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Biodiversity conservation and poverty alleviation: a way out of the deadlock?

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Achieving the goal of liberating half of the world's poor from their poverty by 2015 will either mark the true beginning of sustainability or the end of biodiversity at the hands of the best-intentioned policies.
Sanderson & Redford (2003).

Abstract

The rural poor often depend on biodiversity for a wide range of natural resources and ecosystem services essential for their well-being, and are therefore potentially affected by its degradation. Against this backdrop, conservationists, development practitioners and policy makers often have differing opinions on how—and whether—to link biodiversity conservation with poverty reduction. Nonetheless, the growing volume of literature on the subject often results in platitudes that fail to confront real problems faced by development projects, plans and policies. Indeed, the linkages between biodiversity and poverty are much more complex and dynamic that often assumed; this is why endeavours to address the real issues—rather than pretending they do not exist—as well as efforts to be more specific about definitions, contexts and activities when undertaking assessments, are so badly needed.

As a result, this paper first synthesises the biodiversity-poverty debate in a static perspective by investigating scientific evidence on the links between biodiversity per se, ecosystems and well-being; it further questions whether poor households particularly rely on biodiversity for their livelihoods. In dynamic terms, it thereafter explores whether biodiversity conservation is a route to poverty alleviation, and conversely if poverty alleviation is a route to better biodiversity management. We continue by presenting two emerging (or re-emerging) issues which challenge some key preconceived ideas about the poverty-biodiversity nexus: the "environmentalist paradox" and the need to re-open the Millennium consensus so as to give more weight to inequalities reduction as opposed to poverty alleviation.

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1. INTRODUCTION

The striking observation of overlapping maps of biodiversity and poverty in the world has led scientists and practitioners to increasingly link biodiversity and poverty issues. Indeed, Fisher and Christopher (2006) illustrated the magnitude of the overlap between biological priority sites and poverty in an attempt to indicate key sites where win-win outcomes might be achieved[1]. They found that the overlap between severe multifaceted poverty and key areas of global biodiversity is great and needs to be acknowledged. Countries like Burundi, Nigeria, Sierra Leone, Somalia and Zambia rank highest for the various poverty measures for nations in which hotspots occur. On the same note, Sunderlin *et al.* (2007) found that there is an important overlap between extreme poverty and key areas of global biodiversity.

Against this backdrop, policy makers included this link between poverty and biodiversity in several international frameworks:

- First, in 2002 the CBD adopted a target "to achieve by 2010 a significant reduction of the current rate of biodiversity loss at the global, regional and national level as a contribution to poverty alleviation and to the benefit of all life on earth" (CBD, 2002).
- Second, the Millennium Development Goals (MDGs) simultaneously call for poverty reduction and environmental conservation efforts. Goal 1 target 1A aims to "halve, between 1990 and 2015, the proportion of people whose income is less than one dollar a day" while target 7B, to "reduce biodiversity loss, achieving, by 2010, a significant reduction in the rate of loss" was specifically included since 2006 in Goal 7 (ensure environmental sustainability) with additional biodiversity indicators[2] (United Nations, 2006).
- Third, biodiversity was defined in article 2 of the Convention on Biological Diversity 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". On the other hand, recognizing the complex and multi-faceted nature of such a concept, the Millennium Ecosystem Assessment (MA, 2005) defined poverty as the "pronounced deprivation of well-being" with the latter composed of elements of security, basic material for good life, health, good social relations and finally the freedom of choice and action.

In addition, a growing volume of literature has so far attempted to analyse the relationship and proposed differing opinions, often subjective, and solutions on how—and whether—to link biodiversity conservation with poverty reduction. Nonetheless, attempts to find common ground have often resulted in platitudes that fail to confront real problems faced by development projects, plans and policies (Brockington *et al.*, 2006). This is why endeavours to address the issues—rather than pretending they do not exist—as well as efforts to be more specific about definitions, contexts and activities when undertaking assessments, are now so badly needed. This is thus the main aim of this article.

Empirically, biodiversity and poverty have recently experienced interesting trends. On the one hand, the Millennium Ecosystem Assessment (2005) shows that degradation of biodiversity is still very significant: over half of the 14 biomes that the MA assessed have experienced a 20–50% conversion to human use between 1960 and 2000. Similarly, according to WWF in its Living Planet Report (2012), the Living Planet Index, based on trends in the size of 9,014 populations of 2,688 species of birds, mammals, amphibians, reptiles and fish has globally declined 28% from 1970 to 2008, especially in tropical areas (61%), where most poor people reside3. This eventually led the UN Millennium Development Goals Report 2010 to recognize unequivocally that "the world has missed the 2010 target for biodiversity

1 They calculated the "hottest hotspots" — those most affected by poverty issues. Five poverty indicators were used: percentage of undernourished population, percentage of population without access to water, percentage of population below poverty line, debt service as a percentage of exports, and potential population pressure over the biodiversity hotspots.

2 The official list of MDG indicators is available at http://mdgs.un.org/unsd/mdg/Host.aspx?Content=Indicators/OfficialList.htm

3 In 2005, the Millennium Assessment report (MEA, 2005) stated that across a range of taxonomic groups, the population size or range (or both) of the majority of species was declining and that between 10% and 50% of well-studied higher taxonomic groups (mammals, birds, amphibians, conifers, and cycads) were threatened with extinction, based on IUCN–World Conservation Union criteria for threats of extinction.

conservation, with potentially grave consequences"4 (UN-DESA, 2010).

On the other hand, the most recent report by Chen and Ravallion (2012) displays mixed results on the poverty frontline. According to the authors, the developing world as a whole has already attained the first Millennium Development Goal (target 1A, see above). Indeed, the overall percentage of the population of the developing world living below $1.25 per day[5] in 2008 is 22%, down 30 percentage points from 52% in 1981 (a 57% drop). However, the progress has been uneven across regions and income groups. Notably, though there has been dramatic progress in Asia, particularly China, the trend has been much slower elsewhere. For example, in Sub-Saharan Africa the percentage of the population living below $1.25 per day fell only 4 percentage points, from 51% in 1981 to 47% in 2008. Furthermore, progress relative to the $2 per day[6] benchmark has been less marked: the percentage of people living below $2 a day dropped from 70% in 1981 to 43% in 2008 (a 38% drop). In absolute terms, the number of people living on between $1.25 and $2 per day has almost doubled from 648 million to 1.18 billion between 1981 and 2008. Hence, while not living in extreme poverty, a great number of people in the developing world remain socially and economically vulnerable.

In total, though some progress has been achieved in some places and for specific groups, the issue of biodiversity conservation and poverty reduction remains extremely salient; hence a thorough analysis and presentation of the poverty-biodiversity situation, both in a static and dynamic perspective, is essential. We begin by analysing (in Section 2) the static potential relationship between biodiversity, well-being and poverty; in particular we will see how poor households are significantly (or not) dependent on biodiversity. Section 3 presents the poverty reduction-biodiversity conservation nexus in dynamic terms so as to analyse potential trends and routes which policy makers could follow. In Section 4 we then examine two possible ways to understand and potentially solve the apparent biodiversity-poverty dilemma.

2. EMERGING CONSENSUS ON BIODIVERSITY AND POVERTY: STATIC EVIDENCE

2.1 BIODIVERSITY, ECOSYSTEM SERVICES AND WELL-BEING

2.1.1 FROM BIOLOGICAL DIVERSITY TO ECOSYSTEM SERVICES

The analytical links between biodiversity and well-being/poverty are often simply asserted; in the Millennium Ecosystem Assessment Conceptual Framework for instance, Biodiversity (also called 'Life on Earth') is merely said to underpin all ecosystem services. As a result, biodiversity is often confused with biomass — the latter referring to *availability and abundance*, the former to *variability*. Against this backdrop, the specific pathways through which changes in biodiversity affect people's livelihood choices and strategies need to be more carefully identified (Roe, 2010).

Biodiversity can conceptually contribute to well-being and livelihoods in two separate ways:

First, biodiversity directly contributes to people's livelihoods through ecosystem provisioning services. Balmford *et al.* (2008) showed that direct benefits to people are more about biomass than biodiversity. Indeed, people's income-earning opportunities depend more on the abundance and availability of particular species (*e.g.* timber and non-timber forest resources providing food, medicine, fuel and tradable goods) than the number of different species (Roe *et al.*, 2011). According to Roe (2010), this suggests that in the near-term "people might after all benefit from the existence of biological resources rather than biodiversity in its strict sense" (p.31)[7].

Second, and in the mid- to long-term, biodiversity *per se* (*i.e.* variability) plays a very important role for well-being. Ash and Jenkins (2007) precisely analyse the importance of biodiversity in the supply of ecosystem services, which in turn contribute to human well-being. Among others[8], they mention:

- **Food provision and food security**: First, biodiversity is essential to food provision through the facilitated access to a diverse range of locally produced agricultural and wild foodstuffs (including those that supply micronutrients and flavourings), thus maintaining a balanced and satisfying diet and enhancing adaptation and resistance (resilience) of crops as an insurance against future risks and changing conditions. Secondly, available evidence suggests that biodiversity also supports food production through soil formation and land productivity, pest and disease control in agricultural systems, and pollination. As an example of this last case, Ricketts *et al.* (2004) found that the presence of forest-based wild pollinators increased coffee yields in Costa Rica by 20% and improved its quality for farms located less than one kilometre from the forest. Elsewhere, O'Farrell *et al.* (2007) suggested that biodiversity increases land productivity in semi-arid rangelands.

- **Fresh water quality**: Evidence shows that catchments with well-preserved natural forests almost always deliver higher quality water, with less sediment and fewer pollutants, than water from other catchments. Also, shallow water wetlands with emergent vegetation can improve the quality of water passing through them by

4 The report continues: "In 2009, only half of the world's 821 terrestrial ecoregions—large areas with characteristic combinations of habitats, species, soils and landforms—had more than 10 per cent of their area protected. Under the Convention on Biological Diversity, one tenth of the areas of all these ecoregions should have been under protection by 2010"

5 $1.25 per day is the average of the national poverty lines found in the poorest 10-20 countries (Chen & Ravallion, 2012).

6 $2 per day is the median poverty line of all developing countries.

7 Interestingly, Roe *et al.* (2011) explain that in any case all these resources from biodiversity (provisioning services) do not come in a *vacuum*; in other words these depend on complex relationships and processes which in turn depend on biological diversity.

8 Other services mentioned by Ash and Jenkins (2007) are waste processing and detoxification, nutrient cycling, and cultural services.

trapping and retaining sediments and removing nitrogen, phosphorus and other nutrients.

- **Protection from natural hazards**: Biodiversity regulates floods (through soil specific texture and structure), fires (diverse native plants are more fire-adapted), hurricanes and storm surges (diverse mangroves and coral reefs are better adapted to play a buffer role according to Dudley *et al.*, in press, cited in Lopoukhine *et al.*, 2012). Box 1 illustrates how degradation of biodiversity potentially reduces protection against natural hazards.

- **Regulation of infectious diseases**: An increasing body of evidence suggests that the risk of infectious diseases depends partly on the condition of biodiversity in ecosystems. In particular, strong evidence shows that natural systems with intact structure, especially plant diversity, better resist the introduction of invasive pathogens and diseases (Cardinale *et al.*, 2012)[9].

- **Regulation of climate and air quality**: The role of biodiversity in climate regulation is most important at the regional and global scale, where ecosystems exert a strong influence on climate and air quality as sources and sinks of carbon (Lopoukhine *et al.*, 2012). Indeed, above ground carbon sequestration depends on enhanced biomass production, which in turn depends on species traits and woodiness and thus productivity-enhancing species diversity (Cardinale *et al.*, 2012).

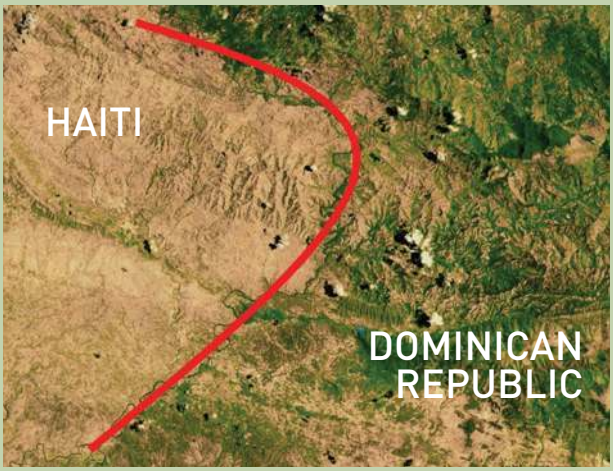
- **Medicines**: Benefits to rural dwellers (as well as to pharmaceutical companies) from harvested plants have largely derived from high diversity ecosystems (due to the variety of natural possibilities).

- **Timber, fibre and fuel**: similarly, the availability of timber, natural fibres and woodfuel is determined by species diversity; according to Cardinale *et al.* (2012), genetic diversity improves yields in commercial crops, tree species diversity fosters wood production in plantations and plant species diversity in grasslands increases the production of fodder[10]. Practically, some studies carried out in forests in the US and in the western Mediterranean suggest that stand productivity and species richness are correlated, probably due to greater leaf litter production in mixed forests, a key process in nutrient cycling.

Box 1: Environmental degradation and vulnerability: Haiti and the Dominican Republic

The relationship between environmental degradation and impacts on vulnerable populations is evidenced by the differing impact of Hurricane Jeanne in Haiti and the Dominican Republic (DR). Haiti was originally fully forested but from 1950-1990 the amount of arable land almost halved due to soil erosion. Deforestation reduced evaporation back into the atmosphere and total rainfall in many locations has declined by as much as 40 percent, reducing stream flow and irrigation capacity. By 2004 only 3.8 percent of Haiti was under forest cover compared to 28.4 percent of DR.

In Haiti, floods and Hurricane Jeanne killed approximately 5,400 people due to destruction of mangroves and the loss of soil-stabilising vegetation, causing landslides that led to most casualties. In DR, which is much greener and still has 69,600 hectares of mangroves, Jeanne claimed less than 20 lives.



Credits: NASA/Goddard Space Flight Center
Scientific Visualization Studio

Source: Peduzzi (2005), in TEEB (2009), p.36

2.1.2 FROM BIODIVERSITY AND ECOSYSTEM SERVICES TO HOUSEHOLDS' WELL-BEING

Empirical evidence tends to show the socio-economic reliance of households on biodiversity, particularly in rural areas in developing countries. Unfortunately, most of this evidence remains heavily focused on the biomass component of biodiversity (availability, abundance); bearing this in mind, we nonetheless present some of these results[11].

The World Resources Institute report (WRI, 2005) demonstrates that rural households derive a significant share of their total income from ecosystem goods and services. Such nature-based income, referred to as "environmental income", is the value derived — in cash or direct use — from ecosystem

9 Nevertheless, Cardinale et al. (2012) interestingly show that *"evidence for an effect of animal diversity on the prevalence of animal disease* [remains] *mixed"* (p.62, emphasis is ours)

10 Once again, Cardinale et al. (2012) found some mixed effects of plant species diversity on yield of the desired crop species (p.62)

11 Moreover, in the previous paragraph we gave some evidence that biodiversity, *i.e.* variability, is essential to the productivity of ecosystems, which in turn provide rural dwellers with natural resources (provisioning ecosystem services).

goods and services[12] and is comprised of two components: "wild income", generated from wild or uncultivated natural systems, such as forests, marine and inland fisheries, reefs, wetlands, and grasslands[13]; and "agricultural income" from agro-ecosystems, *i.e.* all agricultural lands, such as croplands, pastures, or orchards[14].

At the global level, the WRI estimates that 1.6 billion people depend on forest ecosystems in some way for their environmental income. Similarly, over 90 % of the 15 million people working the world's coastal waters are small-scale fishers (FAO, 2002). In West Africa, for instance, small-scale fishing constitutes three-quarters of the region's total fish catch (Kura *et al.*, 2004, p.39) while in Indonesia, small-scale fishers are responsible for almost 95% of the total marine catch (FAO, 2000, p.2).

At the village and household level, although research reports great variation in the extent of household income from biodiversity-based resources, empirical data confirm that rural households' income and livelihood strategies are highly dependent on biodiversity (Roe, 2010); hence WRI (2005, p.38) suggests that wild income generally contributes between 15% and 40% of total family income either cash or in-kind. In Zimbabwe, Cavendish (2000) shows that wild income from ecosystems (wild fruits, timber, thatching grass, fodder) contributed 35% of total household income. Focusing on cash income, Lapeyre (2010) similarly gives evidence that revenues from nature-based tourism outperform local farm labour wages for many rural households in marginal areas and support a great number of family dependents.

When one adds both wild and agricultural components, the environmental income further represents a very significant share of rural households. As an illustration, Campbell *et al.* (2002) find that goods and services from ecosystems contribute two-thirds (66%) of family income in rural Zimbabwe: 30% from agricultural income from crops and home gardens, 21% from livestock rearing and 15% from wild products from woodlands[15].

2.2 DO POOR PEOPLE RELY MORE ON BIODIVERSITY THAN OTHERS, AND WHY?

2.2.1 HOW THE POOR DEPEND ON BIODIVERSITY

Because three-quarters of the more than one billion people living on less than one dollar a day live in rural areas, the poor often depend on a wide range of natural resources and ecosystem services for their well-being, and therefore are said to be more vulnerable when biodiversity is degraded or lost (MA, 2005). Indeed, richer groups of people are allegedly less affected because of their ability to purchase substitutes or to offset local losses of ecosystem services by shifting production and harvest to other regions[16]. On the contrary, for poor people without alternative opportunities, biodiversity loss is often equivalent to the loss of biological insurance (MA, 2005). Four main hypotheses could explain why biodiversity, and its current loss, matter to poor people directly (Timmer & Juma, 2005):

- **Food security and health**: Many poor people have limited access to land ownership and water and so are especially dependent on wild plants and animals for their food security. In many forest countries, bushmeat is an important source of protein. In Ghana for example, 75% of the population eat bushmeat regularly and wild animals constitute the main source of animal protein for rural households. However, in many countries, the availability of bushmeat and wildlife is declining and this is having negative impacts on nutrition (DFID, 2002). Declining ecosystems can also have negative impacts on health, particularly on that of poor women, as they increase the burden of searching for and carrying heavy loads of water, wood or fodder.

- **Income generation and livelihoods**: Ecosystem services and agrobiodiversity are crucial to agriculture (see above in 2.1.1). Yet, the majority of rural poor people highly depend on agriculture while more formally, the agricultural labour force, most of it in the developing world, includes over 20% of the world population and accounts for almost half of its total labour force (MA, 2005); hence, most rural poor's livelihoods critically rely on biodiversity for provisioning services. In many climatically vulnerable regions, poor households prefer traditional varieties or so-called land races of rice and other crops due to their greater resilience to climate fluctuations. For example, in Jeypore, India, cyclonic conditions, long spells of drought and very high temperatures within a crop season can result in yield stress: land races of rice have proved genetically resilient and capable of withstanding the harsh weather, while so called "high yielding varieties" in nearby areas suffer irretrievably (Steele *et al.*, 2006).

- **Reduced vulnerability to shocks**: Poor people are often highly vulnerable to shocks and stresses associated with climatic events. These shocks can be amplified by ecosystem degradation, while better ecosystem management can reduce the impact of such events. There is growing evidence of the role of coastal vegetation (like mangroves) and natural protection (like coral reefs) in

12 According to the report, apart from environmental income, rural households' total income is derived from income from wage labour, remittances and other transfer payments. The environmental income can also include the mineral and energy income, from mining or extraction at a small scale of oil, gas, hydrothermal energy, or hydroelectric energy.

13 This includes commodities such as fish, timber, and non-timber forest products such as fuel wood, game, medicinal plants, fruits and other foods, and materials for handicrafts or art. It also includes income from nature-based tourism, as well as payments that rural landowners might receive for environmental services such as carbon storage or preservation of watershed functions.

14 For rural dwellers in the developing world, agricultural income is mostly generated through small scale agriculture, including commodity crops, home gardens, and large and small livestock.

15 The remaining 34% came from wage labour, income from home industries, and remittances.

16 For example, as fish stocks have been depleted in the North Atlantic, European and other commercial capture fisheries have shifted their fishing to West African seas, but this has adversely affected coastal West Africans who rely on fish as a cheap source of protein.

mitigating coastal storms and cyclones. Where these ecosystems are declining, poor coastal populations often become more vulnerable. In Bangladesh, the disappearing of swamp forests, which have served as a natural barrier in the past against the monsoon waves, has led to much more severe erosion. As a result, poor households have been compelled to increase spending to protect their tiny homesteads every year (Steele *et al.*, 2006).

- **Cultural and spiritual values**: For many poor people, biodiversity is inextricably linked with identity, culture and spirituality. It is therefore an integral part of their very existence. In India for example, there are over 50,000 sacred groves that play an important role in the religious and socio-cultural lives of local people (Gohkale *et al.*, 2001). Located within wilderness areas, protection is provided to patches of forests dedicated to deities and ancestral spirits. A number of religious celebrations take place in these groves, which are an integral part of the spiritual beliefs of the communities.

2.2.2 COMPARING BIODIVERSITY DEPENDENCE OF THE RICH AND POOR

While the accepted wisdom suggests that poor rural households disproportionally rely on biodiversity and ecosystem services, more recent evidence tends to mitigate such a hypothesis.

On the one hand, WRI (2005) states that "environmental dependency and poverty seem to go hand in hand" (p.44). Empirically, Cavendish (2000) found that the dependence of households on environmental income decreased as their average income rose. In Botswana's Chobe region, Kerapeletswe and Lovett (2001) also show that the poorest 20% of households surveyed depend on wild products from nearby common property lands for more than half their total income, while the rich derived less than 20% of their income from the nearby commons and depended mostly on employment income and remittances. Similarly, in Asia, a 1999 study of twelve Himalayan villages found that the poor relied on natural resources for 23% of their income, compared to only 4% for the rich (Reddy & Chakravarty, 1999, p.1145).

On the other hand, case studies have proven that richer families make extensive use of income from ecosystem goods and services because they have larger assets (livestock, access to hired labour and credit, social networks and access to markets) and thus a greater capacity to exploit ecosystems and maximize harvest of natural products. Hence in absolute terms, Cavendish (2000) shows that richer households generate higher environmental income than poorer ones. Similar studies in India suggest that wealthier families are using more fodder resources (to feed their larger herds) and construction wood (Adhikari *et al.*, 2004; Narain *et al.*, 2005; 2008).

In total, it seems that asset-poor households do rely significantly on low-value resources, with limited commercial value, whose access is still not denied (mostly common-pool resources under open-access or common property regimes), whereas asset-richer and more powerful groups of households are able to capture revenues from commercially profitable resources. Furthermore, the poor and the rich also tend to use natural resources differently to derive income. Kerapeletswe and Lovett (2001) calculate that 75% of the rich households' environmental income comes from livestock rearing, while the poor diversify their efforts, spending time in at least five different activities, from collecting wild foods to making baskets and carvings from natural materials. In this context, poor households, with very few possibilities to substitute, have a higher dependence on biodiversity as a risk management strategy or insurance mechanism so as to decrease their vulnerability. This eventually led researchers to attempt to better account biodiversity and ecosystem services in the calculation of the poor's wealth.

2.2.3 THE ECONOMICS OF ECOSYSTEMS AND BIODIVERSITY (TEEB) AS A WAY TO BETTER ACCOUNT FOR BIODIVERSITY IN THE POOR'S WEALTH?

While adjusting national income (GDP) for ecosystem services (flows) and natural capital (stock) is necessary[17] in order to better account for the value of biodiversity and ecosystem services to wealth (and the associated impact on wealth of the loss of it), these tools are still insufficient if one is to analyse the particular relationship between biodiversity and poverty.

In this context, the international G8-initiated Economics of Ecosystems and Biodiversity (TEEB) programme attempted to remedy such accounting gaps by proposing to measure the sectoral "GDP of the poor" and adjust it for biodiversity and ecosystem services' unrecorded values. *In fine* this allows to reflect the dependence of the poor on biodiversity and integrate environmental, economic and social aspects to reflect the vulnerability of poor people if valuable ecosystem services are lost.

The "GDP of the poor" constitutes the proportion of GDP that can be attributed to the rural and forest-dependent poor directly from main natural resource-dependent sectors (agriculture, forestry and fisheries). It is thereafter adjusted to add the value of ecosystem services and the value of natural products not recorded in GDP statistics (non-market prices goods used for subsistence). Table 1 displays measurements of GDP of the poor in the case of three countries: India, Brazil and Indonesia.

In Indonesia for instance, the main natural resource-dependent sectors contribute 11.4% to GDP. When the value of ecosystem services provided by forests and the value of non-marketed products are accounted for, this increases the adjusted contribution of biodiversity to GDP to 14.5%. For the rural poor in particular, while the unadjusted GDP per capita from resource-dependent sectors amounts to 37 US$, ecosys-

17 The World Bank has published total wealth estimates, a stock concept, which seek to account for the contribution of natural capital (Dixon *et al.*, 1997) while the Genuine Savings Indicator aims to adjust GDP to account for natural capital depletion (Pearce & Atkinson, 1993).

Table 1

GDP OF THE POOR AND SHARE OF GDP			
Natural-Resource dependent sectors and ecosystem services (ESS) (2005)	Brazil	Indonesia	India
Original Share of GDP (%) – agriculture, forestry, fisheries	6.1%	11.4%	16.5%
Adjusted share of GDP (%) + non market + ESS	17.4%	14.5%	19.6%
Original per capita unadjusted 'GDP of the poor' (US$/capita)	51	37	139
Adjusted 'GDP of the poor' (US$/capita)	453	147	260
Additional 'GDP of the poor' from ESS and non market goods (US$/capita)	402	110	121
Share of ESS and non market goods of total income of the poor (%)	89.9%	74.6%	46.6%

Source: TEEB (2009)

tem services and non-market products increase this GDP to 147US$.

Those findings clearly suggest that compared with the "average" environmentally adjusted GDP, the lower-income, rural and resource-dependent households are highly dependent on ecosystems and thus are much more vulnerable to any loss in biodiversity. Of course, this calls for further effort in building accounting measures so as to better assess the importance of biodiversity in the rural poor's livelihoods and design efficient policies.

3. A COMPLEX DYNAMIC RELATIONSHIP: THE BIODIVERSITY CONSERVATION–POVERTY ALLEVIATION NEXUS

> In many ways linking conservation with poverty reduction is more of an art than a science. Fisher et al. (2005)

3.1 AN UNRESOLVED DEBATE AT THE GENERAL LEVEL

Theoretical as well as empirical evidence presented above shows that biodiversity has an impact on the welfare and livelihoods of households, especially those of the poor. However, the links between biodiversity conservation and poverty alleviation are much more complex and dynamic (Billé, 2006a), and the intense debate on this nexus demonstrates that there are no simple causal relationships (see Box 2). Widespread concepts such as "pro-poor conservation", often utilized in an incantatory manner, tend to overlook such complexity (Billé & Chabason, 2007). Nevertheless, conservationists, development practitioners and policy makers often have differing opinions on how—and whether—to link biodiversity conservation with poverty reduction. The growing volume of literature on the subject highlights how complex and context-specific poverty-conservation linkages are, and how subjective is their interpretation (Roe & Elliott, 2005).

In this context, as mentioned earlier, attempts to find common ground often result in platitudes that fail to confront real problems faced by development projects, plans and policies (Brockington *et al.*, 2006). This is why endeavours to address the issues—rather than pretending they do not exist—as well as efforts to be more specific about definitions, contexts and activities when undertaking assessments, are so badly needed. Theoretically as well as empirically, the biodiversity-poverty relationship clearly has to be addressed in dynamic terms. Tekelenburg *et al.* (2009), for instance, have identified four types of dynamic relationships between biodiversity and poverty: win-lose, lose-lose, win-win, win more-lose less[18]. Here we shall only briefly discuss two questions that we think are particularly critical (Billé & Pirard, 2007):

- Is biodiversity conservation a route to poverty alleviation?
- Is poverty alleviation a route to better biodiversity management?[19]

Some have argued that biodiversity conservation is incompatible with lifting poor people out of poverty; others that the most effective intervention for biodiversity conservation is poverty reduction. Such questions are quite sensitive and may have concrete consequences for the way development policies and projects are designed. Below, we shall introduce the debate and underline simplifications that should be avoided, but not necessarily answer these questions, which remain partly open.

18 'Win-lose' stands for poverty reduction-decreasing biodiversity, 'lose-lose' stands for poverty increase-decreasing biodiversity, etc..

19 In the next two sections 3.2 and 3.3, we will focus on the 'win-win' trajectories as in Tekelenburg et al. (2009); section 4.1 will discuss the 'win-lose' path where poverty is reduced but ecosystem services decline.

Box 2: What do we know about conservation–poverty linkages? Accepted and contested relationships.

Hypothesis 1: There is a geographical overlap between biodiversity and poverty.

Conclusion: At the global level there is a geographical overlap between biodiversity and poor people but it becomes less pronounced the more 'the South' is disaggregated. At the national and sub-national levels the two occasionally coincide, but governance factors are generally more significant than geography in determining where biodiversity prevails, where poor people live and how the two interact.

Hypothesis 2: Poor people depend on biodiversity.

Conclusion: All of humanity is dependent on biodiversity for the goods and services it provides, but the poor appear to be particularly dependent (although this is hard to quantify). In a large part this dependency is related to the role that biodiversity plays in poor people's farming systems and the degree of resilience and adaptability to environmental change that poor people have developed.

Hypothesis 3: Poor people are responsible for biodiversity loss.

Conclusion: Poverty may contribute to biodiversity loss, but it is only one of a number of factors. Whether poor people conserve or over exploit biodiversity is dependent on specific circumstances and contexts—and particularly on the influence of external governance factors—and is not a question to which a generalized answer can be given.

Hypothesis 4: Conservation activities hurt poor people.

Conclusion: The impacts of conservation activities are not evenly spread: some forms of conservation activity may have negative consequences for poor people; others may benefit poor people or even be initiated by poor people. Governance factors appear to be critical once again.

Hypothesis 5: Poor people can undermine conservation.

Conclusion: Unless different priorities for biodiversity and incentives for conservation are recognised, local people are often bound to be perceived as 'undermining' conservation, and indeed may proceed to do so. Local people need to be engaged to conserve aspects of biodiversity that are critically important to their livelihoods, if broader-based, long-term public support for protection of globally threatened biodiversity is also to be achieved.

Hypothesis 6: Biodiversity is irrelevant to poverty reduction.

Conclusion: A lack of quantitative data—particularly at national levels—makes it difficult to challenge the assumption that biodiversity is irrelevant for poverty reduction. In general, poverty reduction policies tend to rely on agriculture—both at the household level through supporting smallholder farmers for their subsistence and income-earning potentials, and at the national level through agriculture's potential to drive economic growth. Making a better case for biodiversity in poverty reduction therefore means clearer articulation of the links between biodiversity and agriculture and between biodiversity and ecosystem services (those that support agriculture and those that generate other benefits)[20].

Hypothesis 7: Poverty reduction activities can cause biodiversity loss.

Conclusion: Historical patterns of rural development—based on primary commodity production—have not performed well for biodiversity, nor in many cases have they performed well for poor people either. Innovative approaches to poverty reduction that are founded on local knowledge, institutions and processes are critical, both to achieving the Millennium Development Goals (MDGs) and to tackling biodiversity loss.

Source: Roe & Elliott (2005).

3.2 IS BIODIVERSITY CONSERVATION A ROUTE TO POVERTY ALLEVIATION?

Conserving biodiversity is not always favourable to the poor. Many examples have been documented worldwide where conservation activities have negatively affected poor people living nearby (Brockington, 2003; McLean & Straede, 2003). This seems to be especially true of the establishment and management of protected areas, and of related donor-funded projects. Nevertheless, the risk of further marginalizing and impoverishing poor people is clearly not specific to conservation (beside the fact that conservation takes various forms with various impacts). It is part of the vicious circles deeply embedded in most societies that tend to make poor people poorer and rich people richer. The development of any economic activity—including conservation but also forest exploitation, handicraft, trade, tourism, infrastructure, etc.—has a tendency to reinforce these circles ("poverty traps") unless appropriate attention is paid to the issue. To take this one step further, in a given country, with funding from a given donor, conservation activities are usually just as democratic, participatory and pro-poor as the rest of a government and donor's policy (Billé, 2006b). When the political context does not take into account the needs and desires of marginalized groups of stakeholders, especially the poorest, when their access to natural resources, their right to participate in the decisions that directly affect their lives, are denied, projects and policies whose primary objective is biodiversity conservation cannot be

20 For instance, Pretty et al. (2006) demonstrate in 56 developing countries how productivity of crops was increased by almost 70% due to investments in ecosystem services and biodiversity.

expected to be transparent and equitable. Good governance at the national and local levels is obviously necessary for biodiversity conservation to bring expected benefits.

However, that biodiversity conservation can contribute to poverty alleviation is supported by a broad consensus—many even argue that the potential of biodiversity conservation to contribute to poverty reduction is still largely unrecognised by developing countries' governments and international development agencies (DFID, 2002; Koziell & McNeill, 2002).

Much depends on the *how*: how conservation projects are designed and carried out, how poor and marginalized people are consulted, involved in and associated with the conservation objectives and activities, how poverty alleviation is prioritised in biodiversity projects and policies, *etc.*. That said, there are many examples, among others possible, of biodiversity conservation benefiting poor people in developing countries:

i. Command-and-control conservation mechanisms (publicly-managed protected areas) help alleviate poverty inside and outside protected areas. In Cambodia's Ream National Park, effective protection is estimated to generate benefits to local villagers (most of whom are poor) worth 20% more than revenues from current destructive use (De Lopez, 2003). Similarly, McClanahan and Mangi (2000) show that eight years after the creation of the Mombasa Marine National Park in Kenya, fish harvests in the vicinity are three times higher than those further away.

ii. Market-based instruments, *e.g.* payments for environmental services (PES), are shown to improve poor families' livelihoods (Pagiola *et al.*, 2005; van Noordwijk and Leimona, 2010).

iii. As shown by Bandyopadhyay *et al.* (2009) at the national level and Lapeyre (2011) at the local level, community-based natural resource management programmes in Namibia benefit mostly low-education and/or asset-poor households.

Much also depends on the alternative without conservation: does conservation take place instead of local development by local people (*e.g.* agriculture), or does it take place instead of biodiversity degradation as a consequence of activities undertaken by (and for the benefit of) companies unsustainably extracting natural resources (*e.g.* forest conversion for export-oriented oil palm production)?

All in all, Roe (2010) mentions that "at least six conservation mechanisms have been a route out of poverty for some people in some places: community timber enterprises, nature-based tourism, fish spillover, protected area jobs, agroforestry and agro-biodiversity conservation" (p.46).

3.3 IS POVERTY ALLEVIATION A ROUTE TO BETTER BIODIVERSITY MANAGEMENT?

This hypothesis is supported by the well-known Environmental Kuznets Curve (EKC), which suggests that environmental quality declines as income rises until income reaches a certain level, at which point environmental quality improves (Grossman & Krueger, 1995)[21]. McPherson and Nieswiadomy (2005, p.403) suggest for example that an EKC applied to biodiversity, also called a green Kuznets curve, exists for mammals and birds: the percentage of threatened species rises as yearly income per capita increases from US$12,000 to US$14,000, thereafter declining.

However, this curve is strongly disputed, be it by pessimists or optimists (Dasgupta *et al.*, 2006), and even for its advocates the extent to which it applies to biodiversity is questionable: once a species is lost, it is gone forever.

It seems that a majority of analysts believes that poverty alleviation will not in itself achieve conservation goals. For example, experience from Africa and Asia shows that as wealth increases, so does the demand for wildlife (Robinson & Bennett, 2002); and of even greater impact is the availability of capital for more destructive and large-scale activities. More pertinent questions may therefore be: can reducing poverty actually *contribute* to halting biodiversity loss? If so, how?

Swanson, among others, highlights the apparent incompatibility between biodiversity and development: "states with high material wealth have low biodiversity wealth and *vice versa*" (in Koziell & Saunders, 2001, p.18). In the same perspective, under four different scenarios[22] developed by the Millennium Ecosystem Assessment to explore plausible futures for ecosystems, the findings were that:

> "...future development paths that show relatively good progress toward meeting the poverty, hunger reduction, and health targets also show relatively high rates of habitat loss and associated loss of species over 50 years. This does not imply that biodiversity loss is, in and of itself, good for poverty reduction. Instead, it indicates that many economic development activities aimed at income generation are likely to have negative impacts on biodiversity unless the values of biodiversity and related ecosystem services are factored in". (MA, 2005, p.15)

Consequently, while poverty can be a root cause of biodiversity loss, this is just as true of wealth and economic development. For instance Indonesian hunters-gatherers and slash-and-burn farmers never deeply degraded the local biodiversity, contrary to what migrants did through wood harvesting and land clearance for agriculture. In material terms, though, they are equally poor. Indeed, "deforestation, for example, is partly caused by local demand for agricultural land or con-

21 Tekelenburg *et al.* (2009) defines the EKC as showing a turning point from a win-lose trajectory to a win-win trajectory.
22 For a description of the scenarios, see MA (2005), p.3.

struction materials, but is even more fundamentally driven by the industrialized world's demand for timber and the growing international trade in forest products" (UN Millennium Project, 2005, p.29), as well as by demand for biofuels. Do poor people degrade their environment because they are poor? Do increasing incomes affect the way in which poor people exploit natural resources? IIED's Poverty and Conservation Learning Group came to the conclusion that:

> "(...) poverty is only one factor driving biodiversity loss. Reducing poverty will not necessarily, therefore, lead to biodiversity conservation unless the other drivers are also addressed. ... Issues of governance, security of land tenure and access to resources are likely to have a significantly greater impact on the way in which people over-exploit now or conserve for the future." (Roe & Elliott, 2005, p.11).

Poverty alleviation may thus yield better biodiversity conservation only if tied to explicit conservation objectives, strategies, policies and actions, in an appropriate governance context (WRI, 2005).

4. TWO INCONVENIENT TRUTHS? (RE)EMERGING ISSUES ON DEVELOPMENT AND BIODIVERSITY

4.1 THE "ENVIRONMENTALIST PARADOX"

The MEA (2005) closed on the diagnosis that the degradation of biodiversity over the last decades had led to significant improvements in human well-being and a decrease in poverty[23]. Consistent with this, MNP (2008, in Tekelenburg *et al.*, 2009, p.20) suggests that a country's biodiversity (calculated as an MSA indicator: Mean Species Abundance[24]) is inversely related to its Human Development Index (HDI), while WWF (2012) uncovers a clear relationship between increasing HDI[25] and an increasing Ecological Footprint[26].

These research findings can be qualified as a paradox if one considers the environmentalist's expectation that degrading biodiversity has adverse consequences in terms of well-being, as abundantly evidenced in specific cases (*c.f.* previous sections). This is indeed a prominent argument in favour of biodiversity conservation for the sake of the continued provision of ecosystem services over time.

23 Tekelenburg *et al*. (2009) describes this trajectory as 'win-lose'.

24 Note that this MSA indicator is an indicator of biodiversity intactness, and as such is quite different from biomass as defined by the simple availability and abundance of one species. It is defined as « the mean abundance of original species relative to their abundance in undisturbed ecosystems. An area with an MSA of 100% means a biodiversity that is similar to the natural situation. An MSA of 0% means a completely destructed ecosystem, with no original species remaining »; See http://www.globio.info/what-is-globio/how-it-works/impact-on-biodiversity, accessed on the 10th September 2012.

25 The United Nations Development Programme's (UNDP) Human Development Index (HDI) combines per capita income, life expectancy and educational attainment to compare countries' economic and social development.

26 According to WWF (2012, p.36) the "Ecological Footprint tracks humanity's demands on the biosphere by comparing humanity's consumption against the Earth's regenerative capacity, or biocapacity. It does this by calculating the area required to produce the resources people consume, the area occupied by infrastructure, and the area of forest required for sequestering CO2 not absorbed by the ocean".

Several hypotheses have been proposed by Raudsepp-Hearne *et al.* (2010) to explain this apparent paradox:

i. contrasted importance of the various categories of ecosystem services, with food production outweighing the others;

ii. inadequate capture of human well-being by existing indicators ;

iii. the existence of a time lag between degradations of ecosystems and their impacts on human well-being; and

iv. decoupling between human well-being and ecosystem services due to technological substitution.

Despite their efforts to test these four hypotheses—which provide substantial food for thought—the authors do not draw clear conclusions as to which one(s) is/are determinant.

We find it useful here to make a link between the first three of these hypotheses and the issue of poverty alleviation. In hypothesis (i) above, Raudsepp-Hearne *et al.* (2010) point to the possibility that increased overall food production is a key factor explaining the environmentalist paradox. But one may wonder if this increase in food production has benefited equally all categories of the population. It is no mystery that from political, social and cultural points of view, rural populations have often been dominated by urban populations, both in developed and developing countries. Undernourishment is likely to have diminished more in urban areas than in rural areas, and it is important in this respect to remember that among the 840 million undernourished people (Griffon, 2006), about two-thirds live in rural areas and derive a living from agriculture. For reasons of socio-political domination by urban elites and the correlation between national prices for agricultural products and international markets, poor rural populations not only sell their products at low prices but also get only a small share of the added value. In this context, one could argue that, as a factor explaining the environmentalist paradox, increased food production does not necessarily support the interest of the poor, at least in rural areas.

Regarding hypothesis (ii), that human well-being is poorly captured in the MEA, and according to the previous section highlighting the specific effects of the degradation of ecosystem services on poor people, it can also be argued that this is especially true of those living near preserved ecosystems. Beside productive functions as defined by the MEA (and to which food production belongs), cultural functions play an important role in terms of human well-being. Who would assert that living next to an oil palm plantation is equivalent, *ceteris paribus*, to living near a natural forest where biodiversity plays a key role in terms of games, culture and other social practices (Sheil *et al.,* 2005)? Examples from around the world, including again from sacred groves in India, are many and telling[27].

27 Of course, we showed above that the adjusted 'GDP of the poor' tries to calculate the value of those ecosystem services (ES) and include these in the real income earned by the poor; however TEEB (2009) fully recognizes that more needs to be done to include all valuable ES in that indicator.

Arguably, hypothesis (iii) deserves scrutiny. Would it be a hasty answer to an extremely complex question? In a more dynamic approach, it could be argued that if the degradation of ecosystem services generates development, it allows for the substitution of natural capital by man-made capital. Then the poor who suffer from the erosion of biodiversity are those who remain poor as ecosystem services degrade, whereas those who manage to embark on the development process are not considered "poor" anymore; in that sense the actual benefits that the poor retrieve from biodiversity loss tend to remain invisible. Such a view would tend to support the idea that conservation is not directly linked to poverty alleviation, although it may at least avoid more extreme poverty as a safety net.

4.2 POVERTY OR INEQUALITIES? RE-OPENING THE MILLENNIUM CONSENSUS.

While fighting poverty is undoubtedly a noble cause, setting it as a global sustainable development priority is a choice that may need to be debated, at least when it comes to biodiversity conservation. Indeed, there are conceptual and practical reasons why a hasty consensus on the actual global objective may conflict with the biodiversity agenda. Even if accepting as a postulate that the poor should be provided with the right to choose their future and with the opportunity to escape poverty, some important issues should not be overlooked:

- First, despite numerous and valuable attempts at complexifying the concept of poverty so as to account for its many dimensions, in practice poverty is still widely measured in terms of the money a person lives on. Just as GDP remains the main gauge of development, key institutions around the world, at all levels, still assess poverty against this extremely simplistic, if not misleading indicator.

- Therefore, the conceptual frameworks on which policies are grounded, developed and implemented largely fail to account for the complexity and variety of situations. For example, to what extent is someone living with 10 US$ a day in a suburb of a polluted, crowded megacity, working 12 hours a day in a stressful industrial environment and commuting for four hours every day, better off than someone who lives on less than a dollar a day in a remote tropical forest? The answer is not straightforward.

- Challenges are actually such that there is still a worrying—as far as biodiversity is concerned—lack of evidence that poverty alleviation may be decoupled from growth in the consumption of material goods. Hence there is little doubt that current development trends in the South are leading to a somewhat desperate endeavour to catch up with the level of material consumption of the group immediately higher on the social scale.

On the other hand, evidence is mounting for the adverse effects of inequalities in various dimensions of human well-being. For instance, Wilkinson and Pickett (2009) argue that inequality has pernicious effects on society: trust erosion, increasing anxiety and illness, and excessive consumption. They demonstrate that the situation is significantly worse in more unequal rich countries as far as 11 health and social issues are concerned[28]. Interestingly, some recent publications also demonstrate the negative impact of inequalities (more than poverty) on biodiversity (Mikkelson *et al.*, 2007; Holland *et al.*, 2009; see summary in Box 3 for the latter). Inequalities are likely to be a fundamental missing piece of the biodiversity-poverty puzzle, finally putting coherence in fragmented observations that, for instance, poverty is a cause of biodiversity erosion while clearly wealth is an even greater one. If the poor are to develop and if the natural resources that ecosystems provide are limited, a drastic reduction in the gap between the rich and poor may be a first and foremost requirement.

On the whole, the belief that poverty—not inequality—is the core problem with regard to biodiversity and sustainable development in general, and that the answer lies in increasing the GDP, may turn out to be an example of the blindness that comes with dogma. The poverty/inequality debate is obviously a very political one because it is hardly presented as a win-win scenario in contrast with "poverty alleviation": some believe that reducing inequalities is not a legitimate objective; others do wish to reduce inequalities, and believe GDP growth is the best way to achieve it; others believe there is no direct relationship between GDP and inequalities—which does not necessarily mean that GDP growth should be avoided, but that it is not sufficient. It is worth noting that there is little robust literature that articulates the relationships between poverty, inequalities, GDP and biodiversity.

The Millennium consensus at the end of the 1990s set the international agenda on poverty for clear political reasons, although they remained implicit and the choice was usually presented as "neutral". It has seldom been challenged by governments, NGOs or scientists, despite some isolated attempts to couple the poverty alleviation agenda with the inequalities issue[29]. It should therefore become a priority to gather more evidence on the role that inequalities play with regard to sustainable development, for example through biodiversity erosion. The 2015 Millennium Development Goals horizon, as it is quickly approaching, may be the perfect opportunity to bring new arguments to a debate that needs to be revived, as politically incorrect as it may be.

28 These are: physical health, mental health, drug abuse, education, imprisonment, obesity, social mobility, trust and community life, violence, teenage pregnancies, and child well-being.

29 See MAEE (2011): "Fighting poverty and reducing inequalities" appears as one of the four strategic goals of the French development policy.

Box 3: A Cross-National Analysis of How Economic Inequality Predicts Biodiversity Loss.

We used socioeconomic models that included economic inequality to predict biodiversity loss, measured as the proportion of threatened plant and vertebrate species, across 50 countries. Our main goal was to evaluate whether economic inequality, measured as the Gini index of income distribution, improved the explanatory power of our statistical models. We compared four models that included the following: only population density, economic footprint (*i.e.*, the size of the economy relative to the country area), economic footprint and income inequality (Gini index), and an index of environmental governance. We also tested the environmental Kuznets curve hypothesis, and found that it was not supported by the data. Statistical comparisons of the models revealed that the model including both economic footprint and inequality was the best predictor of threatened species. It significantly outperformed population density alone and the environmental governance model according to the Akaike information criterion. Inequality was a significant predictor of biodiversity loss and significantly improved the fit of our models. These results confirm that socioeconomic inequality is an important factor to consider when predicting rates of anthropogenic biodiversity loss.

Source: Holland et al. *(2009)*

5. CONCLUSION: AN INTRICATE PROBLEM WITH NO "SILVER BULLET".

A broad range of theoretical as well as empirical evidence tends to show that biodiversity, defined as variability among living organisms, highly contributes to ecosystem services and in turn to human well-being, *i.e.* security, basic material for good life, health, good social relations and finally the freedom of choice and action. It was also suggested that poor households particularly depend on biodiversity, though mostly through provisioning services (direct use of natural resources and products) provided by the availability and abundance of biomass, rather than its variability. Yet these natural resources do not exist in a vacuum; indeed, their survival depends on the continued presence of the ecological complexes they inhabit, and these in turn depend on a diverse, resilient resource base (Roe, 2010). Hence, biodiversity is essential for human well-being, and policy-makers need to better understand the links between these concepts.

But in this context, the biodiversity-poverty relationship clearly has to be addressed in dynamic terms. Poverty alleviation and conservation trajectories are dynamic and context-specific, reflecting geographical, social and political issues among the groups involved (Kepe *et al.*, 2004) more than their actual poverty level. These linkages are then so complex that they rarely allow simple cause-and-effect analyses. Synergies and positive externalities between sustainably managing biodiversity and alleviating poverty do exist. They are sometimes obvious; but more often, win-win solutions to poverty and conservation dilemmas are elusive, and trade-offs tend to be the more realistic outcome (Petersen & Huntley, 2005): trade-offs between biodiversity and economic development on the one hand, and between those who benefit and those who bear the costs on the other hand. Unfortunately, there is no "silver bullet" (Robinson & Bennett, 2002) for the twin goals of conserving biodiversity and preventing the people whose lives now depend on biodiversity from being driven further against the wall.

Moreover, the highly speculative character of the convergence between conservation and poverty alleviation is reinforced by the various, contrasted meanings of "poverty" (Billé & Pirard, 2007). For example, depending if material wealth or flexibility is favoured, the conversion of a primary forest into a monospecies industrial plantation may be seen as a driver of enrichment (with increased cash incomes in the short or even long term) or on the contrary of impoverishment (reduced choices in the long run, vulnerability to commodity markets fluctuations, *etc.*).

Several authors have attempted to explain the apparent incompatibility between development and reaching the MDG of eradicating poverty on the one side, and the conservation of biodiversity on the other. This calls for re-examining the priority given to the poverty MDG: fighting against inequalities may be a more efficient way to reconcile human development and biodiversity conservation. But this will be far from easy: while the pro-poor agenda remains relatively uncontested in the political arena, reducing inequalities will mean decreasing income and consumption from richer countries and richer households within countries so as to lessen their footprint on biodiversity and redistribute the associated ecological excess to economically and ecologically vulnerable populations. Resistance is to be expected.

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