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Adapting the Congo Basin forests management to climate change: Linkages among biodiversity, forest loss, and human well-being

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ABSTRACT

Tropical forests are at the center of any global debate on climate change and sustainable forest management because of their twin roles in climate change adaptation and mitigation and for resilient development. However, in the countries of the Congo Basin forests receive very little attention in national planning and policies. Climate change is not currently considered in decisions and long-term forest management plans in these countries. This paper demonstrates that: (1) Congo Basin forests are needed for adaptation because they can help to decrease human vulnerability to climate change; and (2) Congo Basin forest management practices need to be adapted to accommodate climate change because these forests are vulnerable to climate change. A framework for facilitating adaptation in forestry is discussed and a review of adaptive actions presented. The paper recommends the adoption of sustainable forest management approach that includes a climate change focus. Such management should not only avoid any adverse effects on the forest resources and conservation of biodiversity, but also provides opportunities for greater, more sustainable rural development and poverty alleviation through income generation and employment opportunities.

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1. Introduction

There is almost a global scientific evidence that climate change is a reality and constitutes one of the major challenges facing humankind this century with substantial, increasing and in many cases irreversible effects on economic activities, populations and ecosystems (IPCC, 2007). On tropical forest ecosystems, climate change effects are predicted to substantially affect the provision of forest ecosystem goods and services. Such effects could amplify the existing pressure on food security urging expansion of current agricultural lands at the expense of forest, biodiversity loss and socioeconomic stresses (Phillips et al., 2007; Locatelli et al., 2008). For instance, according to FAO (2003), 0.1 ha of forest cover is needed per person in low-income countries to supply essential goods. In addition, tropical forests are intrinsically linked to carbon, water, and nutrient cycles. For example, 40% of terrestrial vegetation carbon stocks are contained within tropical forests, making this land cover an important source of carbon sequestering (Malhi & Grace, 2000). Thus, changes in the composition and number of plant species within tropical forests will likely lead to changes in carbon storage and processing well with subsequent effect on climate and biodiversity. Understanding current responses to climate change is therefore important for conservation efforts that seek to sustain the ecological and biological values of the global tropical forest.

1.1. Forests as a source of livelihood and human well-being

Worldwide, the future of millions of the poorest people is inextricably linked to forests (Arnold and Ruiz-Pérez, 1996, 1998;Byron and Arnold, 1999; Sunderlin et al., 2005). As a conservative estimate, 350 million people are estimated to "depend almost entirely for their subsistence and survival needs on forests" and that over 1.6 billion living in extreme poverty continue to depend to varying degrees on forests for their livelihoods including food (e.g. World Bank, 2004; WRI, 2005). In tropical forest ecosystems, about 410 million people (including 60 million indigenous people) live in, or at the fringes of, the forest ecosystems and depend on forest resources for their subsistence (Wiersum et al., 2005). The main contribution of forests to rural livelihoods is through providing subsistence products and services, and a de facto "safety net" (Smith and Scherr, 2003; World Bank, 2004; Nkem et al., 2010). In the tropics, forest foods are extensively used by especially poor people to help meet dietary shortfalls during particular seasons of the year, and during emergency periods such as floods, famines, droughts and wars (Scherr et al., 2004). In developing countries, forest and farm tree resources are the principal assets of the poor, and the most proximate opportunity for food security and poverty alleviation (Nkem et al., 2012). In many cases, the extraction, processing, and

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trading of non-timber forest products (NTFPs) are often the only employment available for the population in remote forest areas. Thus, life would be almost impossible for most of these people in developing countries without the availability of forests. As such, forests play crucial roles in reducing the vulnerability of both natural and social systems and therefore provide the opportunities for formulating adaptation and mitigation strategies. However, forests and forestry are undergoing profound changes that are transforming opportunities for low-income forest users in developing countries. Pressures such as forest fragmentation, reduction in habitat and the resulting adverse effects on wildlife species are already proving difficult to manage. Inappropriate land use practices have led to increased deforestation and forest degradation, soil erosion, flooding of low lying areas, destruction of watersheds, and loss of biodiversity. It is very likely that even more modest losses in biodiversity would cause consequential changes in ecosystem goods and services (IPCC, 2007). Climate change constitutes an added stress to these problems with the potentials of undermining many years of development efforts.

1.2. Linkages among climate change, tropical forests, and adaptation in Africa

In Africa, especially in Sub-Saharan Africa, climate change is a poverty concern, since the poor are the most vulnerable to climate impacts, particularly forest-based communities (Tol et al., 2004). The nature of the exposure of African communities to climate change and their limited adaptive capacity determines the severity of climate impacts where poverty, food security and human adaptive capacity to climate change are intricately linked with developmental challenges (Nkem et al., 2007a, 2012). However, over the last decade, discussions on environmental and developmental concerns have been steadily converging following their complementary roles, as evidenced by the growing global interest in tropical forests as an important ecosystem for effectively adapting to and mitigating climate variability and change. Simultaneously there is interest in preserving their developmental roles and support for livelihoods of people in tropical countries. Unfortunately, future variability and changes in the climatic system will not spare forest ecosystems, but will likely have huge consequences for both the ecological and social aspects of forests (Locatelli et al., 2008; Fearnside, 2004). However, forestry activities play crucial roles in reducing the vulnerability of both natural and social systems and therefore provide the opportunities for formulating adaptation strategies. However, forests receive very little attention in national planning and policies in developing countries especially in the countries of Central Africa. The value of forests to local livelihoods and food security is not fully captured and the potential contribution of forests for climate change adaptation is also not well understood as illustrated in the first national communication reports to UNFCCC by countries in the region.

Given the reliance of the poor on environmental services for their livelihoods, a central element of the adaptation approach should be ecosystem management and restoration activities. Such an approach to adaptation has the advantage of meeting immediate development needs while contributing to longer-term capacity development with subsequent impact on reducing future vulnerabilities.

2. Why the Congo basin forest matter

2.1. Extent of forest cover and resources

The Congo Basin forests of Central Africa constitute the second largest contiguous area of lowland tropical moist broadleaf forests in the world after the amazon. Falling within approximately 7° south and north of the equator, these forests cover a massive expanse of over 180 million ha distributed unevenly among six Central Africa countries (Fig. 1): Cameroon (11.8%), the Central African Republic (3.4%), the Republic of Congo (12.4%), Equatorial Guinea (1.3%), and Gabon (17.7%), with over 54% in the Democratic Republic of Congo (Mayaux et al., 2004; CBFP, 2005). Information about the countries of Central Africa is summarized in Table 1.

The Congo Basin forests constitute about 20% of the world's remaining tropical moist forest (UNESCO, 1978; Justice et al., 2001), and also 70% of the total plants cover in the African continent (CBFP, 2005, 2006). These forests support the world's largest populations of tropical forest vertebrates including lowland gorillas, chimpanzees, bonobos (pygmy chimpanzees), and forest elephants. Although records are very incomplete, the biodiversity inventory so far includes some 400 mammal species, 1000 bird species (of which 36% are endemic), 700 species of fish, and over 10,000 plant species (of which 3000 are endemic) (CBFP, 2006). Large blocks of intact natural forest still remain in DR Congo, Gabon and the Congo (Bryant et al., 1997). As well as endangered wildlife, central African forests also harbor vast reserves of minerals which still remain to be exploited. Furthermore, there is a huge potential for the generation of hydroelectric power.

2.2. Socio-economic and environmental importance

The Congo Basin forests are a major source of wealth to the populations of Central Africa especially indigenous groups who have lived there for millennia. Approximately 30 million people, representing more than 150 indigenous groups, live in the Congo Basin with complete reliance on forest resources for livelihood, which further increases their vulnerability to climate change impacts. Hundreds of millions of USD are generated per annum from the forest as revenue for national governments, mainly in the form of logging fees (WWF, 2007).

The Congo Basin forests actively contribute to the world's environmental stability. They perform multiple roles, such as preventing soil degradation and erosion, protecting watersheds or stabilizing mountainous areas. They generate between 75 and 95% of the region's rainfall (water) through local evaporation and evapotranspiration (Hoare, 2007). In addition, the Congo Basin forests act as sink of CO_2 (the main greenhouse gas). They contain between 25 and 30 billion tons of carbon in their vegetation alone. This amount is equivalent to about 4 years of current global anthropogenic emissions of CO_2 (WWF, 2007). However, estimates of carbon emissions from deforestation for Central Africa range from 20 to 60 million tons per year with the potential for dramatic increases. Protecting an additional 1% of forests in Central Africa would preserve 230 million tons of carbon and which in today's carbon market is worth more than USD 500 million (WWF, 2007).

2.3. Key threats to the Congo Basin forests

The Congo Basin Forests have been in the spotlight for several decades as one of the world's most threatened ecosystems (Nkem, 2008). In spite of its strategic importance in global climate change and biodiversity richness, the forests have been grappling with both historical and contemporary issues like commercial logging, clearing for subsistence agriculture, poaching for bush meat, including civil strife and refugees in some of the countries in the region, including an upsurge in resources for reconstruction after civil wars like in the Democratic Republic of Congo. The threats to the forests of the Congo Basin are also closely tied to critical economic development opportunities in the region. With a sound understanding of threats and the drivers behind them, a sustainable future for the forests of the Congo Basin can become clearer. This should entail more attention to potential ecological impacts, development of mitigation strategies, and compensation schemes.

2.3.1. Deforestation

In the Congo Basin, causes of deforestation[2] are multiple, varied and complex, ranging from the expansion of agriculture (both commercial

[2] Deforestation in this research is referred to as the depletion of tree crown cover to less than 10% (see Mayaux et al., 2005).

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