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## Planetary Boundaries and Governance Mechanisms in the transition to the Anthropocene



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## Original Paper

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# Environment and Inequality: A Complex Relationship

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## Abstract

The objective of this article is to discuss the mutual relationship between environment and inequality. This is a subject that received few attention from the environmental point of view. The economic perspective is usually predominant. Environment is a broad, transversal subject which keeps interfaces with a number of disciplines and affects important dimensions of the human life. We selected two central issues in order to explain their mutual relations with poverty and inequality: climate change and biodiversity. The relation between climate change and poverty/inequality is easier to be understood, in spite of the fact that it is a complex relationship. It is sufficient to consider the natural disasters and the increasing number of environmental refugees. However, in some exceptional cases, global warming may have a favorable effect on poor population living in very cold geographic areas. Insofar as biodiversity is concerned, the question is more controversial. There is a visible dependence of natural resources on the part of poor populations. The depletion of natural resources has a direct impact on the survival of these populations, and this will bring about increased inequality. But the need to conserve biodiversity in protected areas may affect the source of subsistence of low-income population.

**Key Words:** Environment, Biodiversity, Climate Change, Poverty, Inequality

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## Introduction

This paper aims to analyze the relationships between the environment, on the one hand, and poverty and inequality on the other. Many existing texts and books analyze each of these issues separately, but few studies based on research work focus on the reciprocal relationships between them. This Working Paper presents a review of the existing literature.

The environment is a very complex theme that cannot be reduced to a single system of causality or a main cause that would explain the rest. Society can no longer be explained by prioritizing a cause as a basis from which the whole social system can be understood (for example, class struggle in Marx, power in Foucault, symbolic capital in Bourdieu etc.). As a theme, the environment is a crosscutting, multidisciplinary dialogue between the natural sciences and the social sciences. Understanding would derive from the relationship between these areas of knowledge, rather than in-depth study of each specific area.

Bearing in mind the central importance of focusing on the relationship as the subject for study, we selected two environmental issues - biodiversity and climate change - to examine their impacts on poverty and inequality. Likewise, we will examine the impacts of poverty and inequality reduction policies on the environment. Part I and Part II of this Working Paper are devoted to unraveling the mechanisms and instruments to explain the effects of biodiversity conservation and climate change policies on inequality and poverty. In addition, we will explain the effects that policies combating poverty and inequality have on biodiversity and climate.

In order that these mechanisms can be identified better and their operation understood, they were analyzed independently of some of their political or economic connections. The environmental perspective maintains a dialogue with its interfaces - biology, geography, sociology, political science, economics, law etc., but cannot be reduced to any particular one. Therefore, we examine the conditions under which an environmental protection policy may lead to a reduction of or an increase in poverty. We examine the circumstances under which a social protection policy for reducing poverty and inequality may contribute to protecting or degrading the environment.

We note the limited availability of information on the relationship between the environment and inequality. Official United Nations and international institution documents prefer to address the issue of poverty and ignore inequality. It is a mistake to imagine that the eradication of poverty would cause necessarily the reduction of social inequality. This latter consideration is of great importance in the complex problem of the environment and sustainable development. In this way, the delicate question of inequality on an international and domestic level is set aside on purpose in each country.

The economic system "regulator" is the international market, which demands goods and services of great environmental impact, as wood, meat, soy, minerals etc. Greenhouse gas emissions (mainly CO<sub>2</sub>) in using fossil fuels continue to contribute to global warming, despite the warnings made by scientific bodies since the Kyoto Protocol in 1997.



Developed countries count only 15% of the world population and use about half of global resources. This causes great damage to the environment, for example, by releasing into the atmosphere 45% of greenhouse gases emissions in 2004. The poorest 37% of the world's population account for only 7% of emissions (Galgóczy, 2012). In recent years, criticism of development indicators, such as GNP - which is exclusively economic and does not consider quality of life which is not limited to production and income - increased. For example, numerous proposals have been made to replace the GNP by a household income measurement, and not a product measurement.

Economic thought prioritizes the dominant productivist vision and remains a prisoner of the idea that growth is infinite and can be reached by all countries, provided they follow the recipes of economic conservatism which prevails in some international institutions. Only recently they have begun to worry about the depletion of natural resources threatening the very survival of the planet and humanity.

Environmental damages caused by development policies are not shared equally. Environmental injustice exists. The majority of effects of this damage fall on low-income populations, racially discriminated groups, traditional ethnic peoples, working class neighborhoods, marginalized and vulnerable populations.

To combat this inequality, the Environmental Justice Movement emerged in several countries. This movement denounces the fact that the harmful effects of development always fall upon the most vulnerable populations (Alier, 2011). Environmental injustice is caused by a perverse system of production, land occupation, ecosystem destruction and pollution, which undermines the health of residents of poor neighborhoods, often excluded from development projects which leave the poor without safe drinking water, proper garbage collection and sewage treatment in the periphery of cities and devoid of citizenship rights.

As environmental degradation and social inequality are justified by the ideology of progress and economic growth, in Part III we look at the case of Brazil, where the environment is considered a hindrance to the economic developmental model dominant today.

## Biodiversity, Poverty And Inequality

Pursuant to the Convention on Biological Diversity of the United Nations (CBD), biodiversity is crucial to the reduction of poverty, due to the basic goods and ecosystem services it provides. They include the provision of food, fiber and medicine, soil formation, air quality and climate regulation, the regulation and quality of water supply, and the cultural and aesthetic value of certain plants and species.

Biodiversity is also integral to key development sectors such as agriculture and livestock, forestry, and fishing or tourism. More than 1.3 billion people depend on biodiversity and on basic ecosystems goods and services for their livelihoods (availability of usable land, water, plant and animal species). Poverty and disappearance of ecosystems and biodiversity are closely related.



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Poor people are the direct beneficiaries of a number of ecosystems and biodiversity services. The most affected economic activities are subsistence agriculture, livestock, fishing and informal extractivism, which are the activities developed by most poor people in the world (TEEB, 2012).

Since the poor are particularly dependent on the goods and services supplied by biodiversity, development strategies that ignore their protection undermine poverty alleviation and are therefore counterproductive. For this reason, it is crucial for development and poverty alleviation strategies and programs to prioritize biodiversity. In developing countries, natural capital is estimated to be a quarter of total wealth as compared to 13% in middle income countries and 2% in high income OECD (Organization for Economic Cooperation and Development) countries (UN CBD, 2010).

Indeed, over one billion people live with less than one dollar a day in rural areas. They largely depend on natural resources for their subsistence and are deeply affected by their degradation. According to the OECD, in low-income countries the wealth based on environment stands for about 25% of the total wealth, while in developed countries less than 4% (OECD, 2003). As a matter of fact, according to information from the United Nations CBD:

- 1) nearly a sixth of the world's population depend on protected areas for significant percent of their livelihoods.
- 2) Over a billion people in developing countries rely on fish as a major source of food and 80% of the world fisheries are fully or overexploited.
- 3) Cost of global network of marine protected areas conserving 20–30% of the world's seas: up to \$19 billion annually creating around one million jobs.
- 4) Number of people in the world who rely on timber and non-timber forest products: 1.6 billion. Annual rate of deforestation: 13 million hectares (or roughly the area of Bangladesh).
- 5) Sixty percent of ecosystem services have been degraded in fifty years and the cost of failure to halt biodiversity loss on land alone in last 10 years is estimated to be \$500 billion.
- 6) Percentage of people in Africa estimated by WHO (World Health Organisation) to rely on traditional medicines (plants and animals) as the main source of their health care needs: 80%.
- 7) Number of times more likely a person living in a poor country is to be hit by a climate change-related disaster than someone from a rich country: 79.

There seems to be no doubt that biodiversity is extremely important to poor people, but the relationship between them is complex and cannot be reduced to causal factors. Land ownership and water are usually not available to poor population in rural areas who depend on agriculture and wild plants and animals for food. They are vulnerable to extreme climatic events



often produced by ecosystem degradation. In addition, in those low-income areas biodiversity is part of culture and is connected with identity and spiritual values.

However, we cannot say that biodiversity conservation is always a means to reduce poverty and inequality. And, on the other hand, poverty alleviation is not always a means to ensure biodiversity protection. The complex relations between biodiversity and poverty/inequality have been explored by the International Institute for Environment and Development (IIED) as found in Roe&Elliot, 2005:

- 1) There is a geographical overlap between biodiversity and poverty in the national and sub-national level.
- 2) The whole world depends on biodiversity for the goods and services it provides, but poor people are particularly dependent.
- 3) Poverty may contribute to biodiversity loss, but this is only one of a number of factors. Conservation or overexploitation of biodiversity depend on several factors, especially external governance actions.
- 4) Conservation activities may have negative consequences for poor people, but others may benefit them. Governance factors play again an important role here.
- 5) Local people are often perceived as undermining conservation. Public policies should be conducted to protect aspects of biodiversity that are critically important for their livelihoods as well as to ensure protection of endangered species.
- 6) Poverty reduction activities can cause biodiversity loss. In fact, traditional policies of rural development – based on primary commodity production – have been harmful for both biodiversity and poor people. New approaches to reduce poverty and inequality, based on local knowledge and processes are tackling biodiversity loss, with a view to achieving the Millenium Development Goals.

## 1. Inequality and Biodiversity Loss

Biodiversity loss is due to the effects of several factors, as overexploitation, pollution, habitat degradation etc. (MA 2005a). In view of the importance of biodiversity to human life and of the fact that biodiversity loss is irreversible, its degradation is one of the most important threats that humanity faces nowadays (Chapin et al. 2000; Tilman 2000; MA 2005a). The impact on biodiversity is chiefly determined by social and economic activities. For example, the transformation of primary forest into land for agriculture or cattle, market pressures, agrobusiness production of commodities, deforestation for subsistence of small peasants etc.

There are no indications that the conversion of natural ecosystems into agriculture will be reduced in the near future. The demand for food and also meat consumption are expected to increase with population growth. And a small increase in global temperature would reduce the agricultural productivity of tropical and sub-tropical countries (IPCC, 2007).

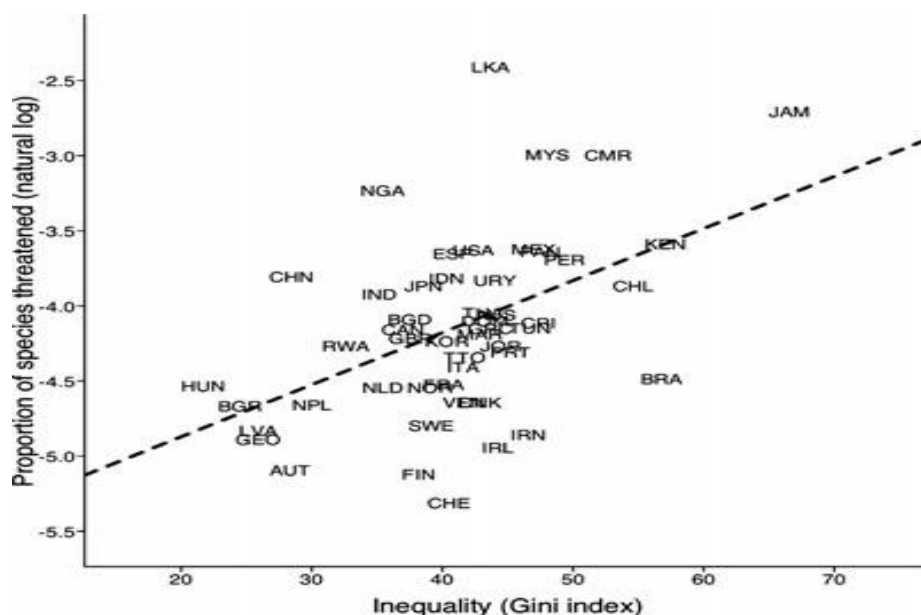
Although it is well known that socioeconomic factors are responsible for biodiversity loss, their role has been overlooked until quite recently (Naidoo & Adamowicz 2001; Asafu-Adjaye



2003). The traditional approach was to review the relationship between socioeconomic factors and environmental change in general (e.g., Ehrlich & Holdren 1971; World Bank 1992; York et al. 2003). Usually, such studies are concerned with the relationship between environmental change and gross domestic product (GDP) or GDP per capita.

Studies of biodiversity loss with an economic perspective have not taken into account the consequences of the distribution of economic wealth. However, empirical evidence shows that inequality has a negative effect on other social outcomes and institutions (e.g., Ronzio et al. 2004; Ross et al. 2005; Wilkinson & Pickett 2009). Social inequality has a significant effect on the environment (e.g., Ostrom 1990; Boyce 1994; Baland et al. 2007). According to Olson (1965), small groups with considerable inequality - when the majority of the wealth is in the hands of a few - are interested to conserve, no matter what the poorer members of the group do. Other more recent analyses agree with this perspective (e.g., Itaya et al. 1997).

In spite of this, other authors think that inequality may hinder conservation, and can thwart the collective action required for environmental protection (Boyce 1994; Dayton-Johnson & Bardhan 2002; Baland et al. 2007). These studies suggest a connection between inequality and environmental degradation, but the relationship with biodiversity was demonstrated only recently (Mikkelsen et al. 2007). Based on the Red List data of the International Union for Conservation of Nature (IUCN), Mikkelsen et al. (2007) state that greater inequality is associated with the number of threatened species. In the USA, for instance, the population decline of bird species is greater in the states with higher socioeconomic inequality. (Mikkelsen et al. 2007). The Chart below shows the relation between the Gini Index of Inequality and the Proportion of Species Threatened.



**Figure 1.** Correlation between the Gini index and the proportion of species threatened (dashed line, best fit of that relationship). Countries indicated by the three-letter codes assigned by the International Organization for Standardization (ISO).

Source: Holland, T.G., Peterson, G.D., Gonzalez, A. 2009



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Inequality may influence biodiversity in several ways that can be considered as individual or collective effects. Individual are those effects in which inequality changes the behavior of individuals, and collective effects are those mediated through environmental management institutions which, either formal or informal, play an important role in how communities manage their natural resources. Collective decision making and action, when effective, can avoid overexploitation. Nevertheless, greater inequality usually affects the effectiveness of these institutions (Boyce 1994; Dietz et al. 2003).

For some authors, environmental degradation is supposed to be greater in intermediate-equality societies and lower in highly equal and highly unequal societies (Baland & Platteau 1999). In very unequal societies, individuals are stimulated to conserve the resources they profit from, and this would have a favorable effect on biodiversity (Olson 1965). And, in very equal societies, groups will collectively manage conservation more effectively (Ostrom 1990).

This theory which advocates better conservation at the extremes of inequality is not based on empirical data and was criticized by other authors. Countries are usually too big for individual conservation decisions to benefit the individuals themselves. Thus, this potentially positive effect of inequality is not likely to occur at the broader scale of countries where institutional decision-making is the predominant pattern.

The importance of inequality as a factor producing environmental degradation in general is recognized theoretically by many different disciplines (Ostrom 2001; Dayton- Johnson & Bardhan 2002; Ronzio et al. 2004; Baland et al. 2007). Insofar as biodiversity is concerned, other studies provide empirical confirmation of the importance of inequality as a determinant of biodiversity loss in particular (Holland et al.'s 2009, Mikkelsen et al.'s (2007).

## 2. Biodiversity: A Path to Poverty Reduction?

It is generally accepted that biodiversity provides the poor an insurance against risk, particularly food security risks, risks from environmental hazards, and health risks. As the poor have few alternative sources for protecting themselves, they have a higher dependency on biodiversity for dealing with risk. Poor people tend to depend disproportionately on relatively low value goods and services from biodiversity, while richer groups utilize those resources if they have higher commercial values.

In this connection, the IUCN – International Union for Conservation of Nature - launched an ambitious Conservation for Poverty Reduction Initiative to secure and improve rural livelihoods through the improved management of ecosystems across the developing world. The Initiative puts into practice the growing experience with and understanding of the ways in which better management of ecosystems can increase livelihood security, improve human health, and reduce poverty. It develops knowledge, empowers communities, and promotes policy changes to provide rural communities with the natural resource base on which to build a healthy future (IUCN 2008).



A research published in the review Public Library of Science (PLOS) demonstrated that healthy ecosystems, with great diversity of plants and animals, can reduce the transmission of certain infectious and parasitic diseases that lead to discrepancies in the per capita income of population from tropical and temperate countries (Public Library of Science (PLOS) Biology, 2012). On the other hand, more than half the global value of ecosystem services which benefit the poorest people Real emissions reductions credits mean that the credits must be binded to projects that exist services pay the people responsible for those services, global benefits to poor communities would increase around 50 per cent, and payments would reach over a dollar per person per day for a third of the 1.1 billion people living in extreme poverty (Turner, BioScience, January 2012).

Biodiversity can be a means for poor people to escape poverty, particularly in areas with scarce economic opportunities. But the relation between biodiversity and poverty is very complex and dynamic. For poor people, biodiversity loss can be better (other sources of income) or worse (disappearance of livelihoods). In some cases, biodiversity conservation can be an obstacle to the economic improvement of poor people, while in others it is extremely important when absence of alternatives prevails.

At least six conservation mechanisms have been a route out of poverty in some places: community timber enterprises, nature-based tourism, fish spill-over, protected area jobs, agroforestry and agrobiodiversity conservation (Roe 2010). hus, it can be taken for granted that the poor depend disproportionately on biodiversity for their subsistence needs and that biodiversity conservation can be a route out of poverty under some circumstances.

Conservation policies and actions usually are oriented towards preserving biological diversity. In order to produce direct benefits to poor people, what is more important: biological diversity or biological mass.

Recent studies (Balmford et al. 2008) show that the direct benefits to people depend more on the abundance of particular species than the number of different species. This indicates that direct benefits to poor people come more from biomass than from biodiversity. In the long range, however, biodiversity is the foundation for biomass production.

### 3. Poverty Reduction: A Path to Biodiversity Protection?

In spite of the overlapping between biodiversity and poverty from the geographic point of view and the consensus regarding policies proposed by international institutions, the biodiversity-poverty relationship is very controversial. There are very different approaches, from a vicious cycle of poverty leading to environmental degradation and thence to more poverty, to a win-win scenario where environmental conservation contributes to poverty alleviation. But the benefits usually are not equitably distributed, and the poor are generally the biggest losers. The biodiversity-poverty relationship is critically affected by social and economic factors, as governance, policies on poverty and biodiversity protection, and population growth, for instance. (Tekelenburg et al. 2009).



Some analysts support the so-called Environmental Kuznets Curve, according to which environmental quality declines as income rises until income reaches a certain level where environmental quality improves. But this theory has been much criticized by other authors (Dasgupta et al., 2006), including by some supporters, based on the argument that once a species is lost, the extinction is forever. A number of analysts state that poverty alleviation in itself will not contribute to conservation. As wealth increases, so does the demand for wildlife (Robinson & Bennet, 2002). Other experts emphasize the apparent incompatibility between biodiversity and development, arguing that States with high material wealth have low biodiversity wealth and vice versa (Koziell & Saunders, 2001).

Biodiversity loss in itself cannot be said to help poverty reduction, but it is true that many economic development activities towards income increase may have negative impacts on biodiversity. If, on one hand, poverty can be the cause of biodiversity loss, the same can be said of wealth. Deforestation, for instance, can be produced by local demand for agricultural land, but even more by international demand for timber and trade in forest products on the part of industrialized countries (UN Millenium Project, 2005).

Indeed, other factors as governance, security of land tenure and access to resources may have a greater impact on the way in which people take action for overexploitation or conservation. Poverty is only one factor. Reducing poverty will not necessarily lead to biodiversity conservation, unless the other drives are also addressed (Roe & Elliot, 2005).

Usually, poor people live in an informal economy, which results in underevaluation of their assets and underestimation of the benefits of a proper ecosystem management. Income from ecosystems, also called environmental income, can be a fundamental encouragement for the economic empowerment of the rural poor. Thus, poverty reduction may lead to biodiversity conservation only if connected to clear conservation objectives, strategies, policies and actions, in an appropriate governance context (WRI, 2005).

#### 4. The Poverty Trap

It is not sufficient to say that the poor depend significantly on biodiversity for income and subsistence. This should be reviewed carefully. It is true that poor people make extensive use of natural resources, but it should be added that these are low-value resources, oriented to subsistence. They don't have access to or are excluded from high-value resources.

This condition has been called "the poverty trap" (Angelsen and Wunder 2003). Poor people are linked with low-value resources, and these low values will perpetuate poverty. Thus, dependence on low-value biodiversity resource is an indication of poverty. The only way out to escape the poverty trap seems to be migration to urban areas to leave the forest (Levang et al. 2005).

Here we have an apparent paradox, inasmuch as resources based on biodiversity have always been considered as an essential factor to provide food safety for the poor. However, when this dependence is reproducing poverty conditions, alternative livelihood strategies should be



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adopted. The Table below shows the relationship between dependence on biodiversity and inequality in some regions.

**Table 1: Equity implications of biodiversity resource dependence**

| Reference                   | Region          | Resource | Impact on inequality    |
|-----------------------------|-----------------|----------|-------------------------|
| Fisher 2004                 | Southern Africa | Forests  | Reduces by 12%          |
| Jodha 1990                  | South Asia      | CPRs     | Lowers Gini coefficient |
| Kamanga <i>et al.</i> 2009  | Southern Africa | Forests  | Lowers Gini coefficient |
| Mamo <i>et al.</i> 2007     | East Africa     | Forests  | Lowers Gini coefficient |
| Reddy and Chakravarty 1999  | South Asia      | Forests  | Reduces inequality      |
| Shaanker <i>et al.</i> 2004 | South Asia      | NTFPs    | Lowers Gini coefficient |

Source: CBD Technical Series No: 55

Data in the Table above show improvements in distribution patterns related to livelihood strategies for biodiversity dependence. However, if dependence of richer groups on high value resources is taken into consideration, this distribution result could be worse. In other words, a policy based on biodiversity will not necessarily reduce inequality.

Until recently, the prevailing opinion was that “the only hope for breaking the destructive patterns of resource use is to reduce rural poverty and improve income levels, nutrition, health care and education” (Wells and Brandon, 1992). But this has not happened in many developing countries. China, Indonesia and Brazil, for example, have greatly reduced rural poverty while continuing to draw down their natural capital. (Roe, 2010).

Two basic reasons explain today why reduction in rural poverty and better incomes, health care and education may not improve biodiversity degradation: First, natural resource consumption tends to increase with income. Second, people with better economic conditions benefit more from natural resource: they have capital to exploit the resource. Reduction of rural poverty will not necessarily prevent biodiversity degradation. Conservation policies should provide permanent benefits to local people. There are conservation mechanisms that can benefit both poor people and biodiversity

A number of studies reviewed the challenges faced by conservation projects regarding poverty and inequality. Four challenges have been found as common to all:



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- 1) Not only were elites more likely to participate, but they were often the main recipients of conservation-induced livelihood benefits.
- 2) Conservation projects sometimes led to a widening of income disparities.
- 3) Better-off households with higher social capital were more likely to participate in a conservation initiative.
- 4) There was some evidence that women could have realized greater livelihood gains from projects but were excluded due to discrimination (UN CBD, 2010)

## 5. Biodiversity-Poverty Combinations

Ecosystem degradation has traditionally been considered to produce negative consequences to well-being. Nevertheless, according to the Millennium Ecosystem Assessment (2005), ecosystem degradation has brought about important improvements in human well-being (World Resources Institute, 2005). This apparent paradox was explained by several factors as, for instance, inadequate concept of well-being by prevailing indicators and the excessive weight given to food production concerning other factors (Raudsepp-Hearne et al. 2010).

But increased food production resulted in more benefits to urban areas than to rural population. Out of 840 million undernourished people (Griffon, 2006), three-thirds live in rural areas depending on agriculture. In view of the fact that agricultural products have lower prices in the national and international market, increase in food production may not have benefited poor people in rural areas.

Furthermore, the argument that degradation of ecosystem services leads to development should be analysed more carefully. In fact, usually this kind of development replaces the so-called natural capital by man-made capital. The poor people affected by biodiversity erosion will remain poor as ecosystem services degrade. As a result, if conservation cannot be said to be directly linked to poverty alleviation, it may at least avoid extreme poverty (Sukhdev et al. 2011).

Less poverty usually means less biodiversity, creating a 'win-lose' situation. Overexploitation can lead to a collapse of the system and an increase in poverty with even more loss of biodiversity, and become a 'lose-lose' situation. Reducing poverty while conserving biodiversity - a 'win-win' - can more probably be achieved on a local scale (Tekelenburg, 2009).

In fact, higher or lower poverty levels may coincide with an increase or decrease in biodiversity in all possible combinations. The relationship between biodiversity and poverty involves a number of factors, linked to socio-economic context, ecosystems and production processes, market integration, access to capital, management skills and productivity. Cross-cutting factors play an important role such as population density and growth, ecosystem sensitivity to degradation, governance, and policies on poverty alleviation and biodiversity protection. Policy interventions may shift negative trends towards a more positive direction, making them policy driven (Tekelenburg et al 2009).



## 6. Poverty or Inequality?

From the sustainability point of view, the poverty alleviation agenda may conflict with biodiversity conservation concerns. In this connection, the following issues should be taken into consideration. Although it is increasingly recognized that the poverty concept is complex, it is still measured, to a large extent, in terms of money. Just as GDP remains the main indicator of development, poverty is still evaluated on the basis of monetary criteria.

Misleading conclusions can be derived from this, inasmuch as other factors that are important to well-being are overlooked. Poverty reduction cannot be identified with increased consumption of material goods. The exclusive quantitative approach considers to be individual progress if someone reaches the level of material consumption of the class immediately higher.

All of these misleading notions are now being rejected. Emphasizing that “more equal societies always do better”, some authors demonstrate the negative effects that inequality has on societies: eroding trust, encouraging excessive consumption, increasing anxiety and illness (Wilkinson & Pickett 2009). More than poverty, inequalities have negative impacts on biodiversity (Holland et al. 2009).

All attempts to blame the poor for biodiversity loss cannot be taken seriously, once wealth is clearly the main cause. If natural resources are limited and if poverty is to be reduced, the first step of a responsible policy should be to reduce the gap between the rich and the poor. The focus on poverty in sustainable development policies leads to the wrong idea that the solution is to increase GDP.

Poverty alleviation is generally presented by international institutions as a win-win scenario: economic growth would benefit all segments of the society. On the other hand, emphasis on inequality reduction would benefit low-income sectors to the detriment of higher classes. Hence, the difficulty to implement inequality reduction policies in most countries. There are, however, some examples that try to relate poverty alleviation with inequality issues, as found in the document “Fighting poverty and reducing inequalities” from the French Ministry of Foreign Affairs, published in 2011. But there is no doubt that further research is needed to assess the role of inequality regarding biodiversity and sustainable development.

## Climate Change, Poverty And Inequality

### 1. Vulnerability

Climate change is considered to be a real threat to the efforts towards poverty and inequality reduction and to the policies aimed to reach economic and social development. Benefits produced by past economic growth can be affected, and people disempowered. Strategies to face climate change issues and to combat poverty are closely linked. Excessive rainfalls leading to floods, droughts, desertification, extreme climate conditions will affect



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natural environment and also the livelihood of poor population. Climate change is an important factor to keep poors in the so-called poverty trap. The Stern Review (Stern, 2006) and the IPCC 4th Assessment Report (IPCC, 2007) have developed an important study of the relationship between climate change and poverty. Throughout a quite long time, the scientific community was divided concerning the anthropic causes of climate change. After decades of debates, the United Nations finally accepted the conclusions of IPCC in relation to this issue. We can say that today there is a large consensus about climate change impacts.

The most known aspect seems to be the rise in temperature level. There are connected problems, however, that should not be overlooked: floods, changes in rainfall pattern, rise in sea level, water shortage, droughts etc. These impacts have different effects on different regions and countries.

The traditional concept of poverty was based only on monetary aspects to measure well-being. GDP was the predominant indicator. Nowadays, not only income, but also social and psychological aspects are taken into account, such as education, health, human rights, empowerment, degraded environments etc. Impacts of climate change on poverty should take into consideration all of these aspects (Narayan et al. 2000).

Although climate change impacts affect more heavily poor people, all segments of the society, in all countries and regions, are vulnerable to the global warming. Either rich or poor, all countries will have to adapt to face the increasing climate change impacts. A recent research work pointed out that in relatively more unequal societies, reductions in income inequality relate to lower per capita emissions. The Gini coefficient and emissions per capita go in the same direction, i.e. when inequality increases, emissions increase and when inequality decreases, emissions decrease (Grottera C, 2012).

Poverty in the traditional sense – measured in monetary terms – is considered to be more vulnerable, because poor families have less ability to adapt. But there are other factors besides income affecting living conditions: land, ecosystem, social and institutional organization etc. Low income is not the only factor and sometimes not the most important (Magnan, 2010).

## 2. Unequal Distribution of Impacts

Climate change is expected to affect developing countries more seriously than the developed nations, in view of their climate condition, dependence on natural resources and a certain lack of capacity for adaptation (IPCC, 2007). Damages caused by climate change in Latin American and Caribbean countries, for example, are expected to vary from 1,3% to 7% of the Gross Domestic Product by 2050, if adaptation actions are not taken into account (Verner 2010). From 2000 to 2005, the average cost per year of damage produced by climate change is estimated to reach around 0.7 percent to 0.8 percent of GDP (Nagy et al. 2006).

And this damage affected much more poor people, whose number is estimated to be 100 million people in the region (World Bank, 2008). Poor people is more vulnerable because their dependence on natural resources is greater and their ability to deal with extreme weather



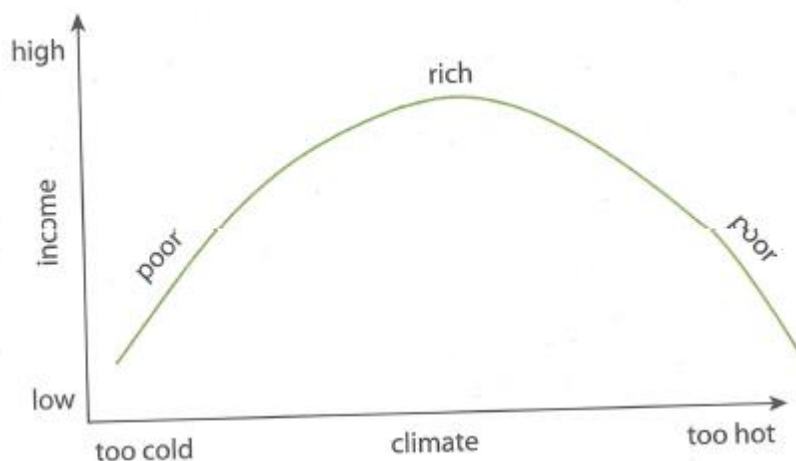
conditions is usually reduced. In spite of the fact that climate change impacts cannot often be avoided, there is much room to develop policies to implement mitigation actions designed to combat the causes of climate change, and also adaptation actions with a view to fighting their consequences.

As the economic and social development will be affected in the next years, it is extremely important that climate change issues be incorporated into development policies (Stern, 2006). As poor people are the most affected social group, it is their interest that governmental policies take mitigation and adaptation measures so that the vicious circle of poverty and inequality be reversed into a path towards sustainable development.

The question to be tackled is to explain how climate change affects the livelihood of poor population, and how poverty affects the capacity to face extreme natural events. The negative effects of climate change have a greater impact on the poor, who depend on natural resources and live in fragile environments subject to natural disasters as floods, droughts, landslides etc. By 2015 more than 375 million people are likely to be affected by climate related disasters – a projected increase of 54% – and this threatens to overwhelm the world's current capacity to respond (OXFAM, 2009).

The impacts of climate change have a very unequal distribution, affecting the social groups in a different way. This is one of the greatest social injustices existing nowadays. The economic and social development becomes more difficult in extreme weather conditions, either too cold or too hot. Regions with moderate temperatures tend to be richer than regions with extreme weather. As shown in the Figure below, poor countries are more sensitive to climate change than rich countries.

**Figure 2 - Theoretical Relationship between Temperature and Income**



Source: Andersen and Verner (2010)

In addition to this relationship between temperature and income, there are other important factors affecting poor people. In rural areas, they are dependent on agriculture which is very sensitive to extreme weather. In both rural and urban regions, they usually live in fragile

areas that are more subject to natural disasters. They have less access to public infrastructure and less savings to face the consequences of natural disasters.

As climate change affects poor people more than other groups, poverty and inequality tend to increase with climate change. As a matter of fact, recent surveys indicate that the growth of income in less developed countries has been affected by climate change over the last half century, while developed countries remained unaffected (Dell et al. 2008).

Specific situations, however, should always be taken into account. In Brazil, for instance, poverty is more concentrated in north and northeast which are supposed to become warmer faster than the south and southeast. People living in those hot areas are expected to be more affected by increased warming than those living in cooler regions. As a result, climate change is expected to bring about an increase in poverty and inequality in Brazil.

On the other hand, the situation in Bolivia is completely different. Poor people live mainly in the cold highlands, and would this way get more benefits from warming than the richer population living in the hotter low lands. Under these circumstances, poverty and inequality in Bolivia tend to be reduced with additional warming. Thus, the climate-income relationship may be very different from one region to another. In other words, the effects of climate change on income, poverty and inequality may be considerably different from country to another.

### 3. Impacts on Some Latin American Countries

The expected increase in temperature over the forthcoming 50 years in Brazil should produce a decrease of 12% in the per capita income, as an average. Of course, the northern and northeastern states will lose much more than the national average and the south and southeast. A good picture of this situation is shown in the Table below.

**Table 2 : Brazil: Estimated Impact of Climate Change on per Capita Income, 2008-58**

| <i>Region</i> | <i>Impact on per Capita income (% change)</i> |
|---------------|-----------------------------------------------|
| North         | - 22.5                                        |
| Northeast     | - 19.8                                        |
| Center-west   | - 15.6                                        |
| Southeast     | - 7.2                                         |
| South         | - 2.9                                         |
| Brazil        | - 11.9                                        |

Source: Andersen and Verner (2010)



Climate change should increase inequality and poverty in Brazilian municipalities. The poorest regions will probably undergo a considerable reduction in income, in view of the increased temperature. A research work conducted in five Latin American countries indicated that the effects of climate change are negative for Brazil, Chile and Peru, where income is expected to decrease. Bolivia would be granted a small benefit and for Mexico no important impact is expected insofar as income is concerned.

Poverty is expected to increase in Chile, Brazil and Peru, decrease in Bolivia and for Mexico no reliable forecasts have been suggested. In relation to inequality, it is expected to increase in Brazil, decrease in Bolivia and remain unchanged for the other three countries.

**Table 3 - Climate Change and Municipal-Level Income, Poverty and Inequality**

| <i>Country</i> | <i>Effect of Future climate change on average incomes (% change)</i> | <i>Effect on poverty</i> | <i>Effect on inequaty</i> |
|----------------|----------------------------------------------------------------------|--------------------------|---------------------------|
| Bolivia        | 2.9                                                                  | Decrease                 | Decrease                  |
| Brazil         | -11.9                                                                | Increase                 | Increase                  |
| Chile          | -6.7                                                                 | Increase                 | Neutral                   |
| Mexico         | Neutral                                                              | Neutral                  | Neutral                   |
| Peru           | -2.3                                                                 | Increase                 | Neutral                   |

Source: Anderson and Verner (2010)

In view of the data above, we have to be more careful regarding the prevailing arguments about climate change always affecting poor people disproportionately and causing poverty and inequality to increase. In Brazil and Chile, the poor people live in the warmest areas and their situation is expected to worsen with additional warming. On the other hand, in Bolivia and Peru the poorest population live in cold highlands and could benefit with the expected warming effects of climate change.

The climate change effects, as a matter of fact, are not so important for income in some countries. They could benefit more with education. In Bolivia, for instance, a 2°C increase in temperatures would increase consumption levels about 3 percent, while a two-year raise in education levels would increase per capita consumption levels by 47 percent. In Brazil, a 2°C increase in temperatures would bring about a 12 percent reduction in average incomes, while a two-year increase in education levels would cause a 94 percent increase in incomes (Andersen and Werner 2010).

The geographic factor is extremely important to explain the vulnerability of poor countries. These least developed nations are usually warmer, have high rainfall precipitations and are dependent on agriculture, a sector highly sensitive to climate. A changing climate

produces alterations in rainfall and temperature patterns which will affect crops in tropical regions. In addition, health risks will increase as, for example, disease vectors like malaria mosquitoes.

Climate change is an important factor behind inequality between poor and rich countries. There is a great variability of climate change effects according to several factors. Vulnerability, as defined by IPCC, is related to how a system is affected by climate. In this connection, the geographic factor plays an important role, as many poor countries are located in tropical areas. This means that they are subject to extreme climate conditions – excessive rainfall, floods, droughts, etc.

Small variations in climate may result in a heavy burden for developing countries, especially those which are more dependent on agricultural activities. The geographic factor, however, should not be overemphasized. There is no geographic determinism: social, economic and political conditions should also be taken into consideration.

Dependence on agricultural rural production is generally related to low income and more vulnerability to climate change. When subsistence agriculture and urban poverty are combined, there seems to be an increased poverty level (Hertel et.al. 2010). Climate change can affect poor people in a number of different ways: water shortage, food security, extreme climate events, health problems, high temperature, diseases, environment migration and so on.

Adaptation to climate change effects requires several actions that should be integrated in a national public policy and considered as a priority for international assistance. Among these actions, the following should not be overlooked: better infrastructure and buildings, climate resistance crop varieties and technologies, and appropriate management practices to face natural disasters.

The total international funds for adaptation in 2007 was equivalent to \$ 279 million (UNDP, 2007). This amount is highly insufficient to cover existing needs. A substantial increase in international aid for development is required to help poor countries to face their heavy climate changes impacts.

## 4. Summing Up

Climate change management and poverty reduction are closely linked. Policies designed to combat poverty and the negative effects of climate change should be considered as two challenges in one strategy. This strategy should emphasize low-carbon objectives for developing countries. Renewable energy can eliminate or reduce dependency on imported fossil fuels. On the other hand, substantial reductions and even elimination of deforestation will protect water supplies and biodiversity.

Nevertheless, only mitigation actions will not be enough to deal with global warming problems: the greenhouse gases, both those existing already in the atmosphere as well as those to come in the next years, require immediate action from Governments and the private sector.



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As a result, along with mitigation actions, adaptation actions are required, especially for poor countries, which are more hardly affected than rich nations. And challenging inequalities is at the heart of climate change adaptation (Fischer, IED, 2013). The September 2013 IPCC Report confirmed that climate change is human-induced. Warming will probably exceed 2° C, which is the level beyond which global warming will produce serious changes to the planet. Other points that have been emphasized are as follows:

- Atmospheric concentration of greenhouse gases are now at levels unprecedented in the last 800.000 years. The burning of fossil fuels is the main reason for a 40% increase in CO2 concentrations since the industrial revolution.

- By the end of the century, global temperatures are expected to rise by 0,3% (optimistic scenario) to 4,8% (pessimistic scenario), depending on how carbon emissions are controlled. Sea levels are expected to rise a further 26-82cm. As a third of CO2 emissions will be absorbed by oceans, they will undergo an increased acidification.

- Heatwaves will probably be more frequent and last longer. Wet regions will receive more rainfall, and dry regions less (IPCC, 2013).

Climate change will undoubtedly have an important impact on social and economic development, especially for poor people. In fact, they are more vulnerable to the effects of climate change and less prepared to face the costs of adaptation. This is tremendously unfair, because their contribution to the emission of greenhouse gases is considerably inferior to that of rich countries.

The developed countries, with only 15% of the global population, use about half of global resources and produce a significant part of environmental degradation. They have been responsible for 45% of the greenhouse gas emissions in 2004, for example. The 37% poorest of the world population are responsible for only 7% of these emissions (Galgóczi, 2012).

As the Intergovernmental Panel on Climate Change has pointed out (IPCC, 2007), while Africa accounts for less than 4 per cent of greenhouse gas emissions, this continent may by 2020 have between 70 million and 400 million people exposed to water shortage caused by climate change. In order to compensate this injustice, developed countries should provide the funds required by national programs with a view to tackling climate change impacts.

## Environment In Brazil: A Threat To Development?

### 1. Developmentalism at Stake

In Brazil, as generally occurs in all countries on a developmental path, the priority is economic growth. After decades of neo-liberal domination, the predominant developmental vision increasingly considers the environment as an obstacle to development. Over the last ten years, successful economic policies resulted in an important increase in incomes and decrease in inequality (IBGE/Contas Nacionais/IPEA). This successful result was utilized to strengthen the



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current prevailing governmental developmentalist strategy which considers environment as a threat to development.

Research conducted in 1997 by ISER/CPDOC showed that nature appeared in first place among reasons for pride in being Brazilian. A recent study in April, 2012 by the Ministry of the Environment showed an advance in relation to previous studies. Among those that feel more pride in being Brazilian (43% of the total), the principal reason for pride is the environment (28%), followed by socioeconomic development (22%).

Virtually 100% of the population consider "care/protection of the environment" important. With regard to the identification of problems, the environment is ranked sixth, behind health/hospitals, violence/crime, unemployment, education and politicians. and above housing, income distribution, inflation, etc.

Those who said that the main problem in Brazil is the environment increased from 5% in 1997 to 13% in 2012. And those who said there is no environmental problem in Brazil or had no opinion, dropped from 47% in 1992 to 11% in 2012.

Research shows a significant evolution in Brazilian environmental awareness. An indicator of this change is in the number of people who spontaneously did not think to mention an environmental problem in the country or in their city. This number went from 46% in 1992 to 10% in 2012.

It appears that the notion of romantic love of nature that so much contributed to the consolidation of national identity has shifted from the imagination and collective unconscious to the level of awareness of the problems to be addressed by public policy. Thus, the degradation of nature destroys the self-esteem of the Brazilian and conflicts with the notion of progress and growth trumpeted to the four winds in developing countries. This is because the official economic and social discourse does not incorporate the issue of the environment, dealing with it separately as if it were an externality.

Public social, economic and environmental policies are discussed in different ministries and institutions that rarely interact with each other. The proposal of a Sustainable Development Council comprising the economic, social and environmental ministries with decision-making power fell flat after the United Nations Conference on Environment and Development (UNCED) held in Rio in 1992.

Public policies in the environmental area are engendered in a field where conflicting economic, political-institutional, ecological and social issues reside. The promotion of sustainable development should be guided by the search for a socially just and ecologically friendly society, which presupposes a series of strategic actions that meet joint efforts of the state, market and civil society at the local, regional and national levels.

It is important to note that the time frame of politicians and businessmen is usually short term. Politicians have short mandates and entrepreneurs aspire to the greatest profits in the shortest period possible. Environmental policies require a long-term horizon. They should not be seen as an obstacle to growth, but as constituent elements of development. Since the



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environmental issue is long term and affects humanity's way of life, it is present in the social and economic question. Moreover, in general it cannot be solved by a single country, since environmental problems are global.

But today's developmental model, which succeeded the neoliberal model that has prevailed for decades in Latin America, prioritizes the quantitative aspects of economic growth and the proper policy to combat poverty, toward reduction of social inequality. And it ignores the reasons for sustainable development, since it still considers the environment as an obstacle to development.

Pollution, environmental degradation, over-exploitation of natural resources, global warming, natural disasters, affect more poor people than the rich. In spite of this, public policies dealing with poverty and inequality usually do not take into account destruction of the environment which brings about environmental migrations and refugees. This fact calls for a revision of social policies designed to eliminate or reduce poverty and inequality.

Another factor requiring a review of present approach to social inequalities is the irruption of differences in the fight for equality in the public sphere (Reis, 2011). In the 18th and 19th centuries, the historical process to create the Nation-State has suffocated differences on behalf of equality. As all people are members of the same nation, differences have been ignored and, as a result, inequality has been maintained or increased regarding black people, women, indigenous people, homosexuals etc.

In last 19th and first half of the 20th centuries, the objective was to build and strengthen the National State and ensure its continuous development by means of economic growth. Thus, the disregard of differences and the destruction of nature were simultaneous processes. As of the second half of last century, however, the weakening of the Nation State as a result of globalization made possible the resurgence of social diversities that began to be accepted and the issue of environmental degradation as a global problem to be recognized (Vieira, 2001).

Environmental discourse has advanced, but remains in the background against the prevailing social and economic discourse. Outside the rhetoric of official UN conferences, the three "pillars" of economic, social and environment remain separate, with enormous difficulties of dialogue. There is no doubt, however, that the environmental discourse has left the collective romantic imagination and overflowed from academia and from the activism of non-governmental organizations to influence projects and programs vying for power in the political arena.

## 2. Biodiversity

Brazil is one of the richest countries for biodiversity in the world. And one of the seventeen countries that together have 70% of the planet's biodiversity. The combined terrestrial biomes (Atlantic Rainforest, Amazonia, Cerrado, Caatinga and Campos do Sul) houses 20% of the species on the planet, and 20% of the total global flora.



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Such biodiversity reinforces the importance of policies oriented to conservation and sustainable use of biomes, since 60% of endangered species are in protected territories, and approximately 75% of Federal conservation areas are home to such populations. The perspective is the conservation and sustainable use of biodiversity and forests, in the face of threats represented by the effects of climate change and overexploitation of natural resources. According to the Ministry of Environment, Brazil has approximately 1, 5 million km<sup>2</sup> of area covered by conservation units, which corresponds to 16.6% of the national continental area and 1.5% of national Brazilian territorial waters.

According to the United Nations Environment Program (UNEP), Brazil is responsible for the protection of almost 75% of the entire protected area established in the world since 2003. The Botanical Garden Research Institute of Rio de Janeiro in 2010 published the "List of species of flora of Brazil", cataloging 40,982 species existent in the country - and each year about a thousand new species are described in Brazil. This demonstrates the potential wealth of the country, to the extent that the resources of biodiversity represent an important source of income and employment generation, contributing significantly to the GDP.

Considering the area covered by units of state and federal conservation and Reservas Particulares do Patrimônio Natural – RPPN (Private Reserves of Natural Heritage) in the country, the majority is located in the Brazilian Amazon biome, as can be seen in Figure 1. Considerable portions of the Cerrado and Atlantic Rainforest area are also protected, with 10.9% and 6.4%, respectively.

Besides the areas which are part of the SNUC (National System of Conservation Units), the indigenous lands represent approximately 13% of the Brazilian territory, and quilombolas territories are also considered protected areas. The rich social diversity, represented by more than two hundred indigenous peoples and local communities (quilombolas, caiçaras, seringueiros etc.), together forms an invaluable collection of traditional knowledge on conservation and use of biodiversity.

In Brazil, the units of conservation have been criticized for often not leaving the paper, for numerous gaps and weaknesses, such as pending land regularization, lack of officials and lack of basic infrastructure, lack of revision or absence of management plan, among other problems. But lack of resources is not always the problem. An example is what happens in Camara Federal de Compensação Ambiental (Federal Environmental Compensation Board), whose bureaucratic functioning makes difficult and sometimes prevents the application of funds for projects in support of conservation units.

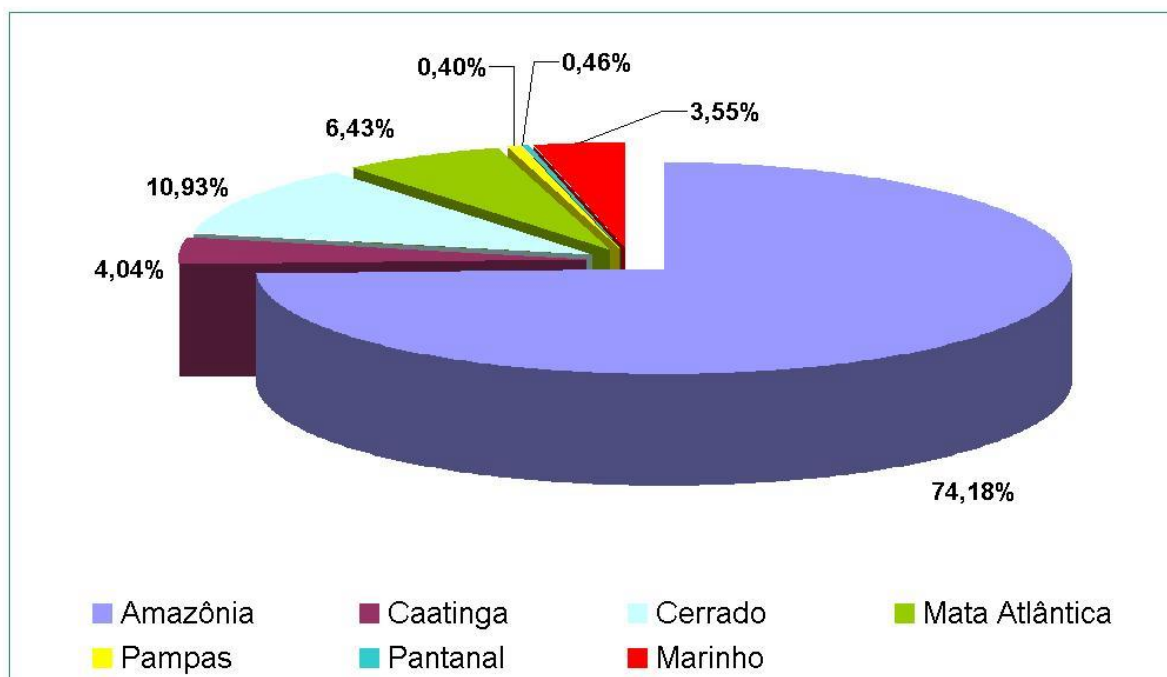
The definition of priority areas for conservation, sustainable use and sharing of the benefits of biodiversity is an important tool developed for territorial planning and management, allowing the identification of areas and priority actions based on specific criteria established for each biome: 26.6% of priority areas are located in the Amazon biome, 21.6% in the Atlantic Rainforest, 18.9% in the Coastal Zone, 15.7% in the Cerrado, 8.9% in the Caatinga, 2.8% in the Pampa and 1.9% of the Pantanal.



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Policies for conservation and sustainable use of biodiversity and forests depend increasingly on a cross-sectional model of public policy implementation. Brazil still needs to move forward in the valorizing agro-biodiversity and socio-biodiversity products, through access to public policies and territories, value aggregation, consolidation of markets, economic and environmental sustainability of different production systems, environmental consideration for services rendered, contributing to conservation, food sovereignty and nutrition, and income generation.

**Figure 3 - Area covered by conservation units SNUC (federal, state and RPPN) by biome, 2010**

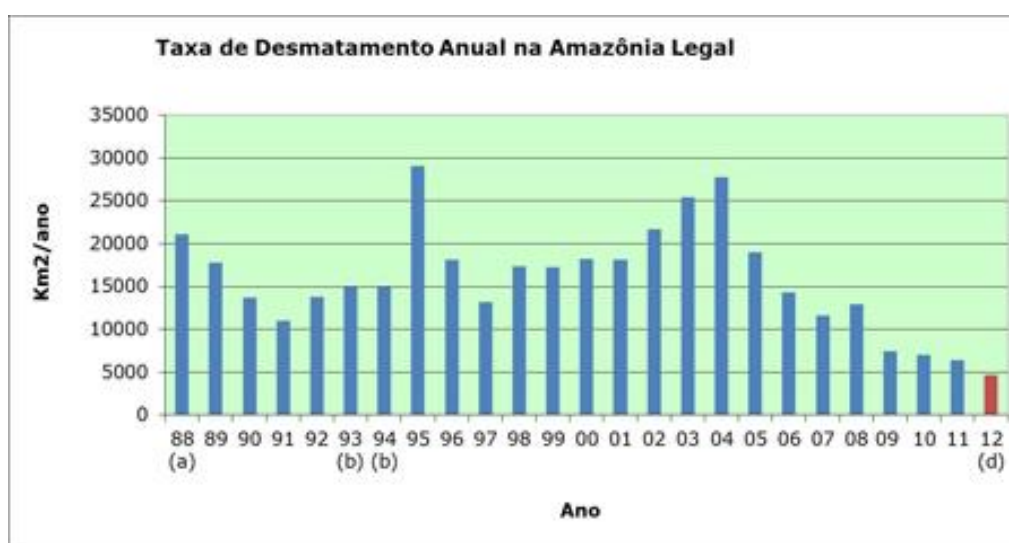


Source: Ministry of Environment, 2010.

## Environment In Brazil: A Threat To Development?

With regard to forest cover in recent years there has been a reduction of the indices of deforestation in the national territory. The Amazon, which already has lost 14.6% of its original cover, has had significant reduction of deforestation, reaching in 2012 the lowest index of deforestation since official measurement began in 1988: 4,656 km<sup>2</sup>. Figure 2 clearly shows that reduction.

**Figure 4: Annual deforestation rate in the Amazon**



Source: Instituto Nacional de Pesquisas Espaciais (2012).

### 3. Climate change and renewable energy<sup>1</sup>

Unlike industrialized countries, where the burning of fossil fuels is the main cause of estimated emissions of CO<sub>2</sub> - greenhouse gas (GHG) that directly influences the change of climate and represents 80% of global carbon emissions into the atmosphere - emissions in Brazil result from changes in land use, primarily from conversion of forests for agriculture and livestock.

A study released in the second half of 2009 by the Ministry of Environment shows that deforestation is responsible for more than half (51.9%) of the emissions of carbon dioxide in the country. The second activity in Brazil that contributes to global warming is agriculture and livestock, with 25%, followed by the energy sector, with 20%. Following are industry and waste with 1.7% and 1.4%, respectively.

In general, the loss of forests worldwide contributes about 17% of emissions of greenhouse gases. In Brazil, the annual agriculture-oriented grain planting represents only 4.9% of the deforested area (34,900 km<sup>2</sup>). Extensive livestock, with expansion and continued growth since the 1970s, is the main cause for deforestation in the Amazon, with 62.2% of almost 720,000 km<sup>2</sup> deforested in the Amazon so far.

As a function of the high participation of renewable energy in the Brazilian energy matrix, the generation of electricity from hydropower, the use of alcohol in transport, bagasse from sugar cane and vegetable charcoal in the industry, the share of CO<sub>2</sub> emissions by the use of fossil fuels in Brazil is relatively small. Nevertheless, it should be noted that Brazilian energy consumption is still modest compared to industrialized countries. Even so, Brazil is still one of the largest emitters of greenhouse gas in the world.

<sup>1</sup> When not otherwise indicated, all data below come from Vieira, L. and Cader, R. (2013).

On the other hand, the question of energy produced in the world is highly relevant to the extent that the change in climate is a global problem and most of the emissions of greenhouse gases come from an unclean energy matrix, i.e., not renewable. It is worth remembering that the change of climate in the world is the result of a historical increase, since the Industrial Revolution, of the atmospheric concentration of greenhouse gases, mainly from burning fossil fuels and land use alterations.

The IPCC Scientific Report IV (2007) presents evidence of changes in climate that may significantly affect the planet more strongly in less developed countries located in tropical region. The results indicate an increase in average global temperatures between 1.8 °C and 4.0°C by 2100. The main conclusions of the report suggest, with over 90% assurance, that the global warming of last fifty years is caused by human activities.

Initial studies on the effects of climatic changes in Brazil, developed by the National Institute of Pesquisas Espaciais (INPE), based on IPCC scenarios, indicate that the areas considered most vulnerable are notably Amazon, with what is called savannization, and the Northeast. The increase in global temperature - which can record up to 4.0°C more later this century - will cause impact on Brazil and all nations of the world. However, it is the poorest populations that will be the most affected, since the intensification of extreme climatic events, the processes of desertification and loss of arable land will lead to food shortages and supply of potable water, spread of diseases and losses in economic and social infrastructure of the country.

With Decree n. 6263, November 21, 2007, Brazil published the National Plan on Climate Change. And the Congress approved Law n. 12.187/2009, the National Policy on Climate Change and the National Fund for Climate Change. As a result, the area for tree planting is expected to increase from 5.5 million hectares to 11 million by 2020.

But some months before the approval of the National Policy on Climate Change, the government reduced taxes on the production of motor vehicles without a required improvement in standards of consumption of fuel or a support for the development of public transportation.

With the publication of Law no. 12.187/2009, Brazil adopted voluntary actions to mitigate emissions of greenhouse gases, in order to reduce by 36.1% and 38.9% its projected emissions by 2020, based on the values of the period 1996-2005. The industrial and agricultural sectors resisted targets imposed by the federal government. It is another example of how conflict between economic, environmental, and social interests permeates contemporary environmental policy.

It is important to highlight the important contribution of hydroelectric generation in the country for reduction of emissions of greenhouse gases. Brazil has a relatively "clean" energy matrix with low levels of emissions of greenhouse gases per unit of energy produced or consumed. The problem here is the usual absence of consultation and benefit sharing with local communities in project development, such as the Madeira, Xingu and Tapajos rivers whose riparian and indigenous communities are harmed by it.

Created in April 2002, the ambitious Incentive Program for Alternative Sources of Energy (Proinfa) created by Law n. 10.438/2002 and coordinated by the Ministry of Mines and Energy,



is a project of great relevance for the generation of renewable energies in Brazil. The program was considered a great initiative to have contributed to the birth of the wind industry in the country, allowing Brazil to have one of the cheapest wind energies in the world. On the other hand, there are other actions that would cause less impact and increase energy supply in Brazil, such as the restructuring of existing hydropower plants.

There is no project on a national scale for this purpose, which would increase supply capacity and reduce the need to deploy so many new environmentally and socially high impact megapower plants. In this sense, Brazil has yet to move forward much in the construction of a new paradigm in the production matrix, and the state has a key role to play in fostering such change which requires climate changes mitigation and adaptation measures. It is a cross-disciplinary and strategic theme that interacts with various sectors of environmental, social and economic policies, and implies the need for interaction of the various actors involved in such policies/sectors for the construction of a new sustainable economy.

#### 4. Impact of Climate Change

The Brazilian Climate Change Panel Report, released in September 2013, estimates an increase in temperature of 6 degrees by 2070, with a drop in agricultural production. Brazilian agriculture may suffer annual losses of U.S. \$ 7 billion. Based on the hectares cultivated in 2009 and at the current production conditions, the projections for 2030 show large reductions in area. Beans will fall from 54.5% to 69.7%. For soy, the reduction is estimated at between 15% to 28%. Wheat, from 20% to 31.2%. Corn from 7% to 22%. Rice, from 9.1% to 9.9%. And cotton, 4.6% to 4.9%. Coffee, for example, needs 18 ° C to 22 ° C, as an average.

Yet over the next seven years, soybean planting could lose 20% productivity. By 2050, the area planted in rice can recede 7.5%, in corn, 16%, and power generation be threatened by a reduction of up to 20% in river flow (PBMC, 2013).

Analyzing the report, former Minister Marina Silva said that "this is because the government's agenda and backwardness of agribusiness sectors stand for dismantling environmental legislation and decided to amnesty those who deforest, as if forests and rivers hold back the country and agriculture. Now they turn against the Indians and their lands, to reduce them and open them to the mining and agriculture "(Silva, M. 2013).

The flow of major rivers of the country and the supply of groundwater, responsible for supplying drinking water to the population, may be affected if the temperature rises to 6° C in the next decades and rainfall decreases in accordance with the scenario which considers that the levels of greenhouse gas emissions remain high.

In this scenario, agriculture and energy sector in Brazil may be strongly affected, with risk of sudden drop in Gross Domestic Product (GDP) and constant crises involving the energy supply and food security. The Report of the Brazilian Panel on Climate Change made the following estimates for climate change in Brazil by 2100:



**Figure 5 - Projection of Climate Change in Brazil until 2100**



Source: G1 - September (2013).

According to the document, the temperature in Brazil may increase from 3° C to 6° C by 2100, a situation that would be even more critical with a possible shortage of rainfall. In the Amazon, for example, in 2100 the temperature may rise about 6° C and rainfall distribution may fall in the region 45%.

Deforestation and burning in the biome can contribute to dramatically alter the hydrologic cycle of the forest (mainly between the months of July and November), extending the season of drought and changing rainfall distribution in the country.

The accentuated heat, up to 5.5° C higher than the present recorded temperature, would trigger a process of desertification in the Caatinga biome which is now considered endangered. In the same high emissions scenario, the Pantanal would suffer a 45% reduction in rainfall and an increase of 4.5° C in temperature. According to the high emissions scenario, the Atlantic Rainforest and Pampa also record an increase in temperature by 2100, a bit milder compared with other regions. However, what is worrisome, according to the report, is the growth in the rates of rainfall. While in the South / Southeast Atlantic Rainforest the amount of rain could

increase to 30% in the coming decades, in the Pampa, which covers the southern states, grows 40% - which increases the risk of floods and landslides in coastal areas.

These are projections in extreme scenarios of emissions of greenhouse gases. If in 30 years we do not change this current rate, the average annual temperature in the country should increase 1° C "(Volume 1 of the Report -" Scientific Basis of Climate Change "). Important basins of eastern Amazonia (near Para) and the Northeast may have significant reductions in their discharges. The estimate is down 20%. According to the document, the Tocantins River, which passes through Goiás, Tocantins, Maranhão and Pará, can be reduced up to 30% in quantity.

This decrease would, for example, affect the generation of electricity by hydropower and distribution of electricity in the country. Also, it would force the government to use thermoelectric power which is considered dirtier. In the South of the country, the Paraná-Plata may have a flow increase between 10% and 40% in the coming decades.

As for the oceans, the document says that acidification will be marked if greenhouse gas emissions remain high and the potential for fishing throughout the Brazilian coast could shrink by 6% over the next 40 years.

Climate change will reduce the productivity of almost all crops existing in the country today. The forecast of economic losses caused by frost and drought in agriculture is around R\$ 7 billion annually by 2020.

Scientific forecasts indicate that if nothing changes in the emission scenario, in the next seven years the planting of soybeans will have lost 20% of their productivity and 24% by 2050. By the same year, the rice acreage in Brazil may reduce 7.5%, to 16% of corn, and cotton cultivation may decrease 4.7%. The orange crop may also be injured by diseases harmful to fruit. It is estimated that by 2050 climate will influence the loss of 10% of all the coffee planted in the country. In contrast, the heat can benefit sugar cane, a plant very resistant to heat and drought.

The year 2020 marks the deadline for compliance with the Brazilian goals for emission reduction announced in 2009 during the Copenhagen climate conference. At the time, Brazil pledged to decrease total national emissions between 36.1% and 38.9% compared to 2005 levels. In June this year, the government announced that the country has reached about 62% of its goal. To reduce emissions after 2020, it will be crucial to deploy a lower power consumption model of economic development with greater proportion of renewable energy.

In urban areas, the poor are those that suffer most from extreme events, especially landslides caused by heavy rains. It will be necessary to prepare plans for protection and prevention throughout the country, especially in the coastal zone, where the majority of the population lives. The investments in infrastructure, which is a priority today, bring about environmental impacts which in turn contribute to increase the ecological consciousness and encourage protests and action by environmental organizations and the movement for environmental justice (Herculano, 2002; Milanez, B. e Fonseca, I. 2010). In the next years, the social and environmental conflicts are expected to increase if the official economic decision-making does not take into account the warnings and recommendations of the socio-environmental agenda.



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