CENTRAL AFRICAN REGIONAL PROGRAM FOR THE ENVIRONMENT

CONGO BASIN Information SERIES

CARPE March 2001

Issue Brief #6

#6 — Deforestation in Central Africa Significance and Scale of the Deforestation

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Key Concepts

- Dense forests extend over 1.9 million km² of Central Africa, covering almost 50% of the landmass.
- Forests in the region are important as: (1) a source of food, materials and shelter for over 20 million people, (2) habitat for a diverse assemblage of globally unique plants and animals, and (3) a sink and source of carbon dioxide, the most important gas implicated in global warming.
- Tropical deforestation threatens biodiversity and forest conservation efforts.

- In a global context annual deforestation rates are relatively low in Central Africa (~0.6%/year between 1980-90) but vary considerably across the region. The location and rates of deforestation in Central Africa are poorly documented, limiting the development of regional and national forest management plans and policies.
- Annual rates of reforestation are very low and do not compensate for forest losses.
- Generation of information on deforestation at different scales within the region has to be driven by a political process that raises public sector and civil society demand for environmental information.
- Accurate estimates of land cover type, location and rates of change and associated biomass are necessary to develop land-use and forest management policies that reflect local, national and international interests and concerns. Political will and public participation is needed to reform present land-use policies and to implement them successfully.

Why Is the African Rainforest Important?

The Congo Basin contains the second largest continuous tropical rainforest in the world. The forest is home to more than 20 million people most of whom depend on natural resources for their livelihoods. The forest also harbors about 400 mammal species, more than 1,000 different species of birds, and over 10,000 plant species of which about 3,000 are endemic to the region.

The acceleration of human transformation of the biosphere is unprecedented in scale, and is dramatically altering important characteristics of the atmosphere, the oceans, and terrestrial ecosystems. With more than 90% of households in Central Africa involved in agriculture, and human population growing at 2-3% per year, demand for agricultural land is increasing, as is the scale of forest transformation. Forest habitat loss is a major threat to biodiversity, and can result in species extinctions. Moreover, extensive conversion of the forest to non-forest land cover would result in changes in soil fertility and rainfall patterns that would certainly affect human livelihood and ecosystem productivity.

West African rainforests are already highly fragmented. The only large forest blocks remaining are in the border zone between Liberia and Ivory Coast. In Ghana, small remnant rainforest patches are restricted to protected areas. Is this likely to be the fate of the Central Africa rainforest?

Accurate information on forest extent and the location and rates of deforestation, combined with socioeconomic information and an understanding of the processes of land cover change, are crucial to develop an understanding of the future of Central African forests. Establishing national and regional systems for tracking rates and distribution of forest transformation is important as a tool for land-use planning, and will be a requirement for implementation of the Kyoto Protocol

of the United Nations Framework Convention on Global Climate Change if ratified. Currently, little technical and institutional capacity is available in the region to develop such estimates due to the lack of funding for training and infrastructure.

Estimating Rates of Forest Loss

Remote sensing images, such as those generated by the Landsat, SPOT, AVHRR satellite systems, provide spatially explicit information gathered at different time periods. These images can be used to directly estimate the location, extent and rate of forest change, but require some form of ground level information on forest cover characteristics to validate the results.

Since the 1980's, the scientific and popular literature has published numerous, often divergent, estimates of tropical deforestation for Central Africa. This is not surprising because deforestation rates reflect the definitions used to characterize what is and is not forest, the data sets used to derive the estimates, and the methods used to summarize the data. For example, the NASA Landsat Pathfinder approach to forest change estimation uses wall-to-wall mapping over a 16 year time period, whereas FAO uses both a direct sampling approach and an indirect modeling strategy of population growth and national forest inventory data over a 10 year period.

CARPE and the UMD/NASA Landsat Deforestation Project

As part of the University of Maryland, NASA-funded Landsat Pathfinder Dense Humid Forest Project, Landsat satellite images are used to assess the rates and extent of deforestation in Central Africa. The major limitation of the wall-to-wall mapping approach has been the scarcity of Landsat imagery for the region, because of persistent clouds and irregular archiving of Landsat data sets. Only 19 pairs of Landsat Thematic Mapper images are available for the 1980s-90s period, and most of them (16 pairs) are located in the Democratic Republic of Congo. This scarcity of data has begun to be alleviated by the comprehensive data acquisition strategy of the new Landsat 7 program (http://carpe.umd.edu/landsat/).

How Are Deforestation Rates Computed?

A series of 16 pairs of Landsat images obtained at two different epochs (1980s and 1990s) within the Democratic Republic of Congo were used to estimate forest extent and rate of deforestation. Each Landsat image was classified into the following three land-cover categories: forest, degraded forest (including forest fallow), and non-forest (including cities, agriculture, bare soils and savannas). By overlaying and comparing the paired images, all transitions over time from one cover category to another (i.e., forest to degraded forest) were mapped.

The extent of rainforest area mapped in each 180 km by 180 km Landsat image varied from 462 km² (1% of the total image area) to 26,000 km² (80% of total area). The smaller and more fragmented forest patches were located in the Forest-Savanna transition zone in Eastern/Oriental Province, South Kivu, and Kasai.

The annual rates of deforestation and forest loss (km²/year) were computed for each Landsat scene as follows:

$$\text{Annual Rate} = \frac{Et_2 - Et_1}{Et_1} \times 100 / \#\text{ years}$$

$$\text{Forest Loss (km 2/y)} = \frac{Et_2 - Et_1}{\#\text{ years}}$$

Where:

Et^1 = Extent forest at time 1

Et^2 = Extent forest at time 2

years = Difference epoch (time 2 - time 1)

What Have We Learned?

Forest change is a dynamic process that reflects how people respond to changes in socioeconomic conditions and opportunities. Consequently, forest loss and reforestation varies across the region and from one time period to the next. Annual rates of deforestation for the period 1984-98 varied from 0.1-0.7% with forest loss within a Landsat image ranging from 9 to 116 km² per year. Annual rates of reforestation are even lower and do not compensate for forest losses.

The largest annual forest loss estimated in this sample of 16 Landsat images was located in one of the most densely forested areas (the Equateur Province of DRC) where the population density is relatively low (6-21 inhabitants per km² in 1990) but population is predominantly rural (95%) and the annual population growth rate was about 3.4% for the 1980-94 period. Though most of the area is assigned to timber concessions only one is presently active, thus logging is an unlikely cause of the observed forest loss.

Predominately forested scenes exhibited less variance in rates of deforestation than those scenes dominated by savannas or at the interface between forest and savanna. This may be associated with greater variability in human population density and access to forest resources in the latter.

Average annual rates of deforestation estimated for DRC (0.4% over the period 1984-98) are lower than those published by FAO (0.6% over the period 1981-90). Though comparison of

these estimates is difficult because the methods and data sets used are different, DRC appears subject to relatively low rates of deforestation (0.4% on average) relative to the rest of tropical Africa (Ivory coast 1%, Ghana 1.3%, Sierra Leone 0.6%, Liberia 0.5%) (Fig.1). However, it has been suggested that deforestation rates in West Africa have been overestimated in the past.

The highest rates of deforestation are not necessarily associated with the highest population densities. In Equateur Province, for example north of Lisala, the rates and extent of deforestation are almost two times higher than those found north of Bumba, even though population density is two times lower in the Lisala. This may indicate errors within the population dataset or suggest that deforestation is fueled primarily by other factors, such as economic activity.

The highest rates of deforestation were located at the forest-savanna interfaces where forest occupies a small area and savannas dominate the landscape. Though the absolute area of deforestation is small and the contribution of these areas to global warming limited, forest clearing is resulting in the rapid disappearance of riparian forests that constitute the last bastions of forest-dependent plant and animal species.

Patterns of deforestation (size, shape and distribution) are also variable. For example, household-level agriculture is typically restricted to within a short distance of roads, and the average size of the disturbed area is small. In contrast, industrial-level or plantation agriculture results in larger clearings, but less forest fragmentation, at a much more variable distance from main roads.

What Next?

Remote sensing image analysis can provide the basis for producing more accurate and more frequent estimates of where and how much deforestation is taking place. However, to understand what policy levers might be appropriate to redirect or reduce forest clearing, decision makers also need a better understanding of the factors driving deforestation at different locations across Central Africa. Furthermore, urbanization and urban growth play important roles in determining the fate of the forest, and warrant greater attention.

Appeals to systematically gather demographic, land-use and household economics data across the region that would help determine the causes of deforestation are unlikely to convince Central African governments with numerous other priorities to invest scarce financial and technical resources. Moreover, donors have had little success in improving forest management through capital intensive supply-side environmental information projects. Consequently, increasing the supply of systematic and timely information on deforestation at its causes at different scales within the region has to be driven by a political process that raises public sector and civil society demand for environmental information.

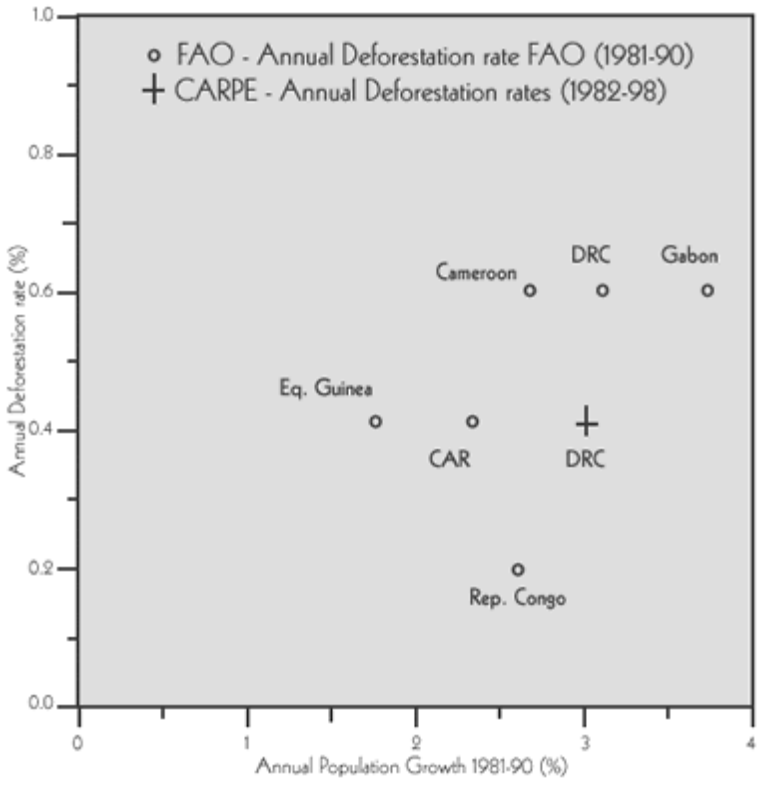

Figure 1: FAO, 1994 rates of deforestation and CARPE estimates for RDC.

For More Information

Technical Reports

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CARPE...What Is It?

Central African Regional Program for the Environment (CARPE)

Launched in 1995, the *Central African Regional Program for the Environment (CARPE)* engages African NGOs, research and educational organizations, private-sector consultants, and government agencies in evaluating threats to forest integrity in the Congo Basin and in identifying opportunities to sustainably manage the region's vast forests for the benefit of Africans and the world. CARPE's members are helping to provide African decision makers with the information they will need to make well-informed choices about forest use in the future. BSP has assumed the role of "air traffic controller" for CARPE's African partners. Participating countries include Burundi, Cameroon, Central African Republic, Democratic Republic of Congo, Equatorial Guinea, Gabon, Republic of Congo, Rwanda, and São Tomé e Principe.

Web site:
http://carpe.umd.edu

The Biodiversity Support Program (BSP) is a consortium of World Wildlife Fund, The Nature Conservancy, and World Resources Institute, funded by the United States Agency for International Development (USAID). This publication was made possible through support provided to BSP by the Africa Bureau of USAID, under the terms of Cooperative Agreement Number AOT-A-00-99-00228-00. The opinions expressed herein are those of the authors and do not necessarily reflect the views of USAID.

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