

## **Effects of Fragmentation on Forest Functioning and Integrity in the Amazon and How It Relates to the CDM**

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### **Abstract**

The loss and fragmentation of natural habitats is the greatest single threat to Earth's biodiversity. The Brazilian National Institute for Amazonian Research - INPA - together with the Smithsonian Institution of the United States operate the largest and longest-running study of habitat fragmentation in the world, the Biological Dynamics of Forest Fragments Project (BDFFP) located near Manaus, Brazil. The BDFFP was initiated in 1980 to study the ecological impacts of rainforest fragmentation on various plant and animal groups as well as on ecosystem processes such as carbon storage, nutrient cycling, and plant-animal interactions.

The project's study area spans about 1,000 square kilometers and includes forest fragments ranging from 1-10,000 hectares in area. The fragments are surrounded by cattle pastures or regrowth forest. The BDFFP is providing critical insights into the responses of Amazonian biotas to habitat fragmentation. Recently fragmented forests are strongly influenced by edge effects, which are diverse ecological changes associated with the abrupt, artificial boundaries of fragments. Hot, dry winds and sunlight penetrate into fragments from nearby pastures, altering forest microclimate. Because of increased wind turbulence and drought stress, rates of tree mortality increase drastically near edges, leading to a sharp increase in treefall gaps which in turn alter forest structure and composition. Large trees are particularly vulnerable to fragmentation. Fragmented forests exhibit a marked decline of biomass, increased necromass, and accelerated carbon cycling, and are probably an important source of atmospheric carbon emissions.

Although edge effects are pervasive, the size of the fragment affects their magnitude, and large fragments are more likely to maintain a core area of intact forest, where function and structure are preserved. Forest fragments under 400 hectares in area will be drastically altered ecologically, but corridors linking fragments or the surrounding regrowth vegetation may help to reduce the impacts of fragmentation on biodiversity. Fragments surrounded by cattle pastures, for example, are more prone to edge effects than those bordered by regrowth forests or agroforestry systems, which help protect the fragment from harsh external conditions. Moreover, some rainforest frogs, mammals, and birds can use regrowth forest for movement and even as breeding habitat. Regrowth forests of the Amazon may accumulate in a few years up to 70% of the mature forest biomass, and therefore are also a significant carbon sink. Unfortunately, many fragments and regrowth forests in human-dominated landscapes are also affected negatively by logging, fire degradation, illegal mining, and overhunting. The combined effects of these multiple human impacts can trigger ecological changes and be far more devastating to biodiversity and forest integrity than forest fragmentation alone. More importantly, they may have equal magnitude of carbon emissions as deforestation and burning of mature tropical forest biomass.

Avoided deforestation and decrease or prevention from excessive fragmentation of forests at a landscape scale may have relevant impacts decreasing carbon emissions, and therefore should be considered important initiatives of land-use and land occupation from the perspective of CDM. In the case of the Amazon, several studies point to the potential that avoided deforestation has to contribute to sustainable development alternatives and social justice. Under current situation, more eligible

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enterprises, such as agroforestry systems and plantations may have comparatively smaller impact diminishing greenhouse gas emissions, and negative social impacts such as increase in property size, or conversion of natural forests to plantations to match the mechanism's requirements. Human societies interested in carbon emission reductions will have to face the ethical dilemma of overruling mature forest protection as the most sound strategy over other, less effective solutions to the declared problem of reducing the amount of carbon in Earth's atmosphere.

**Keywords**

Amazon, fragmentation, edge effects, forest, carbon emissions