What Drives Biodiversity Conservation Effort in the Developing World? An analysis for Sub-Saharan Africa.

Amin Ariane[1]
Centre d'Etudes et de Recherche sur le Développement International,
65 Boulevard F. Mitterrand, BP 320, 63009 Clermont-Ferrand CEDEX 1, France
Tél.: 04-73-17-74-00, Fax: 04-73-17-74-28

Abstract

Biodiversity conservation in low-income economies is a vital issue and hence needs to be addressed for development and poverty eradication. A variety of empirical works exist on the subject, but the focus is often limited on the search for possible causes of biodiversity erosion. Research on the "driving forces" that influence biodiversity conservation effort is still largely missing, especially for developing countries. In this study, we seek to address this gap. We test, using different models, the impact of some domestic and external factors on countries' conservation effort measured by the Ecoregion score. We examine specifically whether strategic interactions matter in conservation policymaking at the country level. The model is tested on a data set comprising 48 sub-Saharan African countries spanning over the period 1990-2009. Through the obtained results, we give empirical evidence that, in the context of underdevelopment especially in Sub-Saharan Africa, strengthening governance is an effective mean to support the promotion of biodiversity conservation. In addition, we find that countries in Sub-Saharan Africa are influenced by their contiguous neighbors in environmental policy for biodiversity management. Finally, the results suggest that tourism development is a valuable incentive to raise governments' dedication to conservation in Sub-Saharan Africa.

Keywords: Biodiversity, Ecoregion score, Strategic interactions, Spatial econometrics.

Code JEL: P48, Q57, C21

[1] Author mail : ariane_manuela.amin@ecogestion.u-clermont1.fr

1 Introduction

'Biodiversity' is an umbrella term that covers all life on the planet, from the genetic level to terrestrial, freshwater and marine habitats and ecosystems (TEEB, 2009). It can be thought of as an economic good (Baumgärtner, 2006; Heal 2000) as it is obviously scarce, it satisfies human needs and allows people to achieve certain ends (Baumgartner, 2007). By offering provisioning services along with regulating, cultural and supporting ones, the diversity of species, ecosystem and genes – in reference to biodiversity (MEA, 2005) - underpins our global economy as well as human well-being (TEEB, 2009).
The benefits from biodiversity are in most case marked by nonrivalry in consumption, nonexcludability, and are quasi universal in terms of countries, people and generations (Kaul et al, 1999). 'Biodiversity' can therefore be thought also of as a global public good.

The supply of this "global public economic good" to humankind is increasingly threatened. The seriousness of the situation has been borne out by different international reports (IUCN, 2004; MEA, 2005; TEEB, 2010). It has been established that in the last century we have lost 35% of mangroves, 40% of forests, 50% of wetlands and that 60% of ecosystem services have been degraded in fifty years (TEEB, 2010). The current species loss is 100 to 1,000 times than in geological times and will get worse with climate change (MEA, 2005). The threats are however more acute in the tropical developing countries where much of the biodiversity resides and where people are less able to adjust to change as compared to developed countries (MEA, 2005) .

The overall cost of the current biodiversity loss is unknown. Yet, some parts of this cost, including the costs of lost bio-prospecting leads, the costs of lost carbon storage, the costs of lost tourism business and the costs of diminished watershed protection, amount to many tens of billions of dollars (Heal, 2005). For the entire biosphere, the economic value of 17 ecosystem services has been approximated to be in average of US$33 trillion per year (Constanza et al, 1997). The costs of inaction in respect to biodiversity loss are not equitably distributed and are more discriminatory for poor people since natural resources are a basic source of their income generation (MEA, 2005). Despite the lack of precise knowledge about the costs of biodiversity loss, the global recognition of the economic and human dimension of biodiversity loss still persist, along with the need for urgent actions.

The debate on strategies to slow the trend of biodiversity loss has lead to an increasing interest of researchers and scholars on different concerns related to biodiversity issues. In that broad framework, many theoretical and empirical studies have attempted to better understand the socio-economic causes of biodiversity loss (Kerr and Currie, 1995; McNeely, 1996; Asafu-Adjaye, 2003; McPherson and Nieswiadomy, 2005; Freytag et al, 2009; Pandit and Laband, 2009); or to assess the real value of biodiversity for humankind (Bingham et al, 1995; Constanza et al, 1997; Seidl and Moraes, 2000; Sagoff, 2011). Little has been done however to analyse biodiversity conservation policy-making. In fact, there is a dearth of analyses that attempt to understand the mechanisms that conduct governments' conservation strategies as well as allocation of public funds for biodiversity conservation. The studies that exist on governments' dedication to species conservation have been narrowed to species characteristics only (Simon et al., 1995; Metrick and Weitzman, 1998; Dawson and Shogren, 2001; Mahoney, 2009). Fewer studies have focused on others determinants for biodiversity conservation policymaking, including the papers of Lightfoot (1994), Dietz and Adger (2003), Archer and Orr (2008). Lightfoot (1994) examined the relationship between level of development and establishment of parks and reserves. He found as main result that a country's development level has no deterministic effect on formal attempts to establish preserved areas. Dietz and Adger (2003) performed a study to find out the relationship between economic development and the level of government intervention in designating protected areas. According to their results, there is a possible tendency towards increased conservation efforts with increasing income. Archer and Orr (2008) used a simple linear model on 129 countries, to test four groups of predictors to land protection: biodiversity, environmental threats, politics (such as treaty participation and NGO activity), and economics (such as GDP and trade measures). They ascertained that environmental threats represent the strongest individual reason for land protection.

In this study we propose to further investigation on biodiversity conservation policymaking in order to add to the sparse literature on this axis of biodiversity conservation debate. We aim to identify specifically the main factors that drive governments' effort for biodiversity conservation.

We begin by considering biodiversity as diversity of genes, species, and ecosystems in a given area and adopting the concept of biome as its measure. Biomes are defined as "the world's major communities, classified according to the predominant vegetation and characterized by adaptations of organisms to that particular environment" (Campbell 1996).

Biodiversity conservation effort is then measured as the capacity of a given country to conserve a proportion of each biome within its territory.

Next, we identify a specific study area guided by two considerations. Firstly, we consider that address the question of factors that influence biodiversity conservation policymaking at a global scale as it has be done in previous studies (Dietz and Adger, 2003; Archer and Orr, 2008) seems problematic, because it supposes that there is homogeneity of government's behaviour between countries. Secondly, we think that the need of knowledge about biodiversity conservation is more critical for "biodiversity-development hotspot" (see map in Appendix A) in reference to areas where we find high threat on biodiversity and low economic development. In fact, the challenge to respond to biodiversity problems is interconnected to the major obstacle that is poverty. Along with these considerations, we limit the study to sub-Saharan African region, one of the poorest regions in the world which exhibit some common structural, politics and economics characteristics. This region has also the world's second largest tropical rainforests and homes the majority of "hot spot" of biodiversity of Africa (see map in Appendix A).

Finally, we extend the factors proposed in previous studies, by testing the existence of strategic interaction in conservation policymaking, in the context of developing countries. This assumption is supported by the fact that we consider that the development of funds for conservation and of biodiversity-based revenue generating activities, have increased the value of biodiversity. This, in turn has raised the benefits from conservation and consequently the opportunity cost of biodiversity loss in the developing countries i.e. the cost of inaction. The presumption is that, given the fact that these economic incentives are based on allocation criteria or market share, if countries' strategies for biodiversity management are sensitive to these economics incentives, developing countries can be leaded in win-lose competition. Countries would then incorporate information on conservation policies in others countries into their own policies making decisions and be induced in strategic interactions.

The next section reviews previous researches carried out in assessing determinants of biodiversity conservation efforts, and details the specific hypotheses of the study. Section 3 presents the data and methodology used in the analysis while section 4 discusses the empirical results derived. The last section provides the conclusion of the paper.

2 Biodiversity conservation effort: previous and new assumptions

When searching for empirical studies on biodiversity conservation policymaking, it is striking that little has been done on the topic. It exist however a variety of work on environmental policymaking in general, that could be applied to conservation policies. According to this literature, causal factors for environmental policymaking can be categorized into domestic and external factors.

2.1 External influences

External influences in the framework of biodiversity conservation refer here to factors such as multilateral negotiations and treaties. In this study we include a new hypothesis in this range of determinants. We consider that competition for international funds can be an important driving force for biodiversity conservation policymaking in the context of developing countries.

2.1.1 Multilateral negotiations and treaties

As global integration proceeds, domestic policy objectives—such as public health, economic growth or environmental protection—are increasingly subject to international forces (Kaul et al., 1999). Those forces lead to a race to the top or at least as a move towards more encompassing environmental policies in countries (Kern et al., 2000). Analyzing the reasons of external influence on environmental policy decisions, Carraro and Siniscalco (1992) argue that external demand for improvements in the quality of global environmental goods such as rain forests, global climate or biodiversity affect national strategies. Botcheva and Martin (2001) also assume that high negative externalities (both environmental and economic) make states benefit from choosing the same course of action, which leads to convergence. The convergence of states environmental policies result from different mechanisms. Busch and Jörgens (2005) propose a typology of three broad classes of them: harmonization (in terms of negotiation, legalization, compliance and enforcement though resolution, convention or protocol implementation), coercive imposition (through economic conditionality), and diffusion mechanisms (as a process by which policy innovations are communicated in the international system and adopted voluntarily by an increasing number of countries over time).

On biodiversity concerns, the main driving forces behind the spread of conservation strategies seem to be harmonization and diffusion. In fact, many multilateral negotiations aim to induce countries to adopt national conservation policies that provide global benefits. For instance, the convention on biological diversity (CBD), the Convention on International Trade in

Endangered Species (CITES), and the International Treaty on Plant Genetic Resources for Food and Agriculture, all emphasize the benefits to nation-states of acting in global interest. Nongovernmental organizations (NGOs) play also a key role in forcing leaders and policymakers to pay attention (Simmons, 1998) for biodiversity conservation. They have an increasingly prominent role in international environmental institutions, participating in many activities—negotiation, monitoring, and implementation—traditionally reserved to states (Raustiala, 1997).

In the specific case of Africa, a convention on the Conservation of Nature and Natural Resources has existed since 1968 but has had a relatively low level of activity and global relevance. It was revised in 2003, in Maputo, guarantying stronger institutional tools to ensure its implementation. Under the impetus of the World Conservation Strategy, we observe that national conservation strategies became increasingly institutionalized in Africa in mid-1980s (Falloux et al., 1990). Also, in the period following the Rio Conference, more than half of African countries had drafted or were in the process of drafting their National Environmental Action Plans NEAP, which included conservation strategies (Kamto, 1996).

2.1.2 International Funds

Biodiversity conservation represents a growing important target for international assistance in direction of developing countries. Indeed, the large part of the world's biological diversity resides in tropical countries where there are the least resources to conserve them (Pearce, 2007). The preservation of the main environmental services provided at local and global scale by biodiversity, require thus some international funding mechanisms in favor of countries which have great biological patrimony. These mechanisms have in charge with meeting the ‘incremental cost’ of developing countries' provision of global environmental goods (Pearce, 2007) i.e. the additional costs without which, we couldn’t go to the global optimum of environmental services supply. Theses mechanisms are of different kinds and are mostly supported by the Global Environment Facility (GEF) established in 1991 in the World Bank to assist in the protection of the global environment and to promote environmental sustainable development. These funding are important levers in the implementation of environmental strategies in most developing countries which often have limited national budget and face problems with more basic issues such as health, poverty and mitigation. They represent also strong incentives to encourage poor countries for sustainable development and biodiversity conservation. Depending on selectivity for the allocation of these financial resources, we

assume that developing countries may be in competition to be a recipient of a specific funding, thereby involving them in strategic calculus.

Ambiguous claims exist about whether there is selectivity between countries for international assistance concerning environmental target. Donors are expected to respond to constituency demands for greater effectiveness and environmental performance or to avoid selectivity in order to maintain their budget amounts (Svensson, 2003; Chong and Gradstein, 2008). Recipients that can determine important global environmental outcomes unilaterally, like Brazil with tropical forests or China with climate change, would receive high amounts of aid even if they only deliver lackluster performance on project objectives (Darst, 2001). For the specific case of international funding such as REED or partnership with pharmaceutical firms for instance, the more performing a country is, comparatively to similar countries for conserving its biological patrimony, more probable it is attractable for these funds. Referring to these claims, if there is an allocation criteria, then it is subject to performance-based or risky-based selectivity. If the criterion is based on the comparative risky situation, the level of species extinction for instance, then the best strategy for a country is to be less efficient in order to attract maximum support. If the criterion is rather the comparative performance, then the strategy is to show superior effort comparatively to other countries.

2.2 Domestic factors

Which domestic determinants drive environmental policymaking at a country level? A widely held view among those in the environmental science is that promotion of economic growth and its induced policies balance environmental strategies.

Some sectoral policies such as in the tourism sector have also a growing impact on conservation policymaking. We assume in this study that countries competitive strategies to tourism market share influence their effort in biodiversity conservation.

2.2.1 Growth promotion

Economic growth is thought to be incompatible with environmental protection. In fact, studies in environmental economics and environmental policy often cited tradeoffs between protecting the environment and encouraging growth.

When looking at empirical findings from literature, we notice different conclusions regarding the role of economic development on biodiversity conservation policies. Archer and Orr (2008) found that economic predictors are not relevant to conservation strategies. They suggest that biodiversity factors (forest area, species richness) and environmental threats (high

anthropogenic impact and timber harvest rates) are primary incentives of protected land policies. According to their result, politics and economics are not influential parameters of conservation and argue that protection policies are not necessarily "meaningful" policies, which require both political and economic resources.

A number of scholars assume contrarily that a conflict between economic growth and biodiversity conservation exist (Czech, 2003). In fact, the acceleration of economic development with the intensification of production and consumption activities exacerbated by an increase of population, act as disincentives to biodiversity conservation policies. Indeed tireless efforts to meet the needs of population in terms of consumption goods and arable land may lead to policies that increase resource depletion at a rate which often exceeds the rate of resource regeneration. In developing countries for instance, extensive agriculture with high rate of deforestation and natural habitat loss, to respond to near-term security of food supplies, weaken countries' capacity to protect biodiversity.

The development of trade in respect to economic development promotion also affects countries' environmental strategies. Liberal trade policies are seen to favor an environmental "race to the bottom" and contribute to declining environmental quality (Grether and deMelo, 2003). Jorgensen and Kick (2006) argue that high levels of export dependence have many consequences for the domestic ecology, such as depletion of raw materials and pollution concentrations.

At other extreme, are those who argue that economic development may promote a country's effort for conservation (Lightfoot, 1994). Dietz and Adger (2003) demonstrate that there is a positive relationship between economic development and the level of government intervention, for example in designating protected areas although it is not the overriding determinant of the rate of designation. Shogren et al. (1999) declare that communities with greater wealth and lower relative land prices can better afford to preserve more habitats.

These optimistic views on the biodiversity income relation think that high level of development induces changes of population preferences and improvements of institution quality that influence government to make choice in favor of biodiversity conservation (Naidoo and Adamowicz, 2001). The increase of preference for the preservation of biodiversity occurs with improvement of education and raise in life expectancy that result in rise in domestic demand for environmental goods. As evidence, Freytag et al. (2009) found that educational level raises awareness and sensitizes people to protect nature. It has been also established that the more democratic a policy is, defined as the sum of political rights and

civil liberty, the more biodiversity is protected in terms of species richness (Dietz and Adger, 2003) and of protected land areas (Midlarsky, 1998).

A third hypothesis postulates that the relationship between economic development objectives and biodiversity conservation effort is not strictly linear. There exist a biodiversity conservation Kuznets curve (BKC), which would assume that in the early stages of the development process, efforts to accelerate economic development kept conservation effort as negligible objectives, but reverse once high levels of development is reached. Recent studies exist on Kuznets curve for biodiversity, but the majority of them use biodiversity loss indicators (Naidoo and Adamowicz, 2001; Dietz and Adger, 2003; McPherson and Nieswiadomy, 2005; Mozumder et al., 2006; Pandit and Laband, 2009; Mills and Waite, 2009). They investigate thus a non-linear relation between income and biodiversity erosion along development path. Bimonte (2002) attempted to test EKC for conservation effort, using percentage of protected area for European countries. His analysis accepted EKC hypothesis for conservation effort. While EKC was not tested, Halkos and Tzeremes (2010) found a different impact of economic development on conservation effort along development level. Their results suggest that economic development has a negative impact on biodiversity performances for developing countries, but a positive influence for developed countries.

2.2.2 Sectoral policies: Tourism sector and biodiversity conservation

Recently, tourism has become one of the most dynamic economic sectors in many developing countries. It represented over 70% of exports of services and was the primary source of foreign exchange earnings in 46 out of 50 of the world's least developed countries in 2005 (UNWTO, 2008). For instance, in Sub-Saharan Africa, tourism is a promising source of development (Christie and Crompton, 2001). According to the WTT data (2011), the total contribution of Travel &Tourism to the region's GDP, including its wider economic impacts, augmented from 4.76 % (1990) to 9.8% (2009) showing an increase of 106%. The market share in the Sub-Saharan region, comparatively to Africa was a growth at 40.76% between 1990 and 2005 (UNWTO, 2006). For the next ten years, the total contribution to GDP is expected to rise by 5.3%, and the total contribution to employment is forecast to augment by 2.6%. Countries in Africa are now widely focusing on tourism as a source of growth and diversification.

Many tourism attractions in developing countries are closely linked to biodiversity, such as protected areas, unspoiled mountains, beaches and islands, traditional ways of life and native culture, charismatic wildlife and natural landscapes. In terms of competition with other

destinations, a site's biodiversity profile might give the destination site a competitive edge or advantage (Macagno et al., 2009).Over the last decade, nature and adventure travel has emerged as one of the fastest-growing segments of the industry. Much of this growth is taking place in mega-diverse sites, areas harboring many species unique to that region (Christ et al, 2003).Biological diversity gives therefore a strategic advantage to the country's sector for tourism. As tourism has an increasing place in the development processes in Sub-Saharan African countries, with destinations engaged in a win-lose competition, we postulate that each country's conservation strategy, will be influenced by the choices of the others.

3 Empirical models of biodiversity conservation effort

Here, we present data, variables and the methodology used to identify the main forces that influence conservation policymaking in sub-Saharan African region

3.1 Data and variables

We use the indicator "Ecoregion protection" developed by the Center for International Earth Science Information Network (CIESIN) of Columbia University and the Yale Center for Environmental Law and Policy of Yale University, as dependant variable. Following the discussion in section 2, we introduce also different independants variables in the models.

3.1.1 The dependant variable: Ecoregion as country's biodiversity management indicator

The Ecoregion protection score measures the degree to which a country achieves the target of protecting at least 10% of each biome (desert, forest, grassland …) within its country's land area. The cap of 10% is consistent with international target following the Convention on Biological Diversity (CBD), at its 7th Conference of the Parties. To calculate the indicator, a ratio is attributed to each biome in reference with its actual protection status and according to the target. The ratio of each biome is then weighted by share of biome's area in the country land area, averaged and converted in percentage to obtain a global score, scaled to 0-100. A score of 100% means that 10% of all biomes in a country are at least protected. (See http://sedac.ciesin.columbia.edu/es/epi/to for more details about the indicator).

Ecoregion, as a measure of environmental policies, reflect well the actions undertaken by governments to protect biodiversity. Indeed the protected status of an area is most often a political decision, and by and large stems from the policy process, political actors, and

governmental decision making. While some conservation actions are initiated by NGOs, policies are usually implemented by the government.

Ecoregion score assessments of the degree of protection in a country do not provide information on the efficacy of conservation strategies. In fact, protected status is not sufficient for an ecological region to be "effectively conserved". However, it is necessary and an initial condition for committing state financial and administrative resources and for actual protection to begin (CIESIN, 2010; Archer and Orr, 2008). As the aim of this paper is to assert predictors of conservation strategies, the indicator "Ecoregion score" is therefore valid and appropriate for it. (See appendix 2 for descriptive statistics on Ecoregion score)

3.1.2 Independent variables

As independent variables, we introduce in the models GDP per capita and its square to test for a linear or a U shaped relationship. The adequate functional form would be chosen according to corrected Akaike information criterion ((AICc[2]). The income variable is derived from the world development indicators (WDI) and measured in US$; We add the variable Trade from WDI database calculated as the sum of exports and imports of goods and services measured as a share of gross domestic product. We separately use export (% GDP) to precise the effect of trade openness on biodiversity in the context of sub-Saharan Africa region. Agriculture valued added in % GDP is also introduced as explanatory variable. Data comes from WDI database. We use the density of population expressed as people per square km of land area and total population as demographic variables. Data comes from WDI database. The World Bank governance indicators of Government Effectiveness is used as proxy for the institutional quality of a country in the models. The source is Kaufmann et al. (2006). The combined gross enrolment ratio in education (both sexes)) (%) from International Human Development Indicators controls for the educational level. Initial forest cover expressed in % of land area is added to control for resource endowment. Data comes from FAO. Percentage of expected reports submitted for the implementation of CITES (Convention on International Trade in Endangered Species) is introduced to measure countries participation to environmental agreements and treaties. Data comes from World Resources Institute (2001). To test for competitiveness hypothesis we use data on tourist arrival expressed in number from UNWTO (2006) and Official Development Assistance.

[2] AIC scores are based on information theory and rest on the assumption that while no particular model is true, the model with the smallest AIC value is the most appropriate (or best) choice of the models under consideration. A corrected AIC is recommended to account for small sample sizes (Burnham et al1998). The best model was the model with the lowest AICc score (Burnharn et al. 1998)

All explanatory variables are averaged for a period of 20 years (1990-2009). By this procedure, we focus on today biodiversity conservation effort based on factors that have influenced it over the past 20 years (McPherson and Nieswiadomy, 2005). This procedure also makes our study immune to short-term effects. Our database comprises a sample of 48 sub-Saharan African countries presented in Appendix B. Summary statistics of independent variables are presented in appendix 2.

3.2 Econometric strategy

The purpose of this study is to identify the driving forces of biodiversity conservation effort in Sub-Saharan Africa. We begin by a simple model, where we test the effect of conventional factors on our dependant variable: the Ecoregion score. Next, we estimate the spatial model, which includes spatial information to test for strategic interaction. Finally we test our competition hypothesis by developing an economic competition model.

3.2.1 Simple model

The simple model specification is:

$$Z_i = \theta X_i + \varepsilon_i, \qquad [1]$$

Where Z is country i Ecoregion score; X is a vector of country i characteristics; θ vector of unknown parameter and ε_i the error term which is assumed to be normally distributed, homoscedastic, and independent across observations.

3.2.2 Strategic interaction model

In order to test the occurrence of strategic interaction in the conservation policymaking, we include in equation [1] a "strategic decision variable" $\sum_{j \neq i} w_{ij} Z_j$, composing of a set of weights (w_{ij}) that aggregate the Ecoregion score of other countries (Z_j). We obtain then equation [2]

$$Z_i = \beta \sum_{j \neq i} w_{ij} Z_j + \theta X_i + \varepsilon_i, \qquad [2]$$

The relationship described in equation [2], implies that a country's biodiversity performance depends on its own characteristics (vector of Xi) and the performance of its neighbors. In the spatial econometrics literature, this specification (equation [2]) is known as a "spatial lag" model (Anselin, 1988). The goal of the econometric analysis is to test the significance of

unknown parameters: θ, β. If the null hypothesis can be rejected for β, then the evidence would point to the existence of strategic interaction among states for biodiversity conservation.

Before the estimation we have to deal with some spatial issues: spatial weights definition, spatial correlation tests, endogeneity and spatial error dependence issues

- **Spatial weights**

One major issue in spatial model is to define Wij, the weighting matrix which assigns a value to each pair of states. Generally Wij has zero diagonal elements, and a representative off-diagonal element wij. The values of the wij's are specified arbitrarily and reflect expectations regarding the spatial pattern of interaction. For example, Wij could reflect the assumption that countries involved in strategic interaction are those sharing a border. In this case, the jth element of the ith row of Wij equals 1 if i and j are neighbors and equals 0 otherwise. This weighting scheme, based on a geographical proximity, is the one common use and is named "binary contiguity matrix". Other weighting schemes have been developed in literature. For instance, while admitting the importance of geographical proximity, some authors argue that not all neighbors should be given equal weight, and weight elements of contiguous matrix by neighbors' characteristics, such as population size or income level (Brueckner, 1998; Heyndels and Vuchelen, 1998; Brueckner and Saavedra, 2001; Fredriksson and Millimet, 2002). Others postulate that countries with similar demographics and economics structures may exert the most powerful mutual influences. They then use matrices whose weights are based on similarity in demographic or economic characteristics between countries, regardless of distance (Case et al., 1993). In addition to the two weighting schemes, we test a third one which considers the importance of both geographic proximity and socio-economic similarity. Thus, we hypothesize that countries i,j will interact more if they are geographically close and have more demographic or economic similarity.

Following the above considerations, the analysis was performed using different weighting schemes (see appendix 3). We can therefore explore several alternative criteria for neighborliness, and then better understand the nature of the interdependencies between countries. If all the matrix show significant results, we will use an absurd weighting scheme – a placebo matrix- to verify whether there is something inherent to the econometric procedure that produces significant results regardless of how 'neighbors' are defined (see Case et al., (1993) for the same procedure)

– **Spatial correlation tests**

We perform some diagnostics tests to check for the presence of spatial dependence and if so, if a spatial lag model is the correct specification. We use: (1) the best-known Moran's I (Moran, 1948) to check for the presence of spatial autocorrelation in the data;(2) The Lagrange Multiplier (LM) test, which tests the null hypothesis H_0 :β =0 in model [2]; (3) The robust Lagrange Multiplier test (Anselin et al., 1996) to investigate for error dependence in a multidirectional spatial model that includes both the spatial lag term and a spatially correlated error structure.

– **Endogeneity and spatial error dependence**

Two main econometric issues must be confronted in estimating our spatial model. These are endogeneity of the Zj in model [2], and possible existence of spatial error dependence (Anselin, 1988).

The hypothesis of strategic interaction supposes that, one state incorporate the decisions of its neighboring states into its own decision-making process, and vice versa. The values of Z in the sample are then, jointly determined in exactly the same fashion. The variable $w_{ij}Z$ on the right-hand side of model [2] is then endogenous. As a result, parameters of OLS are inconsistent. One alternative to address this econometric problem is to use maximum likelihood (ML) estimation (Brueckner, 2003). A second alternative is to perform instrumental variables (IV) estimation. The instruments used are some of the attributes included in Xi (country characteristics) for neighboring states, employing the same weighting scheme for the instruments as we do for neighboring environmental stringency (Brueckner, 2003). State's characteristics are valid instruments if they affect the state's own environmental policy, but not the environmental decisions in neighboring states. (See Fredriksson and Millimet, (2002) for a similar argument). A third solution consists of replacing the weighted averages of neighboring states' environmental performance in the model with lagged values (Smith 1997, Fredriksson and Millimet, 2002). We will therefore obtain the following n-year lag model:

$$Z_{it} = \beta \sum_{j \neq i} w_{ij} Z_{jt-n} + \theta X_{it} + \varepsilon_{it}, \quad \text{n}=\{1, 2, 3,..\} \qquad [3]$$

In addition to resolving the problem of endogeneity- since current own biodiversity performance cannot impact the past environmental policies of neighboring states, this

specification allows us to test for an adjustment period in strategic interaction. The presence of spatial error dependence in the equation complicates also the analysis. When error dependence is ignored, estimation can provide false evidence of strategic interaction. Such spatial error dependence arises when error term includes omitted country characteristics that are themselves spatially dependent. To avoid drawing such incorrect conclusions, we can estimate the model via ML techniques under the assumption that spatial error dependence is absent, relying on hypothesis tests to verify this absence. Another solution is to rely on the IV estimation method. Kelejian and Prucha (1998) show that IV estimation generates a consistent estimate of spatial lag coefficient even in the presence of spatial error dependence.

3.2.3 Economic competition model

We have postulated that strategic interaction is induced by economic competition for tourism market share and international assistance. We check for this competitiveness hypothesis, following this process:

We create a gap variable Gap_Ii for tourism activity and international support between each country and its neighbors:

$$\text{Gap\_Ii} = \frac{1}{N_i}\sum_j I_j - I_i$$

Where, I={tourism indicator, international assistance indicator}, Ni is the number of borders state i shares, J=set of i neighbors. We postulate that this gap variable act like transmission channels. To test it, we include each gap variable (or its lagged value) in model [2] (in model [3]), allowing the strategic decision variable to affect indirectly the country conservation effort. We verify next the effect of strategic decision variable on each transmission channel.

We test the economic competition model with the n-year lag model in order to resolve potential problem of endogeneity between the gap variable and the dependant variable. We then use lagged values for the gap variable, and estimate the following equations for 1-year lag model:

$$\left\{\begin{array}{l} Z_{it} = \beta \sum_{j \neq i} w_{ij} Z_{jt-1} + \theta X_{it} + \theta_1 Gap_{I_{it-1}} + \varepsilon_{it} \text{ (4 a)} \\ Gap_{I_{it-1}} = \theta + \beta \sum_{j \neq i} w_{ij} Z_{jt-1} + \varepsilon_{it} \text{ (4b)} \end{array}\right\} [4]$$

4 Results

4.1 Simple model

Table 1 contains the first set of estimation results. Column 1 and 2 present results of simple models, testing EKC hypothesis and linear relationship between Ecoregion score and GDP per capita.

The quadratic and linear equations both fit the data significantly (see F-statistics). To determine which functional form best represents the data, we use the corrected Akaike information criterion (AICc). The data support a linear relationship according to the best model as determined by AICc score (AICc linear= 475,9; AICc quadratic=478, 9). Beyond the shape of the relationship, we failed to find any evidence of influence of GDP per capita on Ecoregion score. In fact, in both equations, the income variables are not significant at the 10% level. This result is unexpected, and contradicts literature which states that economic variable would have an important negative effect on conservation effort in a context of underdevelopment like that for sub-Saharan African countries. On the other hand, this finding is consistent with Archer and Orr (2008) who argue that land protection policies are not necessarily "meaningful" protection policies, which would require economic resources.

The resource endowment variable (forest initial) has a significant positive effect on Ecoregion score indicating that conservation effort is greater, in countries with more protectable area.

The export variable is not statistically significant, but has the expected negative sign. We found the same results using the variable trade. Commercial activities seem to be not relevant in predicting levels of biomes protection. The agriculture variable (agrigdp) is not significant as well as countries participation to biodiversity protection treaties (CITES). For demographic variables, the density variable has a negative impact on Ecoregion score but is not quite statistically significant. The population variable exhibits a significant positive coefficient. Surprisingly, this result indicates that prioritizing population size, conservation effort becomes more stringent. In fact, the widely accepted view, the anthropogenic hypothesis, points an adverse effect of population on conservation. Nevertheless, some studies have found such a positive impact of population on conservation effort (Archer and Orr, 2008; Dietz and Adger, 2003). Archer and Orr (2008) argued that population can positively drive conservation effort though a reactionary policy approach as a rationale for protecting land or people's preference for beautiful areas.

Table 1.Estimations results for simple and strategic interaction models

Dependant variable : Ecoregion Score of country i

	Simple model (equation 1)		Strategic interaction models (equation 2&3)		
	EKC	Linear	Model2	Model 2	Model 3
Variables	*MCO coefficient*	*MCO coefficient*	*ML coefficient*	*IV coefficient*	*MCO coefficient*
forinitial1	0.815***	0.825***	0.821***	0.815***	0.828***
	(4.08)	(4.13)	(4.40)	(3.85)	(4.43)
agrigdp	0.299	0.360	0.386	0.420	0.344
	(0.74)	(0.97)	(0.90)	(0.86)	(0.78)
lgdp	-14.748	1.478	2.281	3.338	0.326
	(-0.30)	(0.15)	(0.31)	(0.40)	(0.04)
lgdp2	1.161				
	(0.33)				
exportm	-0.020	-0.013	0.035	0.099	0.067
	(-0.04)	(-0.03)	(0.10)	(0.24)	(0.16)
moydens	-0.037	-0.036	-0.022	-0.005	0.002
	(-0.83)	(-0.82)	(-0.56)	(-0.09)	(0.04)
moypopto	3.91 E-7**	3.85 E-7**	4.08 E-07**	4.38 E-07**	3.86 E-07**
	(2.41)	(2.47)	(2.19)	(2.05)	(2.47)
moygov1	11.484	11.721	17.512*	25.137*	21.631**
	(1.01)	(1.02)	(1.68)	(1.89)	(2.37)
moyeduc	-0.056	-0.036	-0.229	-0.483	-0.481
	(-0.11)	(-0.08)	(-0.57)	(-0.96)	(-1.10)
cites	0.191	0.190	0.145	0.084	0.061
	(1.48)	(1.49)	(1.40)	(0.67)	(0.42)
Ecoreglag0			0.350**	0.810*	
			(2.08)	(1.95)	
Ecoreglag1					0.499**
(1year lag)					(2.32)
F-statistics	5.57***	6.12***		3.88***	7.98***
R2	0.4582	0.4571		0.5172	0.5417
Squared corr.			0.515		
N	48	48	48	48	48

Sargan N*R-sq test 2.053 Chi-sq(2) P-value = 0.3583

Basmann test 1.519 Chi-sq(2) P-value = 0.4679

t-statistics are in parentheses; * Indicates p-value less than 0.10; ** Indicates p-value less than 0.05; *** Indicates p-value less than 0.01

This theory is however less relevant in Sub-Saharan Africa, where people have more basic needs in general and low influence on government decision. Here, we think that the important size of the population in the region catches the country's economic size, which is correlated with more government interventions even in environmental field. Government effectiveness is not significant at the 10% level.

4.2 Strategic interaction model

Table 2.Spatial tests results

	Weighting scheme						
	Geographical proximity	Weighted geographical proximity		Similarity-based proximity		Geographical and similarity based proximity	
	W_G	W_{Gi}	W_{Gp}	W_{Si}	W_{Sp}	W_{GSi}	W_{GSp}
Moran's I	0.201**	0.233**	0.014	0.008	-0.129	0.055	0.317**
LM_{lag}	3.190*	2.660*	0.011	0.023	2.375	0.306	2.607*
LM_{error}	1.143	0.989	0.046	1.219	0.158	0.599	2.04
LM_{lag} robust	3.900*	2.637	0.505	3.559*	6.780*	0.121	0.561
LM_{error} robust	1.853	0.966	0.54	4.755*	4.563*	0.414	0.000

* Indicates p-value less than 0.10; ** Indicates p-value less than 0.05; *** Indicates p-value less than 0.01.

Before the estimation of the spatial lag model, we performed some diagnostics tests to check for the presence of spatial dependence, and if so if a spatial lag model is the correct specification. Results of spatial tests are presented in table 2. For three weighting schemes out of four, we get significant statistics. These weighting scheme integrate geographical proximity. On the contrary, the statistics of the weighting scheme based on similarity regardless nearest neighbor concept, are not significant.

The z-values of Moran I test are positive and highly significant for W_G, W_{Gi} and W_{GSp}. This indicates the presence of positive spatial autocorrelation. For the same matrices, the LM test for the spatial lag is also statistically significant. In the remaining cases, the null hypothesis of spatial lag parameter is rejected. The robust LM_{lag} and LM_{error} confirm the spatial autoregressive specification, with probability values near 90% only when the spatial weights matrix is based on geographical proximity. For W_{Gi} and $W_{GSp,}$ the tests suggest that we have both spatial error dependence and spatial lag structure.

These results confirm that the spatial dependence within countries can take the form of a spatial lag specification. The findings suggest also that the interdependence is reliant on geographical proximity. The evidence highlights finally that a nonzero estimates of β in

equation [2], with W_G the contiguity matrix, will not be due to uncorrected spatial error dependence, but instead will reflect the existence of strategic interaction.

Results for the models with strategic decision variable are presented from column 3 to 5 of Table 1. According to literature, we use ML estimation (column 3), IV estimation (column 4)[3] and the procedure for Smith (1997) and Fredriksson and Millimet (2002) (column 5) to solve problem of endogeneity and spatial error dependence in the regression (Smith 1997; Kelejian and Prucha, 1998; Bruckner, 2003; Fredriksson and Millimet, 2002). We use matrix W_G for all spatial models.

From all spatial models, we find that neighborliness influences biodiversity conservation strategies in sub-Saharan Africa. Indeed, one country's score with respect to current neighboring level of biodiversity conservation is positive and significant at, at least the 10% level in all regression. It appears that a change in neighborhood average percentage of protected biomes results in a positive change in own country. It could be argued that countries incorporate information of neighboring states in their own conservation strategies. Interesting findings were derived from the inclusion of the strategic decision variable in the simple model. It appears that governance variable became significant. The degree to which a country achieves the target of protecting at least 10% of each terrestrial biome within its borders is correlated with the quality of public services, policy formulation, its implementation and the credibility of government's commitment. Such an important finding in the comprehension of conservation effort in Sub-Saharan Africa would have been concealed, if the spatial relationship had been occulted. This confirms Anselin (1988) assumption that ignoring spatial effect has some serious consequences in a model.

4.3 Economic competition analysis

Table 3 (a&b) presents a set of results on economic competition analysis. No insight is obtained allowing strategic interaction via competition for environmental aid. Indeed, the inclusion of the aid gap variable does not affect the magnitude and significance of the coefficients of strategic decision variable on ecoregion score (column 1 table 3a). Secondly, the coefficient on the aid gap variable is not statistically significant in the multivariate regression (column 1 table 3a). This indicates that environmental aid gap between a country and its neighbor has no influence on that country's effort in biodiversity conservation.

[3] The set of instruments includes population, population density and resource endowment from neighboring states, using the same weighting scheme as the independent variable

Furthermore, the strategic decision variable has no effect on aid gap variable (column 1 table 3b).

Table 3a.Estimations results for economic competition models (equation 4a)

Dependant variable : Ecoregion Score of country i

Variables	Gap-aid Model	Gap-tourism model	Robustness check for Gap-tourism model
forinitial1	0.845***	0.794***	0.863***
	(4.65)	(3.85)	(4.55)
agrigdp	0.341	0.292	0.34
	(0.84)	(0.65)	(0.81)
lgdp	2.25	-0.482	2.928
	(0.30)	(-0.06)	(0.37)
exportm	-0.138	0.103	-0.155
	(-0.34)	(0.25)	(-0.37)
moydens	-0.005	0.002	-0.005
	(-0.14)	(0.06)	(-0.13)
moypopto	3.00 E-7*	3.44 E-7*	2.81 E-7
	(1.68)	(2.02)	(1.6)
moygov1	14.22	19.77*	11.48
	(1.51)	(1.99)	(1.08)
moyeduc	-0.38	-0.442	-0.404
	(-0.92)	(-0.95)	(-0.94)
cites	0.04	0.049	0.033
	(0.27)	(0.31)	(0.23)
Ecoreglag1	0.5**	0.471**	0.436*
	(2.32)	(2.39)	(1.94)
Gap_aid	-0.066		
	(-0.52)		
Gap_tourism		-0.03**	
		(-2.39)	
Tour			0.039**
			(2.29)
Tour_neighbors			-0.007
			(-0.19)
F-statistics	9.08***	7.38***	8.48***
R2	0.5729	0.5448	0.5783
Squared corr.			
N	48	48	48

t-statistics are in parentheses; * Indicates p-value less than 0.10; ** Indicates p-value less than 0.05; *** Indicates p-value less than 0.01.

An adverse effect occurs with tourism gap variable. We observe that the coefficient of tourism gap variable is highly significant, affects negatively country ecoregion score in the multivariate model (column 2 table 3a), and changes the coefficient of strategic decision variable. The magnitude of the change is however very low. This is certainly due to the

tourism data used in the analysis. Averaged data (1990-2005) was used for proxy 2008 data, and thus undervalued the indicator. The next step of the transmission channel investigation reveals that the comparative conservation performance is not a significant factor in explaining variations in tourism gap (column 2 table 3b).

Table 3b.Estimations results for economic competition models (equation 4b)

Dependant variable : Gap_I_{it-1}

Variables	Gap-aid Model	Gap-tourism model
Ecoreg_Lag1	-0.32	-0.133
	(-0.24)	(-0.68)
Cons	26.49	17.63
	(0.27)	(1.11)
F-statistics	0.06	0.46
R2	0.001	0.008
N	48	48

We can therefore conclude that, the indirect effect of neighboring countries conservation efforts on a country's own conservation effort, though tourism market share competition is not obvious. Nevertheless, we have observed that tourism gap has a direct effect on country conservation effort. This finding suggests that conservation effort in a country is affected by tourism activity in that country along with its adjoining countries. The development of regional tourism seems to have therefore some influence on biodiversity conservation.

Robustness of this result was check by including separately the different parts of the tourism gap variable -ie- tourism indicator for own country (Tour) and averaged neighborhood tourism indicator (Tour_neighbors) in the model (column 3 table 3a). The effect of tourism gap variable was found to be mainly driven by the tourism activity in own country. The coefficient of tourism arrivals is positive and statistically significant. The impact of neighboring tourism is not significant and marginal. State's conservation performances are thus influenced by the development of their own tourism activity and nor by tourism activity in adjoining countries.

While the analysis doesn't support that strategic interaction occurred via competition for tourism or aid, it was noted that the inclusion of gap variables as well as other independent variables (spatially lagged or not) do not significantly remove the influence of neighboring conservation efforts on a country own conservation effort.

5 Conclusion

Factors influencing biodiversity conservation effort is an area of study with insufficient literature and hence requires more studies to be conducted in that body of research, especially for tropical countries. This paper presents an empirical investigation on this issue for Sub-Saharan Africa countries using a cross-country analysis. The question of whether trans-boundary influences play a role in biodiversity conservation efforts in sub-Saharan developing countries was addressed. For this purpose, a spatial lag model was adopted. It indicated that economic competition may lead to engagement of countries in strategic environmental policymaking. A data set of 48countries spanning over the period 1990-2009 and Ecoregion score (2009) as measure for countries biodiversity protection level, were used.

Following, is a summary of the major findings of the analysis. Firstly, the country protected biome's area is primarily related to resource endowment, effective governance, and tourism activities. Secondly, data analysis suggests that countries are influenced by their contiguous neighbors in environmental policy for biodiversity management. Thirdly, the interdependence between countries for conservation strategies is not as a result of competition for tourism market share or environmental aid.

These results must be however interpreted with caution. Indeed, empirical analysis of strategic interaction among countries generally uses times series data spanning one or more decades for a set of countries (Devereux et al., 2008; Altshuler and Goodspeed, 2002; Redoano, 2007). Detailed data on conservation effort at the country level do not exist over these time scales for most countries, unfortunately.

Despite this shortcoming, this paper adds to the research on global biodiversity conservation. In fact, in that issue the developing countries are at the forefront. Most of the world's biodiversity in terms of species abundance and diversity is found in developing countries. They home also the poorest and one third of humanity who generally rely on natural resources of their environment for their livelihoods. Enhancing conservation effort in these regions is therefore crucial to maintain some global environmental services. In this respect, the study recommends for sub-Saharan African countries to strengthen effective governance –i.e.- quality of public services, policy formulation and its implementation, and the credibility of government's commitment to induce stringent conservation policies. As neighboring countries interact, regional collaboration in biodiversity conservation strategies should be reinforced. It is also recommended that strategies rely on economic incentives like tourism

outcomes in order to influence the decisions of policymakers and inspire dedication from leaders in governance to biodiversity conservation.

References

Altshuler, R. and Goodspeed, T. J. (2002), *Follow the Leader? Evidence on European and U.S. Tax Competition*, Rutgers University, Department of Economics.

Angelsen, A., Brown, S., Loisel, C., Peskett, L., Streck, C., and Zarin, D. (2009), *Reducing Emissions from Deforestation and Forest Degradation (REDD): An options assessment report*, The Meridian Institute.

Anselin, L. (1988), *Spatial Econometrics: Methods and Models*, Springer.

Anselin, L., Bera, A. K., Florax, R. and Yoon, M. J. (1996), 'Simple Diagnostic Tests for Spatial Dependence', *Regional Science and Urban Economics*, Vol. 26, No. 1, February, 77-104.

Archer, C. and Orr, S. (2008), 'Protecting Paradise: a Cross-national Analysis of Biome Protection Policies', *Sustainability: Science, Practice, & Policy*, Vol. 4, No. 1.

Asafu-Adjaye, J., (2003), 'Biodiversity loss and economic growth: a cross-country analysis', *Contemporary Economic Policy* , Vol. 21, No. 2, April, 173-185.

Azomahou, T., Laisney, F. and Nguyen Van, P. (2006), 'Economic Development and CO2 Emissions: A Nonparametric Panel Approach', *Journal of Public Economics*, Vol. 90, No. 6-7, 1347-1363.

Baumgärtner, S., (2007), '*Why the measurement of species diversity requires prior value judgements'* in *Biodiversity Economics. Principles, Methods and Applications*, A. Kontoleon, U. Pascual and T. Swanson (eds), Cambridge University Press, Cambridge, 2007, pp. 293–310.

Beckerman, W. (1992), 'Economic Growth and the Environment: Whose Growth? Whose Environment?', *World Development*, Vol. 20, No. 4, April, 481-496.

Bimonte, S. (2002), 'Information access, income distribution, and the Environmental Kuznets Curve', *Ecological Economics, Vol.* 41, No. 1, April, 145-156.

Botcheva, L. and Martin, L. L. (2001), 'Institutional Effects on State Behavior: Convergence and Divergence', *International Studies Quarterly*, Vol. 45, No. 1, March, 1-26.

Brueckner, J. K. (1998), 'Testing for Strategic Interaction among Local Governments: The Case of Growth Controls', *Journal of Urban Economics*, Vol. 44, No. 3, November, 438-467.

Brueckner, J. K. (2003), 'Strategic Interaction among Governments: An Overview of Empirical Studies', *International Regional Science Review*, Vol. 26, No. 2, April, 175-188.

Brueckner, J. K. and Saavedra, L. A. (2001), 'Do Local Governments Engage in Strategic Property-Tax Competition?', *National Tax Journal*, Vol. 54, No. 3, June, 231-253.

Burnham, K. P., White, G. C. and Anderson, D. R. (1998), 'Comparison of Akaike Information Criterion and Consistent Akaike Information Criterion for Model Selection and Statistical Inference from Capture-recapture Studies', *Journal of Applied Statistics*, Vol. 25, No. 2, 263-282.

Busch, P. and Jörgens, H. (2005), 'International Patterns of Environmental Policy Change and Convergence', *European Environment*, Vol. 15, No. 2, March, 80-101.

Carraro, C. and Siniscalco, D. (1992), 'The International Dimension of Environmental Policy', *European Economic Review*, Vol. 36, No. 2-3, 379-387.

Case, A. C., Rosen, H. S. and Hines, J. R. (1993), 'Budget Spillovers and Fiscal Policy Interdependence : Evidence from the States', *Journal of Public Economics*, Vol. 52, No. 3, October, 285-307.

Chambers, J. Q., Higuchi, N., Schimel, J. P., Ferreira, L. V. and Melack, J. M. (2000), 'Decomposition and Carbon Cycling of Dead Trees in Tropical Forests of the Central Amazon', *Oecologia*, Vol. 122, February, 380-388.

Christ, C., Hillel, O., Matus, S. and Sweeting, J. (2003), *Tourism and biodiversity: mapping tourism's global footprint*, UNEP Publications

Christie, I.T. and Crompton, D.E. (2001), 'Tourism in Africa', *Africa Region Working Paper Series*, No. 12, February.

CIESIN (2010), *Natural Resource Management Index, 2010.* Center for International Earth Science Information Network , Columbia University.

Chong, A. and Gradstein, M. (2008), 'What Determines Foreign Aid? The Donors' Perspective', *Journal of Development Economics*, Vol. 87, No. 1, August, 1-13.

Coleman, W. D. (2001), 'Agricultural Policy Reform and Policy Convergence: an Actor-centered Institutionalist Approach', *Journal of Comparative Policy Analysis: Research and Practice*, Vol. 3, August, 219-241.

Czech, B. (2003), 'Technological Progress and Biodiversity Conservation: a Dollar Spent, a Dollar Burned', *Conservation Biology*, Vol. 17, No. 5, October, 1455-1457.

Daly, H. E. (1991), 'Towards an Environmental Macroeconomics', *Land Economics*, Vol. 67, No. 2, May, 255-259.

Darst, R. G. (2001), *Smokestack Diplomacy: Cooperation and Conflict in East-West Environmental Politics*, MIT Press.

Dawson, D. and Shogren, J. F. (2001), 'An Update on Priorities and Expenditures under the Endangered Species Act', *Land Economics*, Vol. 77, No. 4, November, 527-532.

Deacon, R. T. and Norman, C. S. (2006), 'Does the Environmental Kuznets Curve Describe How Individual Countries Behave?', *Land Economics*, Vol. 82, No. 2, May, 291-315.

Devereux, M. P., Lockwood, B. and Redoano, M. (2008), 'Do Countries Compete over Corporate Tax Rates?', *Journal of Public Economics*, Vol. 92, No. 5-6, June, 1210-1235.

Dietz, S. and Adger, W. N. (2003), 'Economic Growth, Biodiversity Loss and Conservation Effort', *Journal of Environmental Management*, Vol. 68, No. 1, May, 23-35.

Dolowitz, D. P. and Marsh, D. (2000), 'Learning from abroad: The Role of Policy Transfer in Contemporary Policy-Making', *Governance*, Vol.13, No. 1, January, 5-23.

Elkins, Z. and Simmons, B. (2005), 'On Waves, Clusters, and Diffusion: a Conceptual Framework', *The ANNALS of the American Academy of Political and Social Science*, Vol. 598, No. 1, March, 33-51.

Falloux, F., Talbot, L. and Christoffersen L. (1990), *National Environmental Action Plans in Africa: Early Lessons and Future Directions, AFTEN.*

Fredriksson, P. G. and Millimet, D. L. (2002), 'Strategic Interaction and the Determination of Environmental Policy Across U.S. States', *Journal of Urban Economics*, Vol. 51, No. 1, January, 101-122.

Freytag, A., C. Vietze and W. Völkl (2011), *What Drives Biodiversity? An Empirical Assessment of the Relation Between Biodiversity and the Economy*, Friedrich-Schiller-University Jena, Max-Planck-Institute of Economics.

Gawande, K., Bohara, A. K., Berrens, R. P. and Wang, P. (2000), 'Internal Migration and the Environmental Kuznets Curve for US Hazardous Waste Sites', *Ecological Economics*, Vol. 33, No. 1, April, 151-166.

Goetz, S.J., Debertin, D. L. and Pagoulatos, A. (1998), 'Human Capital, Income, and Environmental Quality: A State-Level Analysis', *Agricultural and Resource Economics Review*, Vol. 27, No. 2, October, 200-208.

Goetz, S.J., Kemlage, D.J. (1996), 'TSD facilities location and environmental justice ', *Review of Regional Studies*, Vol. 26, 285-300.

Grether, J-M. and de Melo, J. (2003), 'Globalization and Dirty Industries: Do Pollution Havens Matter?', *National Bureau of Economic Research Working Paper Series*, No. 9776, June.

Grossman, G.M., Krueger, A.B. (1993), 'Environmental impacts of the North American Free Trade Agreement', in *The U.S. – Mexico Free Trade Agreement*, P. Garber (eds), MIT Press, Cambridge.

Grossman, G.M., Krueger, A.B. (1995), 'Economic growth and the environment', *Quarterly Journal of Economics*, Vol. 110, No. 2, 353-377

Halkos, G. E. and Tzeremes, N. G. (2010), 'Measuring Biodiversity Performance: A Conditional Efficiency Measurement Approach', *Environmental Modelling & Software*, Vol. 25, No. 12, December, 1866-1873.

Heichel, S., Pape, J. and Sommerer, T. (2005), 'Is There Convergence in Convergence Research? an Overview of Empirical Studies on Policy Convergence', *Journal of European Public Policy*, Vol. 12, October, 817-840.

Heyndels, B. and Vuchelen, J. (1998), 'Tax Mimicking Among Belgian Municipalities', *National Tax Journal*, Vol. 51, No. 1, 89-101.

Hoberg, G. (1991), 'Sleeping with an Elephant: The American Influence on Canadian Environmental Regulation', *Journal of Public Policy*, Vol. 11, No. 1, January, 107-131.

Hollander, J. M. (2003), *The Real Environmental Crisis: Why Poverty, not Affluence, is the Environment's Number One Enemy*, University of California Press.

Huybers, T. and Bennett, J. (2003), 'Inter-firm Cooperation at Nature-based Tourism Destinations', *Journal of Socio-Economics*, Vol. 32, No. 5, November, 571-587.

Jorgensen, A. and Kick, E. L. (2006), *Globalization and the Environment*, Leiden, Boston, Brill.

Joyce, C. (1994), *EARTHLY GOODS - Medicine Hunting in the Rainforest*, Little Brown & Co (T).

Kamto, M. (1996), *Droit de l'Environnement en Afrique*, Universités Francophones, Edicef.

Kaufmann, D., Kraay, A. and Mastruzzi, M. (2006), 'Governance Matters V: Aggregate and Individual Governance Indicators for 1996-2005', *World Bank Policy Research Working Paper*, No. 4012, September.

Kaul, I., Grunberg, I. and Stern, M. (1999), *Global Public Goods: International Cooperation in the 21stCentury*, Oxford University Press, New York.

Kelejian, H. H. and Prucha, I. R. (1998), 'A Generalized Spatial Two Stage Least Squares Procedure for Estimating a Spatial Autoregressive Model with Autoregressive Disturbances', *Journal of Real Estate Finance & Economics*, Vol. 17, No. 1, July, 99-121.

Kern, K., Jörgens, H. and Jänicke, M. (2000), 'The Diffusion of Environmental Policy Innovations: A Contribution to the Globalisation of Environmental Policy', *WZB Working Paper*, No. FS II 01 - 302.

Kerr, J. T. and Currie, D. J. (1995), 'Effects of Human Activity on Global Extinction Risk', *Conservation Biology*, Vol. 9, No. 6, December, 1528-1538.

Knill, C. (2005), 'Introduction: Cross-national Policy Convergence: Concepts, Approaches and Explanatory Factors', *Journal of European Public Policy*, Vol. 12, October, 764-774.

Lightfoot, D. R. (1994), 'An Assessment of the Relationship between Development and Institutionally Preserved Lands', *Area*, Vol. 26, No. 2, June, 112-122.

Macagno, G., Loureiro, M. L., Nunes, P. A. and Tol, R. S. (2009), 'Assessing the Impact of Biodiversity on Tourism Flows: A Model for Tourist Behaviour and Its Policy Implications', *FEEM Working Paper*, No. 21, June.

Mahoney, J. (2009), 'What Determines the Level of Funding for an Endangered Species?', *Major Themes in Economics*.

McNeely, J. A. (1996), 'Politics and Economics', in *Conservation Biology*, I.F. Spellerberg (eds), *Essex, Longman*.

McPherson, M. A. and Nieswiadomy, M. L. (2005), 'Environmental Kuznets Curve: Threatened Species and Spatial Effects', *Ecological Economics*, Vol. 55, No. 3, November, 395-407.

MEA (2005), *Millennium Ecosystem Assessment: Living Beyond Our Means-Natural Assets and Human Well Being*, Word Resources Institute.

Meadows, D.H., Meadows, D.L., Randers, J., Behrens, W. (1972), *The Limits to Growth*, Universe Books, New York.

Metrick, A. and Weitzman, M. L. (1998), 'Conflicts and Choices in Biodiversity Preservation', *The Journal of Economic Perspectives*, Vol. 12, No. 3, July, 21-34.

Midlarsky, M. I. (1998), 'Democracy and the Environment: An Empirical Assessment', *Journal of Peace Research*, Vol. 35, No. 3, May, 341-361.

Mills, J. H. and Waite, T. A. (2009), 'Economic Prosperity, Biodiversity Conservation, and the Environmental Kuznets Curve', *Ecological Economics*, Vol. 68, No. 7, May, 2087-2095.

Mozumder, P., Berrens, R. P. and Bohara, A. K. (2006), 'Is There an Environmental Kuznets Curve for the Risk of Biodiversity Loss?', *The Journal of Developing Areas*, Vol. 39, No. 2, April, 175-190.

Naidoo, R. and Adamowicz, W. L. (2001), 'Effects of Economic Prosperity on Numbers of Threatened Species', *Conservation Biology*, Vol. 15, No. 4, 1021-1029.

Oberthür, S. and D. Tänzler (2002), 'International Regimes as a Trigger of Policy Diffusion: The Development of Climate Policies in the European Union', in *Proceedings of the (2001) Berlin Conference on the Human Dimensions of Global Environmental Change "Global*

Environmental Change and the Nation State", F. Biermann, R. Brohm and K. Dingwerth (eds), Potsdam.

Ostergren, D.M., and Holle, S.J. (1999), 'Convergence in Protected Area Policy: A Comparison of the Russian Zapovednik and American Wilderness Systems', *Society & Natural Resources*, Vol. 12, May, 293-313.

Panayotou, T. (1993), *Empirical tests and policy analysis of environmental degradation at different stages of economic development*, Technology Environment and Employment Geneva International Labour, Geneva.

Pandit, R., Laband, D.N. (2009), 'Economic well-being, the distribution of income and species imperilment', *Biodiversity Conservation* , Vol. 18, No. 12, November, 3219-3233

Paudel, K. P., Zapata, H. and Susanto, D. (2005), 'An Empirical Test of Environmental Kuznets Curve for Water Pollution', *Environmental & Resource Economics*, Vol. 31, July, 325-348.

Perrings, C. and Gadgil, M. (2003), 'Conserving biodiversity: reconciling local and global public benefits', in *Providing Global Public Goods Managing Globalization*, I. Kaul, P. Conceicao, K. Le Goulven and R.U. Mendoza (eds), *Oxford University Press, New York.*

Pimm, S. L., Russell, G. J., Gittleman, J. L. and Brooks, T. M. (1995), 'The Future of Biodiversity', *Science*, Vol. 269, No. 5222, July, 347 -350.

Redoano, M. (2007), 'Fiscal Interactions Among European Countries: Does the EU Matter?', *CSGR Working Paper Series*, No. 222/07, February.

Richmond, A. K. and Kaufmann, R. K. (2006), 'Is There a Turning Point in the Relationship Between Income and Energy Use And/or Carbon Emissions?', *Ecological Economics*, Vol. 56, No. 2, February, 176-189.

Rock, M. T. (1996), 'Pollution Intensity of GDP and Trade Policy: Can the World Bank Be Wrong?', *World Development*, Vol. 24, No. 3, 471-479.

Rogers, E. (2003), *Diffusion of Innovations*, New York: Free Press.

Rosenzweig, M. L. (2003), 'Reconciliation Ecology and the Future of Species Diversity', *Oryx*, Vol. 37, No. 2, 194-205.

Sandler, T. (1999), 'Intergenerational Public Goods: Strategies, Efficiency, and Institutions', in *Global Public Goods: International Cooperation in the 21st Century* , I. Kaul, I. Grunberg and M.A. Stern (eds), Oxford University Press, New York.

Shafik, N. and Bandyopadhyay, S. (1992), *Economic Growth and Environmental Quality: Time Series and Cross-Country Evidence*, Background Paper for the World Development Report, The World Bank, Washington DC.

Shogren, J., Tschirhart, J., Anderson, T., Ando, A., Beissinger, S., Brookshire, D., Brown G. M., Coursey, D., Innes, R., Meyer, S. M. and Polasky, S. (1999), 'Why Economics Matters for Endangered Species Protection', *Conservation Biology*, Vol. 13, No. 3, December, 1257-1261.

Simon, B. M., Leff, C. S. and Doerksen, H. (1995), 'Allocating Scarce Resources for Endangered Species Recovery', *Journal of Policy Analysis and Management*, Vol. 14, No. 3, January, 415-432.

Svensson, J. (2003), 'Why Conditional Aid Does Not Work and What Can Be Done About It?', *Journal of Development Economics*, Vol. 70, No. 2, April, 381-402.

TEEB (2009), The Economics of Ecosystems and Biodiversity for National and International Policy Makers –Summary: Responding to the Value of Nature 2009.

TEEB (2010), The Economics of Ecosystems and Biodiversity: Mainstreaming the Economics of Nature: A synthesis of the approach, conclusions and recommendations of TEEB.

Torras, M. and Boyce, J. K. (1998), 'Income, Inequality, and Pollution: a Reassessment of the Environmental Kuznets Curve', *Ecological Economics*, Vol. 25, No. 2, May, 147-160.

Trauger, D.L., Czech, B., Erickson, J.D., Garrettson, P.R., Kernohan, B.J., and Miller, C.A. (2003), 'The Relationship of Economic Growth to Wildlife Conservation', *Wildlife Society Technical Review*, Vol. 03, No. 1, March.

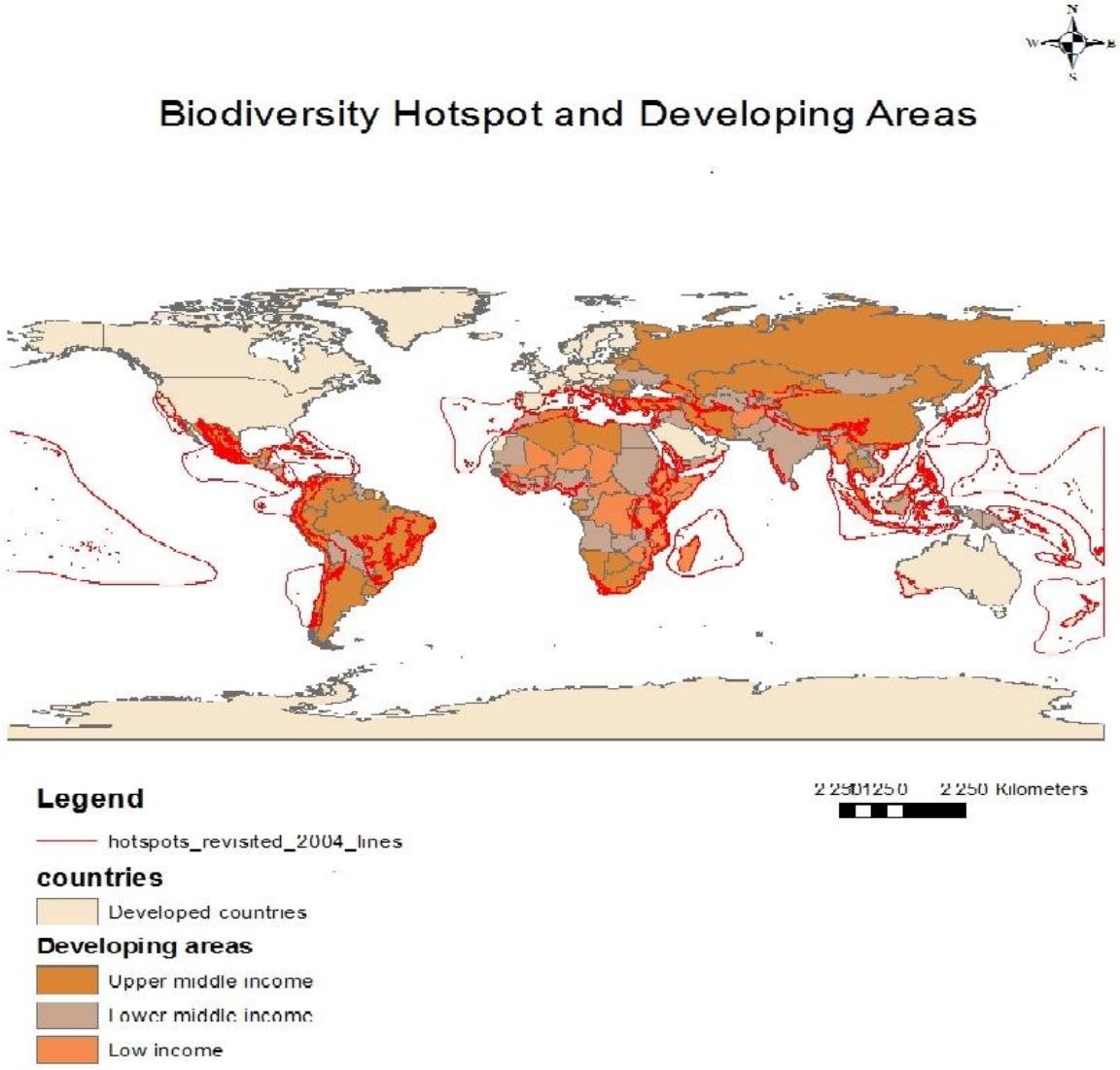
UNEP (2007), *UNEP 2006 Annual Report*, UNEP Publications.

UNWTO (2006), *Africa: Tourism Market Trends*, UNWTO Publications.

UNWTO (2008), *UNWTO Tourism Highlights*, UNWTO Publications.

Wang, P., Berrens, R., Bohara, A., and Gawande, K. (1998), 'An environmental Kuznets curve for risk-ranked US hazardous waste sites', *Applied Economic Letters*, Vol. 5, No. 12, 761-76

Appendix A : Map



Source: Author with shape files from Conservation International

Appendix B. Countries in the sample

Angola	Cote d'Ivoire	Madagascar	Seychelles
Benin	Djibouti	Malawi	Sierra Leone
Botswana	Equatorial Guinea	Mali	Somalia
Burkina Faso	Eritrea	Mauritania	South Africa
Burundi	Ethiopia	Mauritius	Sudan
Cameroon	Gabon	Mozambique	Swaziland
Cape Verde	Gambia, The	Namibia	Tanzania
Central African Republic	Ghana	Niger	Togo
Chad	Guinea	Nigeria	Uganda
Comoros	Guinea-Bissau	Rwanda	Zambia
Congo, Dem. Rep.	Kenya	Sao Tome and Principe	Zimbabwe
Congo, Rep.	Lesotho	Senegal	
	Liberia		

Appendix 1.Statistics on Ecoregion Score (2009)

	Central Africa	Eastern Africa	Southern Africa	Western Africa	Western indian Ocean	Afrique Sub-saharienne
Mean Ecoregion score	79,577	57,2893	79,3848	71,9337	44,6695	69,91
Ecoregion=0	13%	0%	0%	0%	25%	4%
Ecoregion <50	13%	44%	27%	31%	75%	33%
Ecoregion >50	88%	56%	73%	69%	25%	67%
Ecoregion =100	25%	11%	36%	19%	25%	23%

Appendix 2. Independent variables summary statistics

Variable	Unit	Mean	Std. Dev.	Min	Max	Data source
Ecoreg	%	69,91	36,48272	0	100	http://sedac.ciesin.columbia.edu/es/epi/
GDP	US$	1153,46	1724,589	137,7816	7994,31	World Development Indicator
Trade	%	74,31	35,15738	28,01144	163,7785	World Development Indicator
Dens	hab/sq.km	73,84	102,8518	2,159947	576,4587	World Development Indicator
Popto		1,39E+07	2,15E+07	79306,85	1,24E+08	World Development Indicator
Gov_effvt		0,7535132	0,6037337	-2,092727	0,6327273	World Governance Indicator
						International Human development Indicator
Educ	%	49,88711	15,59739	7,9	83	
Agri_gdp	%	29,0314	16,63044	3,231028	66,92438	World Development Indicator
Forestcover	%	31,40476	23,62931	0,2588438	89,13043	FAO
Cites	%	66.1875	39.12536	0	100	Word Resources Institute
Tour		200,5172	243,1203	0	1019,4	UNWTO
Aid_envt	US$	33,63455	34,88484	0,1034003	158,2853	OECD database

Appendix 3. Weighting scheme

Weigthingscheme	Weight matrix	Matrix elementsdefinition
Geographical proximity	W_G	*wij*= $1/N_i$ if *i* and j share a border; wij = 0 otherwise; and N_i = the number of borders state i shares.
Weighted geographical proximity	W_{Gi}	$w_{ij} = GDP_j / \sum_j GDP_j$, with j ϵ J_i
	W_{Gp}	$w_{ij} = pop_j / \sum_j pop_j$, with j ϵ J_i
Similarity-based proximity	W_{Si}	$w_{ij} = (1/S_{ij}) / \sum_j (1/S_{ij})$, with i#j , $S_{ij} = \lvert GDP_i - GDP_j \rvert$
	W_{Sp}	$w_{ij} = (1/S_{ij}) / \sum_j (1/S_{ij})$, with i#j , $S_{ij} = \lvert pop_i - pop_j \rvert$
Geographical and similarity based proximity	W_{GSi}	$w_{ij} = (1/S_{ij}) / \sum_j (1/S_{ij})$, with j ϵ J_i; $S_{ij} = \lvert GDP_i - GDP_j \rvert$

J_i=set of countries neighboring country i:Weight matrices are row standardized such that their rows sum to unity in order to compute neighborhood averages