depend critically on biophysical and demographic conditions and local pressures that are, in turn, intricately linked to the nature of economic policies, markets and institutions (Ayoo 2008). Also in terms of human development, human societies and economies necessarily leave less room for other species, and possibly ecosystems (Swanson 1995 as cited by van Kooten and Bulte, 2000).

All the above underlying causes of biodiversity decline give a strong justification to the use of economic instruments such as fees and taxes for biodiversity conservation. This is because they provide a suite of tools for overcoming market, policy and institutional failures and for encouraging people to conserve biodiversity in the course of their economic activities (Emerton, 2000). These economic instruments can therefore be used improve the efficient allocation and use of natural and environmental resources so as to better reflect the social cost of using these resources (OECD, 2004).

3. Economic Instruments for Biodiversity Conservation.

Economic instruments are widely used in the health and education sectors to achieve development goals. For biodiversity conservation, economic instruments can be defined as mechanisms that aim at changing behaviors of economic agents by internalizing costs to natural resource utilization. Their use is predicated on the assumption that the social costs or benefits of biodiversity use, degradation, and restoration can be internalized in the price of activities that cause these losses or gains in biodiversity (OECD, 2004). This is because it is assumed that economic agents will use natural capital for activities that are most productive as per the

Ricardian Rent Theory, which posits that the economic rent (price) for a fixed factor of production such as land will be higher for more productive lands. Natural capital usually has high discount rates, thereby making economic sense to convert them to reproducible capital now. Economic instruments are therefore aimed at lowering the discount rate so that the people who bear the immediate cost of conserving the resource can conserve for longer periods. This can be explained by understanding the underlying causes of biodiversity decline.

Examples of these economic instruments include measures such as property rights, taxes, conservation easements, subsidies, charges, fees, market establishment, funds, loans, performance bonds, deposit systems, payment for ecosystem services, and livelihood support systems. They aim to change people's behavior by making sure that they take into account the real value of biodiversity and the broad costs associated with its loss when they make decisions (Emerton, 2000). In many parts of the world they are used to supplement and not replace other conservation strategies such as existing regulations and land acquisition programs designed to conserve habitats and species (Defenders of Wildlife, 2006).

The use of economic instruments for biodiversity conservation could be explained with the following example: A forest owner cuts the forest down for agriculture because that provides more marginal and immediate benefits. He or she does that without considering future costs such as watershed protection, source of medicine to him/her or to society. If future costs to the owner or society were considered or internalized, the owner could have kept the forest. Therefore, economic instruments should be aimed at making the forest owner appreciate and consider the future costs of cutting the forest now in his or her decision-making – internalization of future costs. If that makes the returns from cutting the forest down now (including future costs of having no forest such as erosion, loss of potential medicine source, loss of habitat for pest-controlling species and loss of windbreak) lower than keeping the forest, the owner will decide to keep the forest. So the core aim of these instruments is to maintain optimal value of environmental goods and services for current and future generations. In low-income countries, development assistance in the form of livelihoods support programs is provided to communities living near biodiversity hotspots and other conservation areas. Some of these include development and promotion of ecotourism, beekeeping and wildlife domestication. Such interventions indirectly provide desirable services by redirecting labor and capital away from environmentally unsustainable activities, such as agricultural intensification that degrade ecosystems, and by encouraging commercial activities such as ecotourism that supply ecosystem services as joint products (Ferraro 2001).

3.1 Classification of Economic Instruments for Biodiversity Conservation

Several economic instruments are currently used for biodiversity conservation. To facilitate their understanding different organizations use different criteria for classification. The International Union of Conservation of Nature (IUCN) classifies them into market-based mechanisms and non market-based mechanism (IUCN, 2008^b), while Defenders of Wildlife (2006) classifies them into

property rights innovations, market-oriented institutions, financial incentives and public tax incentives (Tables 1 and 2).

Classified group	Examples
Market-based mechanisms	<ul style="list-style-type: none"> • Markets for carbon sequestration • Markets for watershed services • Biodiversity offsets and mitigation • Conservation banking • Markets for recreation
Non-market-based mechanisms	<ul style="list-style-type: none"> • Global environment facility • Debt-for-nature swaps • Conservation trust funds or environmental funds • Taxes • Compensation to communities for opportunity cost and damages

Table 1: IUCN classification of economic instruments for biodiversity conservation.

Classified group	Examples
Property rights innovations	<ul style="list-style-type: none"> • Conservation easements • Covenants and deed restrictions • Stewardship exchange agreements
Market-oriented institutions	<ul style="list-style-type: none"> • User fees • Ecotourism • Eco-labeling and certification • Mitigation banking • Conservation banking • Transferable development rights • Ecosystem services markets
Financial incentives	<ul style="list-style-type: none"> • Compensation programs • Insurance • Cost-share incentives • Conservation stewardship incentives • Land and water rental leases • Conservation contracts • Debt forgiveness
Public tax incentives	<ul style="list-style-type: none"> • Income tax incentives • Property tax incentives • Estate tax incentives • Capital gains tax

Table 2: Defenders of Wildlife classification of economic instruments for conservation.

Examples in the Defenders of Wildlife classification are largely those economic instruments being used in the USA. As explained by IUCN (2008^b), there has been increasing interest in market-based approaches to environmental conservation. The rationale is to create incentives for resource managers and/or owners to behave in ways that sustain environmental functions like carbon sequestration, watershed protection, and habitat for endangered species, maintenance of landscape beauty. The incentives can take the form of direct payments for ecosystem services or ecosystem markets, tradable permits or quotas, and eco-labeling or certification schemes (Ibid.).

Markets for carbon sequestration (IUCN, 2008^b) stem from the growing evidence of global warming due to the greenhouse effect, and increasing credence to the threat of rising sea levels, loss of coral reefs, diseases, and desertification. This led to the development the United Nations Framework Convention on Climate Change in 1992 and the signing of the Kyoto Protocol in 1997 to help reduce the build-up of greenhouse gases like carbon dioxide and methane. The Kyoto Protocol set emission reduction targets for countries, providing a foundation for a system of emission rights trading – a carbon market. The rationale is that some countries will find it simpler and cheaper to reduce emissions than others, for instance through

carbon sequestration activities such as afforestation. They can therefore sell emission rights with those who will find it expensive to reduce emissions. Funds from such sales would be used for afforestation and reforestation which sequester greenhouse gases and contribute to biodiversity conservation. Though big emitters such as the USA and China have not ratified the protocol, a voluntary market in carbon offsets has emerged and is likely to continue developing, both within and outside the framework of the protocol (IUCN, 2008). This market includes industries, project developers, consumers, several registries and even a trading exchange, the Chicago Climate Exchange (Bayon et al. 2006).

Markets for watershed services stem from the growing recognition of the watershed services provided by forests. The increasing willingness of downstream populations to pay for these services has led to the emergence of payment mechanisms in parts of the world, from New York to Quito, and from Haryana to Costa Rica (IUCN, 2008^b). Costa Rica's pioneering environmental services program seeks to maintain socially optimal forest cover by compensating landowners for the external benefits provided by their forests (Chomitz et al., 1999).

Biodiversity offsets and mitigation, as well as conservation banking refer to protected areas that are created and managed as a means of providing compensation for habitat loss resulting from land development. In this, developers buy credits from approved conservation bankers for each area of habitat that is destroyed. These funds are used to support species and habitat conservation efforts in the surrounding areas. Examples used in the USA are mitigation banking, conservation banking, and transferable development rights.

Markets for recreation stem from the fact that alternative forms of tourism (ecotourism, green tourism, or nature tourism) are the fastest growing segments of the tourism sector, constituting about 30 percent of the global market today (IUCN, 2008^b). Ecotourism is defined as responsible travel to natural areas that conserves the environment and improves the well-being of local people (International Ecotourism Society 2008). Ecotourism is therefore culturally and environmentally sustainable and so minimizes adverse impacts, especially in the long term. Ecotourism helps in effective conservation of biodiversity-rich areas and improving livelihoods in poor indigenous communities by providing jobs, income and business opportunities to local communities.

Many other market-based mechanisms to finance biodiversity have emerged, including bio-prospecting, certification schemes for sustainable practices, eco-labeling for organic products and user fees.

IUCN (2008^b) describes the rationale for non-market based mechanisms as that biodiversity and ecosystem services have both public as well as private good/service characteristics, and that the market will fail to deliver on the value of public goods. Thus public investment (in the form of various taxes, funds and other measures) is required in order to finance conservation.

The Global Environment Facility (GEF) provides grants to developing countries and countries with economies in transition for projects that achieve global environmental benefits in the area of biodiversity (GEF 2008). GEF funds are contributed by donor countries. In 2002, 32 donor countries pledged USD 3 billion to fund operations between 2002 and 2006 (IUCN 2008). GEF finances only the incremental cost of projects, which is the difference between the benefits that will accrue to the country, and the benefits to the world.

Debt-for-nature swaps are debt conversions which mean the cancellation of a country's foreign debt in exchange for new obligations. A variety of debt conversion mechanisms exist, such as debt-for-equity, debt buy-backs, and debt-for-nature swaps (Moye, 2001). Debt-forgiveness programs are also used in the USA (Defenders of Wildlife, 2006).

Conservation trust funds or environmental funds include trust funds established by legislation, foundations, common-law trusts and non-governmental organizations (NGOs). Their aims range from financing the cost of protected areas (park funds), supporting national environmental plans or strategies (strategy funds), and providing grants for biodiversity conservation (grant funds) (Bayon, Lovink and Veening, 2000 as cited by IUCN, 2008^b).

Taxes are also used as economic instruments. These include income tax incentives, property tax incentives, estate tax incentives, capital gains tax. These taxes are usually enjoyed by landowners for conservation actions. IUCN (2008^b) gives some examples of other taxes such as visitors to the Fernando de Noronha Marine National Park on the Atlantic coast of Brazil have to pay a daily environment tax that increases incrementally as the visit continues. The Caribbean island of Dominica levies USD 1.5 on all tourists on departure. Another example is the ecological value-added tax in Brazil. This levy on the circulation of goods and services rewards municipalities for the positive externalities of their conservation areas, thus giving them an incentive to increase the area under conservation (Ibid.).

Another instrument is compensation to communities for opportunity cost and damages or investments in livelihoods support activities. These stem from factors such as increasing demographic pressure, expansion of cultivation and the emergence of large-scale commercial farming. These are usually in terms of Integrated Conservation and Development Projects (ICDPs). ICDPs aim at compensating people for the costs or providing alternative and/or complementary livelihoods activities. Thus they increase supply of ecosystem services by increasing supply of natural resources which would have been exploited from within protected areas or other conservation areas.

3.2 A Demand and Supply Classification of Economic Instruments

As explained earlier, biodiversity is viewed in economics as the source of biological resources which can be allocated by providing choices to improve human welfare. Therefore, the relationship between demand and supply underlies the forces that drive the allocation of natural resources from biodiversity. An evaluation of the success or failure of economic instruments for biodiversity would be to figure out whether they have addressed the demand and supply of resources they were aimed to address. I therefore classified the economic instruments by the demand and supply. This is an attempt to use the basics of economics to classify economic instruments for biodiversity conservation. Though the instruments affect both demand and supply of biological resources, the criteria is based which of these two factors are directly affected by the economic instrument. The specific determining criteria are that demand instruments directly decrease or increase demand for biological resources and the supply instruments directly increase or decrease supply of biological resources. The classification is presented in Table 3.

For example, ecotourism is a demand instrument. Ecotourism in a forested area will reduce how the nearby communities which benefit from the tourism proceeds may demand biological resources such as timber and bushmeat from the forests. Eco-labeling and certification also increases demand for products from sustainably managed resource bases.

On the other hand, when there are tax incentives for landowners to keep biological resources on their land that directly reduces the supply of resources such as timber to the markets. Also, debt conversion mechanisms such as debt-for-nature swaps encourage poorer countries to protect their natural resources and this directly reduces the supply of biological resources from their natural areas.

Demand instruments	Supply instruments
<ul style="list-style-type: none"> • Ecotourism • Markets for recreation • Eco-labeling and certification • User fees • Markets for carbon sequestration • Markets for watershed services • Compensation programs for opportunity cost and damages 	<ul style="list-style-type: none"> • Biodiversity offsets and mitigation • Conservation banking • Conservation easements • Covenants and deed restrictions • Stewardship exchange agreements • Mitigation banking • Transferable development rights • Tax cuts • Insurance • Cost-share incentives • Conservation stewardship incentives • Land and water rental leases • Conservation contracts • Property and estate tax incentives • Capital gains tax • Debt conversion mechanisms

Table 3: A demand and supply classification of economic instruments.

4. Experiences with the Use of Economic Instruments for Biodiversity Conservation

Many experiences of the use of economic instruments for biodiversity conservation focus on their economic effectiveness and efficiency. Defenders of Wildlife (2006) state that from an economic perspective study of 1,250 land trusts in the USA (Parker, 2004), conservation easements have been one of the most cost effective incentives for conserving land. IUCN (2008^b) explain that though the voluntary carbon markets are not doing much because of the increasing emissions, all countries stand to potentially gain from such trade. But the economic impacts on poor people in developing countries will depend on whether afforestation activities engage local communities, and whether they lead to loss of access to forest resources and fast-growing plantations that deplete groundwater supply. Also, there is little

evidence that mechanisms exist for and little reason to be confident that the benefits from credits will be transferred to communities and especially the poor.

There are a few examples of positive social impacts from carbon markets. The Noel Kempff Mercado National Park is a partnership between the Government of Bolivia, various non-governmental organizations, American Electric Power, BP Amoco and PacifiCorp to protect four million acres of tropical forest. The primary purpose of the project is to capture carbon dioxide, but it also includes health care programs and alternative economic development activities to assist local people who live in and around the park and who depend on local resources for their livelihood. More than half the park rangers were hired from local communities. The project has resulted in formalized land tenure for the local communities. Another example is a community silviculture carbon offset project in the Sierra Norte of Oaxaca, Mexico, which finances the development of women's groups (Ibid.). In Ghana, United Nations Development Program/ Global Environment Facility (GEF) projects that have largely employed investments in alternative livelihoods activities resulted in about 2500 square kilometers (250,000 hectares) of land outside protected areas being placed under effective community management (GEF, 2008^b). These examples show some of the positive effects of economic instruments used for biodiversity conservation.

There are also negative impacts. The biggest social concerns from carbon projects are exclusion and erosion of rights, eviction, and the potential negative impacts of fast-growing plantations on soil, water and biodiversity. There is real potential for carbon projects to help poor people through new sources of income, diversified income streams, institutional development, and formalization of rights over resources. There are also real risks, however, of exclusion and increased vulnerability of the poor, and control of benefits by more powerful actors (GEF, 2008^b).

In the USA, it is generally acknowledged that although there are many public and private incentive programs designed to encourage conservation, they tend to be overly specialized and prescriptive, fragmented and under-funded. These programs are also generally constrained by the fact that the primary threats to biodiversity – habitat loss, degradation and fragmentation – operate across public and private ownerships (Defenders of Wildlife 2006).

According to the Regional Environmental Center (REC, 2008) of Central and Eastern Europe, as in many countries in that region, there is low efficiency on using economic instruments for conservation in Romania because of inadequate funding. Other reasons for the low efficiency of the economic instruments used in the past system include the following:

- Deficiencies in the monitoring system, partly due to the lack of technical and material support, making it impossible to establish a link between the pollution and the polluter.
- Socialist property generalization; the inappropriate use of economic instruments in environmental protection reduced the importance and character of those instruments;
- Lack of priorities concerning environmental protection necessary for an economy with limited economic resources.

The Forest Biodiversity Program for Southern Finland started in 2003 as a toolbox of several government-financed conservation programs (Mayer and Tikka 2006). One tool, Natural Values Trading, is being actively tested. It involves contracts with private forests to conserve usually for 10 years. However there is not systematic monitoring. The mean value of incentive is US\$1790 lump sum per hectare.

In Sweden, Nature Conservation Agreements were started in 1995 (Mayer and Tikka 2006). The program is run as a contract between a landowner and Swedish Forest Agency to maintain or restore ecologically valuable forest habitats for a maximum of 50 years. This program is systematically monitored every four to five years. The mean value of incentive is US\$1260 lump sum per hectare.

The Indiana Classified Forest Program started in 1921 in Indiana, USA (Bennet et al. 1995). It uses property tax relief as an incentive to encourage forest owners to manage or restore forests. There is no fixed-term contract so landowners can withdraw but they have to pay the tax back with interest. It is monitored every five years. The mean value of the incentive is US\$1300 per hectare per year in tax relief

Two examples from Africa are the Selous Game Reserve, Tanzania (Gillingham and Lee 1999 as cited in Spiteri and Nepalz 2006); and Afadjato-Agumatsa Community Forest, Ghana. In both examples there is high level of dependency on resources. In the Selous Game Reserve, incentives are in the form of support for livelihoods, promotion of agroforestry and plantation. The land is state-owned but with traditional interests. The value of the incentive is \$9.09 per hectare per year. In Afadjato, incentives are in the form of support for livelihoods, promotion of agro-forestry and benefit-sharing from ecotourism. The project started in 1999. The value of the incentive is \$7/hectare per year.

In Australia, (Australian Department of the Environment, Water, Heritage, 2008) there is a government taxation concession in which the government providing a donor, who has donated a gift of \$5,000 or more to an environment or heritage organisation, the opportunity to claim the donation against their tax returns over a five year period.

In India, as in many parts of Asia, economic instruments were used for soil conservation. This conserves biodiversity in the soil as well as reduces the use of biodiversity-rich areas for agriculture. Incentives provided Include were input subsidies, distribution of tree seedlings, implements under subsidy, compensation for wages, investment in water harvesting structures (Reddy et al, 2004).

An observation of the level of investments is that there has been a significantly lower dollar value of the incentives employed in developing countries. The examples in this paper do not represent the total figures from the regions. However, a computation of the figures from Finland, Sweden and the USA compared to those from Ghana and Tanzania gives a ratio of 181:1 in the dollar value of incentives employed per hectare of land being conserved for biodiversity. This is the situation despite the fact that the developing countries tend to have more biodiversity.

5. Conclusion

One obvious trend from this study is that there are a lot more supply instruments than demand instruments worldwide. This could be because of the need to increase supply of biological resources to satisfy human needs and wants. This is especially important because of the slower growth of natural resources compared to the demand for them by an increasing human population and other factors.

Current research methodologies are biased because they fail to use controls, which would be required in an experiment. This is because the sites at which conservation programs are implemented are not selected randomly (Ferraro and Pattanayak (2006). I therefore suggest that future research in evaluating the effectiveness of economic instruments should use controls by using matching method which can account for observable correlated covariates. The results of this will present more objective evaluations of economic instruments used for biodiversity conservation. An example of the use of this is in Andam et al (2008). However, they studied the effectiveness of protected area networks and not economic instruments.

Another issue for future research and conservation project implementation is the need to account for the value of the resources to be conserved before deciding the type and quantity of economic instruments to be used. This is not clear in current research and projects. An example is that GEF funds by policy are to pay for incremental costs, which is the difference between the benefits that accrue to the implementing country and benefits that accrue to the whole world. However no empirical valuation has been documented to be used to determine what the incremental cost will be. This process is even not accounted for in the in GEF's project cycle policies and procedures (GEF, 2007).

Generally, economic instruments being used for biodiversity conservation are serving good economic as well as conservation purposes. Based on current research, they contribute a lot to biodiversity conservation. They are, however, not panacea that can be used on their own and should therefore be used as complements and supplements of other biodiversity conservation strategies.

Bibliography

- Andam, K. S., Ferraro, P. J., Pfaff, A., Sanchez-Azofefia, G. A., & Robalino, J. A. (2008). Measuring the effectiveness of protected area networks in reducing deforestation, *PNAS*. 105, 16089-16094.
- Australian Department of the Environment, Water, Heritage (2008). Retrieved from <http://www.environment.gov.au/about/tax/index.html>
- Ayoo, C. (2008). Economic instruments and the conservation of biodiversity, *Management of Environmental Quality: An International Journal*, 19(5), 550-564.
- Bayon, R., Hawn, A., & Hamilton, K. (Eds). (2006). Voluntary carbon markets: an international business guide to what they are and how they work, *Earthscan*, 164.
- Bennet, J. (2003). The economic value of biodiversity: a scoping paper. *Australian Government, Department of the Environment, Water, Heritage and the Arts*. Retrieved from <http://www.environment.gov.au/biodiversity/publications/scoping-paper/index.html>
- Chomitz, K. M., Brenes, E., & Constantino, L. (1999). Financing environmental services: the Costa Rican experience and its implications, *The Science of the Total Environment*. 240, 157-169
- Convention on Biological Diversity. (2008, November). Retrieved from <http://www.cbd.int/convention/>
- Defenders of Wildlife. (2006). *Incentives for biodiversity conservation: an ecological and economic assessment*. Defenders of Wildlife, Washington D.C.
- Dobson, A. P. (1996). *Conservation and biodiversity*. New York, NY: Scientific American Library.
- Ehrlich, P. R., & Kremen, C. (2001). Human effects on ecosystems: overview. In Levin, S.A. (Ed.), *Encyclopedia of Biodiversity* (Vol. 2) (pp. 383-93). Durham, NC: Academic Press.
- Emerton, L. (2000). Economics and the convention on biological diversity. *The World Conservation Union* (IUCN).
- European Commission (2008). *The economics of ecosystems and biodiversity: an interim report*. Retrieved from <http://ec.europa.eu/environment/nature/biodiversity/economics/>

- Ferraro, P. J. (2001). Global habitat protection: limitations of development incentives and a role for conservation performance payments. *Conservation Biology* 15(4), 1-12.
- Ferraro, P. J. and Pattanayak, S. K. (2006). Money for nothing? A call for empirical evaluation of biodiversity conservation investments. *PLoS Biology* 4(4), 105, 482-488.
- Global Environment Facility (GEF). (2007). *Policies and procedures for the GEF project cycle*. Retrieved from http://gefweb.org/uploadedfiles/GEF_Project_Cycle_Policy_Paper_Oct29_07.pdf
- Global Environment Facility (GEF). (2008). *Joint evaluation of the GEF small grants programme*. Washington DC: GEF Evaluation Office.
- Groom, M.J., Meffe G.K., & Carroll, C. R. (2006). *Principles of Conservation Biology* (3rd ed.). Sinauer Associates.
- International Union of the Conservation of Nature (IUCN). (2007). *IUCN Red List of Threatened Species, State of the World's Species*. Accessed December 1, 2008. Available at: http://cmsdata.iucn.org/downloads/state_of_the_world_s_species_factsheet_en.pdf
- International Union of the Conservation of Nature (IUCN). (2008). *Economic instruments for financing conservation and poverty reduction*. Retrieved from http://www.iucn.org/about/work/initiatives/sp_cprihome/index.cfm
- Mayer, A.L., & Tikka, P. M. (2006). Biodiversity conservation incentive programs for privately owned forests. *Environmental Science and Policy*, 9, 614-625.
- Moye, M. (2001). *Overview of debt conversion*. Debt Relief International Ltd. London, UK. 47pp.
- Norton-Griffiths, M. & Southey, C. (1995). Opportunity costs of biodiversity conservation in Kenya. *Ecological Economics*, 12 (2), 125-39.
- Organisation for Economic Cooperation and Development. (2004). Recommendation of the council on the use of economic instruments in promoting the conservation and sustainable use of biodiversity. Retrieved from <http://acts.oecd.org/Instruments/ShowInstrumentView.aspx?InstrumentID=50&InstrumentPID=47&Lang=en&Book=False>

- Organisation for Economic Cooperation and Development. (2012). Environmental outlook to 2050. Retrieved from <http://www.oecd.org/env/environmentalindicatorsmodellingandoutlooks/49897175.pdf>
- Parker, D. (2004). Land trusts and the choice to conserve land with full ownership or conservation easements, *Natural Resources Journal*, 44(2), 483-518.
- Perman R., Ma, R., McGilvary, J., & Common, M. (2003). *Natural resource and environmental economics* (3rd ed.). Pearson Education Limited.
- Reddy, B. V. C., Hoag D., & Shobha B. S. (2004). *Economic incentives for soil conservation in India*. Proceedings of the 13th International Soil Conservation Organization Conference, Brisbane.
- Regional Environmental Center for Eastern and Central Europe. (2008). Retrieved from <http://www.rec.org/REC/Publications/EcInstruments/Romania.html>
- Spiteri, A., & Nepalz, S. K. (2006). Incentive-based conservation programs in developing countries: a review of some key issues and suggestions for improvements. *Environmental Management*, 37, 1-14.
- The International Ecotourism Society. (2008). Retrieved from <http://www.ecotourism.org/>
- United Nations Environment Programme (UNEP). (2004). *Economic instruments in biodiversity: related multilateral environmental agreements*. Retrieved from http://www.unep.ch/etu/etp/events/Economic_Instruments/EIMEAWorkingPaper.doc
- van Kooten, C.G., & Bulte E. H. (2000). *The economics of nature: managing biological assets*. Massachusetts: Blackwell Publishers.