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Economic Growth and Biodiversity: An Overview

Conservation Policies in Africa

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Abstract

From the economic literature on the relationship between economic growth and environment pioneered by Grossman and Krueger (1991) and Shafik and Bandyopadhyay (1992) we first conduct a theoretical and critical reflection on the existence of a Kuznets curve for biodiversity. It appears that results are strongly contrasted; economic growth does not seem to be necessarily the solution of biodiversity loss. Then, we focus on the main biodiversity conservation policies implemented in Africa (with the example of Côte d'Ivoire), i.e. protected areas and we discuss its effectiveness in achieving the dual objective of conservation and economic development for local communities.

Keywords: economic growth, environmental Kuznets curve, biodiversity conservation policies, protected areas, Africa, Côte d'Ivoire

1. Introduction

The Convention on biological diversity (1992) defined 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.*»

We distinguish genetic biodiversity related to the diversity of genetic information stored in each species, species biodiversity related to the richness and abundance of species and ecosystem biodiversity related to the ecosystem variability; in the literature, biodiversity of species retains more attention (Dietz & Adger, 2003; McPherson & Nieswiadomy, 2005). Biodiversity has huge economic, ecological and scientific interrelated contributions. In an economic perspective, biodiversity improves productivity of natural ecosystems and agricultural activities (Heal, 2004). It enables humanity to be protected against risks of disease and other problems that could destabilize agricultural systems (e.g. phenomena of resistance). Biodiversity is also a source of genetic knowledge; it helps medical scientists to understand life and the role of each species in maintaining ecosystems. Biodiversity is also essential to intrinsic ecological functions (i.e. the ecological balance) and ecosystem services. For example, the removal of keystones species - which provide unique key services for the functioning of ecosystem and often lead to better actions in favor of biodiversity protection - produces irreversible consequences for the entire ecosystem (Batabyal, 2002; Heal, 2004). Ecosystem services can be merchants (timber production, ecotourism, pharmaceutical uses.) or non-merchants such as watershed protection, carbon sequestration, soil fertilization (Norton-Griffiths & Southey, 1995; Edwards & Abivardi, 1998; Batabyal, 2002; Heal, 2004; Pearce, 2007). Biological diversity is undoubtedly an essential resource for human beings and for the preservation of natural ecosystems; only a joint ecological and economic management of ecosystem can allow humans to continue to benefit from its services.

One estimates total number of species between 3 and 100 million (Armsworth, Kendall, & Davis, 2004); but unfortunately one observes increasing loss of species as well as transformation and disappearance of many ecosystems (Mills & Waite, 2009). Estimates of extinction rates are uncertain; however today, many ecologists argue that the annual rate of extinction is between 20 to 200 extinctions per million species, higher than past extinction rates (Pearce, 2007). The main causes of biodiversity loss are human activities (Edwards & Abivardi,

1998; McPherson & Nieswiadomy, 2005; Polasky, Costello, & Solow, 2005; Pearce, 2007): habitat loss and fragmentation, exploitation of resources, introduction of invasive or non-indigenous species, climate change, over-harvesting, etc. In the biodiversity literature, habitat loss and degradation is widely thought to be primary cause of biodiversity loss (Polasky et al., 2005). According to Batabyal (2002), biodiversity preservation requires establishment of a resilient management system which deals with a threshold of use and an acceptable disturbance allowing system to regain its ecological balance. Indeed, research show that a more diverse ecosystem has more ability to withstand stress and becomes productive; thereby the loss of biodiversity has a high probability to decrease ability of the system to maintain or recover from damage or disturbance (Heal, 2004). Then, some authors such as Roberts and Grimes (1997), Margules and Pressey (2000), Heal (2004) and Pearce (2007) rather suggest establishment of worldwide protected areas because biodiversity conservation yields important positives externalities and may provide global public goods. The biodiversity conservation effort also results through several agreements or conventions including the "big five", i.e. the Convention on wetlands of international importance especially as waterfowl habitat (or Ramsar 1971), the Convention concerning the protection of the world cultural and natural heritage (1972), the Convention on international trade in endangered species of wild fauna and flora (or CITES 1973), the Convention on the conservation of the migratory species of wild animals (or CMS 1979) and the Convention on biological diversity (or CBD 1992) (Note 1).

Africa is not on the sidelines of the global commitment for conservation. The continent is rich in biodiversity; and so, African countries have been considered as strategic areas for scientific investigations on choices, means and opportunities to conservation. Biodiversity conservation policies in Africa present a major challenge for sustainable development. However, Lightfoot (1994) and Roe and Elliot (2005) show that other factors act indirectly and create favorable conditions for biodiversity loss: population growth, distribution and migration of population structure, poor governance, poverty and inequality, inefficient macro-economic policies. But as a rule, most of African countries present these characteristics. So, the question to provide or not biodiversity conservation efforts in Africa is relevant.

Fortunately, the extensive economic literature on relationship between economic growth and environmental quality initiated by Grossman and Krueger (1991, 1995) leaves us optimistic. Indeed, it appears an hypothesis that long-run economic growth would solve the environmental degradation problem (Grossman & Krueger, 1995; Shafik, 1994; Selden & Song, 1994; Cropper & Griffiths, 1994; Barbier, 1997; Stern, Common, & Barbier, 1996). This hypothesis, so-called environmental Kuznets curve (henceforth EKC), is inspired by the work of Kuznets (1955) about the existence of an inverted-U-shaped relationship between per capita income and income inequalities. Kuznets points out two stages in the growth of social inequality in developed economies: first, a phase of increase over time with income up to a peak and then a phase of decline. So, based on empirical observations related to several developed countries (including United States, United Kingdom and Germany) Kuznets (1955) established a profile of income disparities in economic development process. In a similar way, the EKC-concept states that nation pressure on environment ends up decreasing when a high level of economic growth is achieved (Grossman & Krueger, 1991, 1995). It implies for example that African countries will give more interest to the preservation of environment with economic growth.

In this study the main question is to know whether the EKC hypothesis may be applied if the variable of environment is a biodiversity index. In other words, is there a direct relationship between economic growth and biodiversity conservation at long run term? From a general economic literature on biodiversity, we conduct a theoretical and critical reflection on the existence of a Kuznets curve for biodiversity. Then we choose to discuss about the efficiency of biodiversity conservation policies implemented in African countries. But in a first part we briefly review the economic literature on the EKC concept.

2. Environmental Kuznets Curve Hypothesis

2.1 Theoretical Arguments

The Shafik and Bandyopadhyay (1992), Grossman and Krueger (1991, 1995) and Selden and Song (1994) seminal works mark the beginning of thinking about relationship between development and environment. They use various indicators of pollution - sulfur dioxide (SO_2), carbon oxides (CO_X), nitrous oxides (NO_X), heavy and fine suspended particulates, pathogenic contamination, heavy metals, deforestation, etc., in relation with the level of economic development. The EKC hypothesis states that the level of development, expressed as per capita gross domestic product (GDP), has positive effect on environment. The low income countries have little concern for environment degradation at the first stage of economic development characterized by subsistence economic activities and industrialization (Stern et al., 1996); but after satisfying primary needs and improving living

standard, one reaches a threshold of economic development for which awareness of environment increases. In other words, the use of natural resources to create one unit of wealth decreases gradually; the efficiency gains are expected to be large enough to reverse the direction of relationship between economic growth and degradation (Meunié, 2004). Note that according to Faucheux and Noel (1995, pp. 239-325) typology of sustainability approaches, EKC hypothesis can be qualified as "econo-centric" vision and therefore is close to "weak sustainability" concept, i. e. environment is not the support of socio-economic development, but rather is simply an common external factor and so there will exist possibility of total substitution between natural capital and manmade capital.

The theoretical existence of EKC would be an outcome of the both economic growth and rising of individual incomes; indeed revenue act through changes in production structures, changes in demand or individual preferences and finally depend on the institutional and policy framework that prevails in the country (Grossman & Krueger, 1991, 1995; Plassmann & Khanna, 2006; Nourry, 2007; Kaika & Zervas, 2013).

The evolution of productive structures following the increase of wealth can have three effects highlighted by Grossman and Krueger (1991, 1995): scale effect, composition effect and technology effect.

- scale effect is the fact that an increase of goods and services production leads to more pressure on environment and causes greater pollution as by-product.
- composition effect is due to the change in economy towards cleaner production systems; the idea is that the economy tends to change through three stages of development: rural economy, industrial and urban economy and finally a more "tertiarized" economy, which is intensive in human capital and eco-friendly.
- technological effect occurs when, from a certain threshold of wealth, the nation massively invests in R&D for more efficient and cleaner production techniques. The existence of an EKC presupposes that above an income threshold, the scale effect is more than offset by the other two.

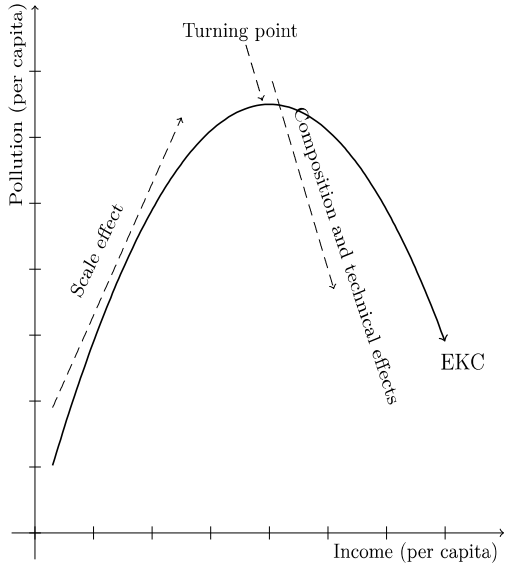

Figure 1. Environmental Kuznets curve

An EKC occurs also owing to changes in demand or consumers preferences vis-à-vis environmental goods. For instance, Fuentes (2011) focuses on human preferences and inefficiency of social coordination as the main causes of loss of biodiversity. According to Plassmann and Khanna (2006), if consumers show any reduction effort when they are rich, no sophisticated technology can reduce degradation. In fact with an improvement of their living conditions, individuals give more value to environmental amenities (Selden & Song, 1994). So the perception of the quality of environment plays a role in the decline stage of EKC; ecological variable becomes an argument of consumers' utility function, influences the market and encourages productive structures to move towards clean processes (Plassmann & Khanna, 2006; Ranjan & Shortle, 2007). The quality of environment is analyzed as a luxury good: $E_R>1$ or income-elasticity of demand for "green" goods exceeds the unity (Yandle, Vijayaraghavan, & Bhattarai, 2002; Dinda, 2004).

The political aspect of EKC is explained by the negative effects of corrupt and less effective political system on economic growth (Acemoglu, Johnson, & Robinson, 2001). Indeed, efficient institutions which are capable to impose enforceable and strict regulation to protect environment of market failures may partly explain pollution mitigation (Kaika & Zervas, 2013); moreover, with increase of income and information access, people put pressure on governments to take measures of environment protection (Nourry, 2007).

Apart from the above classical factors, the theoretical literature gives other reasons - such as international trade - as an explanation of observation of EKC; here, the underlying idea is that trade liberalization and mobility of capital allow economic expansion; however an increase of export goods production generates pollution and affects environment quality. Therefore the EKC comes from the specialization of countries. Indeed, due to the strict costly environmental regulation in force in rich countries, these ones relocate their polluting industries toward developing countries. And unfortunately, developing countries with low environmental standards accept such polluting industries in the aim to promote foreign direct investment, employment and production. In other words, low income economies specialize in polluting industries and become "pollution havens" while rich countries specialize in clean industries (Birdsall & Wheeler, 1993; Neumayer, 2001). However the hypothesis of pollution havens is challenged by another one called "race to the bottom"; in fact the relocation of industries and the exits of capital to developing countries will lead to job losses in rich economies, otherwise they will be forced to relax their regulation and this leads to a race to the bottom until reaching a low level of protection. This will result in a sharp environmental deterioration in both rich and developing countries (Porter, 1999; Wheeler, 2001). Note that the validity of these two hypotheses - "pollution havens" and "race to the bottom" - has been questioned in the empirical EKC literature.

2.2 Contradictions and Criticisms

Several empirical studies incorporating all or part of data used by the pioneers show contradictions about EKC-concept. For example Shafik (1994) shows that the EKC hypothesis is not automatic; Harbaugh, Levinson and Wilson (2002) rather shows a inverted-N shaped relationship, De Bruyn, Berg and Opschoor (1998) detect monotonically increasing relationship between economic growth and emissions, Shafik (1994) and Holtz-Eakin and Selden (1995) show that turning points are higher than maximum income of sample used. It is generally accepted that the inverted U relationship is checked for local pollutants such as SO_2 and NO_X (Stern & Common, 2001; Stern et al., 1996; Yandle et al., 2002). Emissions of pollutants that have a more diffuse impact, such as CO_2, continue to increase with growth; thus, here economic growth contradicts the fight against global warming.

There are also methodological limitations to the existence of an EKC, e.g. impacts of panel composition (Stern & Common, 2001), choice of dependent variable and specification of the econometric model (Bulte & van Soest, 2001), negligence of irreversibility of environmental damages (Arrow et al., 1995) and phenomenon of simultaneity (Stern et al., 1996). In addition, according to Roberts and Grimes (1997) the inverted U-shaped could be the result of two divergent and juxtaposed trends and not the path of individual countries following various stages of development. The irreversibility means there is no return to the old balance once ecosystem's carrying capacity is exceeded; the simultaneity means there is potential feedback effects of pollution on economic growth; in other words, pollution affects health, labor productivity and natural resources (Nourry, 2007). Therefore a search for a rapid economic expansion at the expense of natural resources may be counterproductive; the idea of an EKC is not a systematic and general result.

3. Kuznets Curve for Biodiversity

Few empirical works really analyze the existence of a Kuznets curve for biodiversity. When they do it, most of them are specifically interested in deforestation rates as indicator of biodiversity loss. Cropper and Griffiths (1994) examine the effect of demographic pressure on deforestation in 64 countries in Africa, Latin America and Asia over the period 1961-1991. They use a quadratic panel model and show the existence of an EKC only for Africa and Latin America with respective turning points at 4,760 $US and 5,420 $US; the authors also find that the average income of these countries are below these peaks; they deduce that countries are on the first part of the Kuznets curve. These results were confirmed by the work of Bhattarai and Hammig (2001), but here the turning points are much higher than those of Cropper and Griffiths (1994). Similarly, Culas (2007) highlights the existence of an EKC for deforestation in Latin America countries and the key role played by institutional factors in mitigating deforestation. In contrast, other works on deforestation contradict the existence of an EKC for biodiversity; for example, Shafik (1994) and Koop and Tole (1999) use other estimation methods and invalid the existence of Kuznets curve for deforestation; Nguyen and Azomahou (2003) use a panel model in which they focus on spatial interactions of indicators of deforestation; with a sample of 85 developing countries (Africa, Latin America and Asia-Oceania) over the period 1961 to 1994, they show that per capita income growth rate has

no relevant effect for all groups; the relationship between GDP and deforestation is "anti-Kuznets" i.e. U-shaped. In another study, the same authors introduce new variables such as access to information, political institutions and trade, use semi-parametric models and invalidate the hypothesis of Kuznets curve for biodiversity.

In addition to studies on forest biodiversity, literature is interested in biodiversity of animal species. Naidoo and Adamowicz (2001), McPherson and Nieswiadomy (2005) and Kerr and Currie (1995) analyze the relationship between economic growth and the number of endangered species; results are very mixed; while Naidoo and Adamowicz (2001) and McPherson and Nieswiadomy (2005) find evidence of EKC for mammals and birds threatened, Kerr and Currie (1995) identify a monotonic relationship where the rate of mammals and endangered birds decreases with economic growth. Dietz and Adger (2003) emphasize the disadvantage of using the number of threatened species as a measure of biodiversity loss; for them, the number of threatened species is a pressure indicator on biodiversity and not of biodiversity loss. Then they built a biodiversity proxy (species richness) using Arrhenius law (Note 2) to estimate biodiversity loss. Their results show that there is no Kuznets curve for biodiversity; indeed the mechanism of species extinction is much faster than the renewal mechanism or creation of new species; there is no turning point in the relationship between biodiversity and per capita income. Biodiversity loss is essentially irreversible and monotonous. These results point in the same direction as those of Asafu-Adjaye (2003). Finally more recently, Mills and Waite (2009) re-analyze the data used by Dietz and Adger (2003) by using a quantile regression and a spatial filtering; their results argue the presence or absence of a proof of a Kuznets curve is an insubstantial and simplistic information to draw conclusions about income-biodiversity relationship. Therefore, they advocate further exploration to understand mechanisms by which income affects biodiversity; they discourage also the use of the hypothesis of a Kuznets curve for biodiversity in defining public policies for biodiversity conservation.

As it is clear from the literature review, results about Kuznets curve for biodiversity are mixed. Economic growth does not seem to be necessarily the solution of biodiversity loss. Also, note that the Kuznets curve for biodiversity is subject to the same criticism as environment: irreversibility, model specification, selection of indicators, simultaneity, etc. Otherwise environmental Kuznets curve hypothesis assumes a perfect knowledge of "environmental good" or enough information to consumers to express their preferences; it is not the case for the good "biodiversity"; indeed, biodiversity remains somewhat appropriate and a distant concept of people's concerns. Besides, the scientific community has been really aware of the benefits of biodiversity and ecosystem services recently. Even though various regional and international agreements promote biodiversity protection, it still takes a lot of time for this to be apparent to many people. Today, biodiversity conservation is mainly implemented through management of protected areas policy. So, to understand this policy, we focus on the case of African countries in order to describe the principles of the policy and to discuss its effectiveness. However since Africa is too huge and varied with different levels of sustainable development, we present the example of Côte d'Ivoire, a West Africa country.

4. Biodiversity Conservation Policies in Africa

4.1 Conservation Strategies

Habitats loss and degradation is widely considered as the leading cause of biodiversity loss; this is why most conservation strategies is based on the preservation of terrestrial and aquatic habitats. Thus private conservation groups and government agencies use protected areas and marine reserves for mitigation of the phenomenon of loss of biodiversity.

Indeed, today protected areas are thought to be key elements of any strategy for biodiversity conservation of a country or region (Margules and Pressey, 2000; Doumenge, Garcia-Yuste, Gartan, & Ndinga, 2001); this is particularly true in Africa which is rich in biodiversity. According to the International Union for Conservation of Nature and Natural Resources (IUCN) (Note 3), a protected area is:

«A clearly defined geographical space, recognized, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values (Dudley, 2008) ».

This definition shows that a protected area (national parks, monuments, nature reserves, etc.) globally aims conservation of species and their genetic variability and thus first maintaining natural processes and ecosystems that sustain life. The "2014 United Nations List of Protected Areas" contains just over 209,000 protected areas with a total 3.4% of the world's marine area and 14% of the world's terrestrial, covering a total area of 32,8 million Km^2. On African continent in particular, protected areas represent 14 % of terrestrial areas and 2.4% of marine areas; sites are generally very large and cover 15 % of the world's area protected (Deguignet et al., 2014). Biodiversity conservation in Africa is a priority (Note 4). Indeed the continent is a unique heritage for the future

and many communities still rely on today.

4.2 Protected Areas Paradigms in Africa

Africa remains one of the most important continents in experimentation of management models of conservation policies and wildlife; this has prompted creation of national parks and protected areas during and after colonization (Korahiré, 2009). In terms of planning, in the last two decades, biodiversity conservation policies in Africa, through protected areas, have moved from "fortress conservation" approach to "new conservation" approach (Mengué-Medou, 2002; Guéneau & Jacobée, 2005; Hoon, 2008).

The "fortress conservation" was characterized by a monopoly control of central government, exclusion of local populations and prohibition of traditional uses of fauna and flora. Exclusion is done without subsidies, nor reciprocities or assistances to local people who derive most of their livelihoods from nature; local populations are considered a direct threat to maintaining biodiversity. So, they felt threatened and expropriation victims of their lands and rights (Nelson, 2004). The fortress approach is qualified "green imperialism" or "top-down" conservation and is unsustainable; it resulted in a rift between environmentalists and local communities (Igoe, 2004); i.e. the creation of protected areas was done in pain. However, this approach was vigorously fought because he did not consider costs of damage caused to local communities (Hoon, 2008); restrictions aroused misunderstandings, revolts and predatory behaviors opposed to conservation (infiltration for farming, poaching, grazing of livestock.). There was a real conflict between conservation programs and the needs of local people. Tanzania's Tarangire National Park created in 1970 by central government in disregard of needs and culture of local Maasai people is an example; they are prohibited from accessing water sources and pasture land in game reserves. We can also mention the Djoudj National Bird Sanctuary in Senegal created in 1971 after evacuation of entire villages, the National Park Omo, one of the nine national parks in Ethiopia whose boundaries and recovery in 2005 by private sector still threatens local populations (Triplet, 2009). The "fortress" approach of conservation failed and was abandoned in favor of the "new conservation" approach.

The "new conservation" or "community-based conservation" or "people-oriented conservation", initiated in the late 80s and widely adopted in the 90s, is based on participation and strengthening capacity of local people in conservation objectives. According to Hulme and Murphree (1999), it involves transition from a centralized governance to a local participatory governance, a revision of the concept of conservation by taking into account the concept of sustainable development and finally the incorporation of liberal ideas and the use of market forces to finance conservation. This indirect method of conservation also emphasizes recognition of the rights of local communities without which achieving biodiversity conservation objectives would be difficult (Nelson, 2004). The participation of local communities through co-management becomes an institutional way of reconciling on one hand, people with environmentalists and on the other hand, conservation and development (Haller, Galvin, Meroka, Alca, & Alvarez, 2008). Thus, many donors such as USAID, GTZ, World Bank and NGOs have funded integrated projects of conservation and development (or IPCDs) - such as ecotourism, biodiversity prospecting, extraction of non-timber forest products - initiated by local populations (Ferraro & Simpson, 2003). The Tafi Atome Monkey Sanctuary created in Ghana in 1996 is a good example; the local communities work as tourist guides, shops owners, etc.; many other projects IPCDs (Note 5) were introduced in the early 1990s in Southern Africa, including Zimbabwe, Zambia, Namibia and Botswana (Note 6). However, although praised by ecologists and social scientists as the most accurate of the two conservation approaches, "community-based conservation" is severely criticized: low added value for local communities, short-term vision, IPCDs worsen conservation problems because they generate new inhabitants and therefore population pressure and over-exploitation of resources, persistence of competition problems between hunting and agriculture, ambiguous effects on incentives for conservation, etc. (Ferraro & Simpson, 2003; Nicholls, 2004 ; Guéneau & Jacobée, 2005).

In the 2000s, these criticisms have led to a resurgence of strict protectionist paradigm, similar to the fortress approach but specially an emergence of a new approach extending the new conservation concept and considering biodiversity as a merchant good (Conrad & Ferraro, 2001; Ferraro & Simpson, 2002, 2003); the idea is to offset the relative costs of conservation through direct aid to local people rather than encourage, through subsidies, alternative activities such as ecotourism (Guéneau & Jacobée, 2005). According to Ferraro and Simpson (2003), it is simply to encourage conservation by paying directly for "conservation performance"; direct payments have already been successfully tested in high-income countries. Obviously to be effective, direct transfers will exceed the benefits derived from the destruction of biodiversity; there would be a kind of "commodification" of biodiversity. In the literature, one talks about "market-oriented" conservation approach. Crook and Clapp (1998, 2002) emphasize that biodiversity loss is due to market failures problems; for them, effective conservation must be done through formalization and expansion of markets for biodiversity. Although the idea of direct payments is still hypothetical for protected areas planning in Africa, according to ICEM (2003) soon we'll see its

implementation.

4.3 The Example of Côte d'Ivoire

The Côte d'Ivoire is rich in biodiversity. However over the last 50 years, there has been a deterioration of more than 83% of its forest area (Djezou, 2014). A large part of the forest cover disappeared due to the logging and farming causing a loss of species, habitats and genes (Ministère de l'Environnement et de la Forêt, 1999). That is why protected areas play an important role for the sustainable conservation of biodiversity in this country. Indeed, the country has a network of 14 protected areas, including 8 national parks and 6 natural reserves, covering a total of just over 20,000 km^2 or about 6.5% of the Ivorian territory (Kadio, 2009; UICN/PACO, 2010). Three of these protected areas are registered as World Heritage, two are listed as biosphere reserve of UNESCO and two are registered as Ramsar sites. And, the country is ranked at the first place among francophone African countries in terms of protected areas (Lauginie, 2007).

The Côte d'Ivoire government has adopted a new Law for protected areas (*Law No. 2002-102 of February 11, 2002*) in order to regulate the establishment, management and funding of national parks and nature reserves. Since then, protected areas is no longer created by orders and decrees as before, but by legislation. The new legal framework is updated and has corrected past deficiencies; it provides severe sanctions against offenses. However, despite this stronger legislation, we note that there is a weak application of sanctions due to the poor knowledge of environmental law by judges.

At the institutional level, two public structures are directly involved in the implementation of the new legal framework: the direction of the protection of nature (DPN) of the Ministry of environment, water and forests and the Ivorian Office of Parks and Reserves (OIPR). The first one is responsible for the development of national policy on protected areas and the second is responsible for its implementation; in other words, the OIPR implements the sustainable management of parks, reserves and peripheral areas, ensures the administrative and judicial police and coordinates studies relating to the creation of protected areas. The OIPR centralizes information related to protected areas to ensure national monitoring of conservation indicators. But, some exploitation missions can be granted to private actors under operating agreements or to local communities under the so-called "land management contracts". These last contracts include terms of cooperation with the local population in the aim of implementation of development programs of peripheral areas; that is a first step towards a community-based management. So there is a real political will which unlikely often faces to weak funding (UICN/PACO, 2010), inadequacy between customary rules and those adopted by the State and finally the poor governance.

5. Concluding Discussions

Biodiversity conservation is a major environmental issue, but the literature does neither invalidate nor confirm the existence of a Kuznets curve for biodiversity. In other words, economic growth is far from being systematic solution to biodiversity loss. However, the effort of conservation is not zero but is characterized by proactive conservation policies such as protection of areas around the world and especially in Africa, a continent rich in biodiversity. It is still important to note that "protected area" does not always mean "effective protection"; many protected areas are ineffective (Triplet, 2009); however, measuring the effectiveness of protected areas, especially in Africa, can be a quite complex task because of many factors that may be taken into account. In our view, three essential points to be taken into account to improve their effectiveness: operationalization of the institutional and legal framework of conservation plans, integration of economic aspects of conservation and, increased financial incentives.

Firstly at the institutional and legal level, most African countries have a satisfactory framework for protected areas. For instance, some countries such as Ghana and Burkina Faso have registered conservation priorities of nature in their Constitution. However, despite abundance of laws and institutions, the framework is often ineffective and less strictly enforced for management of protected areas, and especially when there are economic interests. Pearce (2007) rightly points that the most biodiversity-rich countries are the same which have poor governance and high levels of corruption; for example, a study of UICN/PACO (2012) on actors and governances of protected areas in West Africa shows that the types of "official" governance (Note 7) formalized by laws and regulations are really in inadequacy with daily practice. While we strongly advocate involvement of local communities in management and decision-making, we find that the management is still centralized by public authorities with insufficient resources. It also requires that creation mechanisms for protected areas, taking into account the dual objective of conservation and local socio-economic development, are supervised by laws and regulations to avoid past mistakes (Note 8). Moreover, the institutional framework must favor environmental collective awareness of African people and their policy-makers; it must also support

public-private collaboration and political stability for biodiversity conservation.

Secondly according economic aspects of conservation, recent literature explicitly states that the economic aspects often have been ignored in the methods for identifying priorities of diversity conservation (Naidoo et al., 2006; Adams, Pressey, & Naidoo, 2010; Chiozza, Boitani, & Rondinini, 2010). Indeed, systematic conservation planning has long been the preserve of biologists and ecologists; they often ignore the trade-off between costs and benefits of conservation in the analysis of effectiveness of policy (Hauer et al., 2010). Furthermore, most of African countries suffer from lack of spatial economic information for the analysis. Yet, integration of conservation costs including opportunity cost (Note 9) is important and affects conservation policies results. For example Chiozza et al. (2010) show that integrate opportunity costs in conservation planning allow to identify sites to be added to existing sites in achieving objective of protecting mammals and amphibians in Uganda and also to reduce conflicts between economic development and conservation. The analysis of effectiveness of conservation policies needs a monetary valuation of benefits and costs; the quantification task is not always easy despite several methods developed in environmental economics. Then, authors such as Norton-Griffiths and Southey (1995), Ferraro and Simpson (2002), Barnes, Macgregor and Weaver (2002), Lindsey, Alexander, Du Toit and Mills (2005), Siikamäki and Layton (2006) and Chiozza et al. (2010) use a cost-effectiveness analysis instead a cost-benefit analysis. For example Norton-Griffiths and Southey (1995) use approximations and show that the net profit of conservation in Kenya is below its opportunity cost; in other words, there is a competition between alternative activities and biodiversity conservation, and when demand for alternative uses is very high, it raises questions about relevance of creation mechanisms for protected areas. Thus it is clear that costs of conservation should be integrated early in planning process. So, economists have an important role to play in helping to design and evaluate conservation strategies.

Thirdly the last aspect of our thinking is related to the funding of conservation. Funding opportunities provided by law in each African country remain below the real needs for protected areas. According to Nelson (2004), many countries spend less than 20% of annual investment needed for efficient conservation. The lack of funding to cover the costs of biodiversity conservation is one of the main factors limiting efficiency. The use of markets of environmental services to improve private sector contribution to conservation and the establishment of permanent funds may be ways to remedy this problem; a depth reflection on direct payments should be seriously considered.

Finally let's say that although the effectiveness of protected areas in Africa is often questioned, they continue to play a key role in biodiversity conservation; considering the above reflections will undoubtedly help improve their efficiency. Moreover, further research on the determinants of conservation effort will provide essential information to analyze the sustainability of protected areas and local economic development.

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Notes

Note 1. We can quote other more specialized conventions such as the International convention for the regulation of whaling (1946), the International convention for the protection of birds (1950), the African convention on the conservation of nature and natural resources (1968) and the Convention on the conservation of European wildlife and natural habitats (1979).

Note 2. $S = cA^Z$ with S: number of species, A forest area, c: constant reflecting the density of species per unit of area, z: slope of the relationship between S and A expressed in logarithm and its value range is 0.15 and 0.35.

Note 3. Also, note that the IUCN brings together all protected areas into six management categories; these categories provide a kind of common language and framework for creation, planning and regulation of protected areas. The guidelines for applying protected area management categories are reported in Dudley (2008).

Note 4. For example, to enhance conservation in Africa, it was adopted in 2010, with the support of the Convention on diversity, a strategic plan on biological diversity 2011-2020 accompanied by 20 ambitious goals called "Aichi targets".

Note 5. Some agencies or authors prefer speaking more generally about projects or programs community based-natural resources management (CBNRM) or wildlife community management (WCM) (Hughes and Flintan, 2001). IPCDs projects must be financially attractive to local communities, economically viable for nations and reasonable for donors (Barnes et al., 2002).

Note 6. The Communal Areas Management Program for Indigenous Resources (CAMPFIRE) in Zimbabwe, the Luangwa Integradted Resources Development Project (LIRDP) in Zambia, the Tribal Grazing Land Policy (TGLP) in Botswana (Hoon, 2008) and CBNRM initiatives in Namibia.

Note 7. IUCN recognizes four types of governance or structures of management of decision power about protected area: governance by government, by cooperative arrangements, by private entities and finally by local

communities (Dudley, 2008). These four "official" types of governance are represented in Africa.

Note 8. Indeed, Mengué-Medou (2002) and Guéneau and Jacobée (2005) argued that some protected areas in Africa are created not on ecological considerations but economic and political or simply because lands consist only of little interest for other uses (i.e. landlocked areas or areas serving as refuges for emblematic species) ; also, there are protected areas that are only created on paper but not physically (Triplet, 2009).

Note 9. When you decide to create protected area, you exclude and restrict immediately the use of the site for profitable alternative economic activities. The net profits of the most cost-effective alternative activity represent the opportunity cost of the conservation project (Barton et al., 2013); in addition to opportunity costs, one includes acquisition costs, management costs, transaction costs, damage costs.