

Key Findings

- In 2002, approximately 47 percent of the Brazilian Amazon was under some type of human pressure including deforested areas, urban zones, agrarian reform settlements, areas allocated for mining and mining exploration as well as areas under pressure as indicated by incidence of fire.
- Our analysis suggests that in 2002 there remained enough forest area without evidence of human pressure to fulfill the government's goal to expand the protected areas system. This includes about one million km² of land considered priority for establishing new protected areas and public production forests. However, we can assume that the pressure has continued to increase in the region, so the government must act quickly to implement their protected areas goal.

Establishing new protected areas in lands free of pressure will help prevent land use conflicts. Areas of incipient human pressure are still valuable for conservation—due to relatively low intensity of use—but the political costs of establishing protected areas in these zones will be higher given the interests already in place.

- About 80 percent of the total area deforested is located within 30 km of an official road. However, about half of the area of older fire zones (1996-1999) and two-thirds of more recent fire zones (2000-2002) are located farther than 30 km from roads. There is a need to better account for this environmental impact in the planning, building, and maintenance of transportation corridors.

EXECUTIVE SUMMARY

The Brazilian Amazon harbors about one-third of the world's tropical forests, an area covering some 4.1 million square kilometers. However, land-use conversion in the Brazilian Amazon is triggering forest loss and degradation and rapidly changing the regional landscape. FAO data reveal that Brazil accounted for approximately 42 percent of global net forest loss from 2000 to 2005; most of this deforestation occurred in the Brazilian Amazon.

In response to public demand for forest conservation many stakeholders are attempting to reconcile economic development and conservation through initiatives that include forestry regulation, enforcement of environmental legislation, and the creation of protected areas. Given the rapid expansion of activities such as cattle ranching, agriculture, and logging, these initiatives must quickly target priority areas to be successful. This demands

accurate and detailed information on the current state of Amazon forests and the pressures they face. Yet such information remains elusive. Despite advances such as satellite imaging, our understanding of the extent and degree of human activities in the Brazilian Amazon is only partial. Even deforestation (forest clear cutting) is not fully understood. Up to 1997, the Brazilian Space Agency (INPE) mapped deforested areas greater than 6.5 ha. Since then, INPE has improved mapping technique but it still misses deforested areas smaller than 3 ha.

Identifying small deforestation plots and other indicators of incipient human activities in forests could flag areas at risk of increased deforestation and forest degradation. Pinpointing these areas at risk would provide strategic guidance for conservation and sustainable development in the region. But despite this potential, no comprehensive analysis that integrates such spatial data with other standard measures of forest condition yet exists to help conservation and development planners understand the true extent of human activities in the region.

This report seeks to help fill this gap. It compiles and integrates geospatial information on various indicators to present a picture, roughly as of 2002, of the human pressure on forests in the Brazilian Amazon. *Human pressure*, for this report, is defined broadly as the presence of human activities that lead to forest loss and degradation.

The report distinguishes two major types of areas under human pressure:

Areas under pressure from human settlements. In these areas, human presence is fully established, settlements are permanent, and land use tends to be more intensive.

Environmental impacts in these areas are higher than in occupation frontiers because of greater forest fragmentation as well as urban and industrial activities. Three indicators were analyzed in this category: *deforested areas, urban zones, and agrarian reform settlements.*

Areas subjected to incipient human pressure. In these areas human presence may be temporary, but in some cases people will settle in the future and influence the forest condition (for example, fragmenting the forest ecosystem). Logging, wildcat (part-time) mining, hunting, harvesting of non-timber forest products, and shifting cultivation are some of the human activities that occur in these areas. Two indicators were analyzed in this category: *fire zones and areas allocated for mining and mining exploration.* For the purposes of this analysis, *fire zones* are defined as areas of human activity associated with the incidence of forest fires.

At the time of the analysis, no comprehensive information on *roads* and *logging* in the Brazilian Amazon region was available. Thus, the map of human pressure we produced did not factor in these two important indicators of human activity. However, understanding the crucial role of these two factors in forest impact, we did examine the relationship among human pressure, roads, and logging using available information. Finally, we also examined the relationship between human pressure and *protected areas.*

FINDINGS

In 2002, approximately 47 percent of the Brazilian Amazon was under some type of human pressure, either as areas under pressure from human settlements (19 percent) or areas subjected to incipient human pressure (28 percent).

Areas under pressure from human settlement were found primarily along official roads in the so-called “arc of deforestation,” comprising the eastern and southern edges of the forests in the states of Rondônia, Mato Grosso, and Pará. Other significant locations under human pressure were along the Trans-Amazon highway in the State of Pará, along the Amazon River between Manaus and Belém, along the Cuiabá-Santarém highway near the city of Santarém, and around the main urban centers in the states of Roraima and Amapá.

Areas showing incipient human pressure were generally clustered and adjacent to areas of human settlements, indicating frontier expansion. This was especially true in the states of Pará, Mato Grosso, and Rondônia. There were, however, isolated areas of incipient human pressure along navigable rivers throughout the region. Such areas appeared to be associated primarily with traditional *mestizo* communities and indigenous populations.

PRESSURE FROM HUMAN SETTLEMENTS

Deforested Areas. In 2001, deforested areas covered 11 percent of the Brazilian Amazon.

Cattle ranching is the predominant land use in deforested areas throughout the region (Schneider et al 2002). Between 1990 and 2003, the cattle herd in the Legal Brazilian Amazon increased from 26.6 million to 64 million head, representing a 140 percent increase (IBGE 2005).

Urban Zones. The area under pressure from urban zones covered 6 percent of the Brazilian Amazon. Urban zones were identified as the area within a 20-km radius around the region’s 450 municipal seats as of 1997 (the most updated dataset available at the time of the analysis) (IBGE 1999). The 20-km radius was based on field observations, and was intended to capture areas under pressure from urban populations, such as small-scale clearings used for periurban agriculture, spontaneous settlements, intensive extraction of forest products, waste deposits, and release of untreated sewage.

Agrarian Reform Settlements. The extent of Agrarian Reform Settlements (lands granted by the federal government to landless people) established as of 2002 (INCRA 2002) covered nearly 5 percent of the Brazilian Amazon. Of this area, about half is made up of forested areas that do not overlap with any other indicator of human pressure.

INCIPIENT HUMAN PRESSURE

Fire Zones. Approximately 28 percent of the Brazilian Amazon was subjected to incipient human pressure associated with fire activity. Fire zones are defined as the 10-km radius around a forest fire, as detected by satellite between 1996 and 2002.

Human pressure may vary within fire zones. Two-thirds of fire zones are concentrated near deforested or urban zones; forests in these areas have likely been subjected to intensive pressures such as logging. The remaining third is found in more isolated locations, indicating fires caused by shifting agriculture carried out by traditional *mestizo* communities or indigenous populations. Forests in these areas may be subjected to less intensive pressures such as hunting, harvesting of non-timber forest products, and selective logging.

There are overlaps between fire zones and other indicators of human activity:

- With areas affected by selective logging, including the location of half of the selective logging permits issued by the Brazilian Government;
- With the location of informal roads (identified from satellite imagery) in the northern portion of Mato Grosso and South-Central Pará.

Between 2000 and 2002 the number of annual forest fires nearly doubled from 22,000 per year to almost 43,000 per year, showing an acceleration of incipient human activity.

Areas Licensed for Mineral Exploration. In 1998, the total area legally allocated for mineral exploration and mineral reserves was approximately 2 percent of the Brazilian Amazon. More than half of the allocated area overlapped with other indicators of human pressure. However, should areas licensed for mineral exploration become economically viable in the future, improved access and services could spark

rapid in-migration and deforestation. Gold mining, for instance, has been an important catalyst of colonization in the Tapajós Mining Reserve in western Pará.

LOGGING

The total area of selectively logged forests in the Amazon is unknown, although estimates indicate this activity may affect 10,000-20,000 km² of forest per year in the Brazilian Amazon (Nepstad et al. 1999; Matricardi et al. 2001; Cochrane 2000; Asner et al. 2005). Some of these forests are converted to agricultural and pasture land soon after timber is harvested, while other areas remain as logged forest. Evidence suggests that most logged forests are within the areas of human pressure identified in this report. However, analysis is needed to fully and accurately map the extent of logging.

A substantial share of the timber harvested in the Brazilian Amazon—estimated at 47 percent in 2001 and 43 percent in 2004—is thought to be illegal (Lentini et al. 2005). These figures probably represent an underestimate of illegal logging, since numerous licensed loggers fail to implement forest management plans or harvest illegally in public unclaimed lands. As conventionally practiced, logging causes substantial damage to the forest, especially when associated with wildfires. Some companies have adopted best practices and have obtained green certification. Nevertheless, there are no recent independent evaluations of approved logging outside certified operations. There is a need to combine fieldwork with interpretation of satellite

imagery to systematically monitor the impacts of logging throughout the Brazilian Amazon.

ROADS

About 80 percent of the total area deforested is located within 30 km of an official road. However, about half of the area of older fire zones (1996-1999) and two-thirds of more recent fire zones (2000-2002) are located farther than 30 km from roads.

Human activity in distant areas is possible given access by rivers and a growing network of unofficial roads opened by loggers, ranchers, and miners. In southern Pará, for instance, about 17,000 km of roads were built between 1985 and 2001, 60 percent of them on unclaimed public land. Protected areas seem to slow the advance of unofficial roads; average growth rates for unofficial roads inside protected areas are three times lower than those outside protected areas (Souza et al. 2004).

HUMAN PRESSURE AND PROTECTED AREAS

Some 28 percent of protected areas have been subjected to human pressure. This is significantly smaller than the percentage of forest areas showing human pressure outside protected areas, which totals 59 percent. As proximity to roads increases (< 25 km), there is a significant increase of deforestation and fires within protected areas. Increasing transportation infrastructure without a corresponding capacity for enforcement is likely to result in greater

human pressure on protected areas. Better infrastructure may also increase demands to shrink existing protected areas to benefit the expansion of agribusiness, as the State Government in Mato Grosso approved in 2003.

Human Pressure in Non-Protected Priority Areas for Conservation

About 48 percent of the non-protected areas identified as a priority for biodiversity conservation (Capobianco et al. 2001) show evidence of human pressure. Lands under pressure from human settlements account for 18 percent and those areas subjected to incipient human pressure account for 30 percent. Most of the area under human pressure is in the eastern and the southern Brazilian Amazon, and along the largest rivers such as the Lower and Middle Amazon and the Upper Rio Negro.

Human Pressure in Potential Public Production Forests

Nearly 30 percent of the 1.5 million km² identified in 1999 (Verissimo et al. 2000) as having the potential to become public production forests show some type of human pressure. Furthermore, the majority of these areas showing human pressure overlap with the areas identified to be economically accessible for logging (Verissimo et al. 1999). Economic accessibility to logging would be beneficial to promote sustainable use of forests if appropriate concession regulation and enforcement capacity were in place. However, insufficient regulation and ineffective enforcement has spurred illegal and predatory occupation of some existing National Forests.

Risks and Opportunities for the Creation of Protected Areas

About one million km² of land considered priority for establishing new protected areas and public production forests have not yet been affected by human pressure, according to our analysis. This is enough land for the federal and state governments to achieve their stated goals, which are to expand the protected areas system to 270,000 km² of conservation-oriented lands by 2009 and 395,000 km² of public production forests by 2010.

Some areas remain valuable for conservation purposes even though they are subject to incipient human pressure. However, in some instances, the presence of settlers, loggers, and gold miners is hindering the establishment of protected areas in favor of other more popular alternatives, such as agrarian reform settlements or the establishment of titled land. In fact, the Brazilian Congress recently ratified legislation foregoing a bidding process for titling small land holdings (less than 5 km²) on public lands in the Brazilian Amazon occupied before December 2004, thwarting any possibility for these lands to be considered for the establishment of protected areas. The Ministry of Land Reform expects to grant titles for more than 20,000 km² of public lands, benefiting 150,000 families (MDA 2005). The continued and rapid expansion of human pressure requires rapid action by governments to create protected areas even before incipient human pressure occurs.

Responding to a national demand for conservation and encouraged by the lending policies of Multilateral Development Banks, some state governments have supported the creation of public production forests and reserves for sustainable development. This has occurred

despite local opposition to strictly protected areas and indigenous territories. Therefore, societal demand and rapid government action can work for the protection of priority areas for conservation.

POLICY IMPLICATIONS

As our analysis shows, mapping and monitoring deforestation alone is not sufficient to understand the full range of human pressure on forests in the Brazilian Amazon. A more comprehensive analysis of pressures from human settlements, logging, roads, fires, and other sources is required. The findings presented here have several implications for public policies:

Vast areas in the eastern and central portions of the Brazilian Amazon show evidence of human pressure, especially in the form of fires. Nonetheless, the area that does not show evidence of human pressure is large enough for the federal government to meet its goal to expand and consolidate the protected areas system by 2010. However, the opportunities are diminishing. Human pressures are expanding rapidly, as indicated by trends in deforestation, cattle ranching, human population growth, and others. This expansion requires rapid action. Recent federal legislation allowing temporary limitation of land use in areas of interest for conservation could be applied in areas identified in this report to establish new protected areas. This has already occurred in an 82,000-km² area in western Pará in which 68,000 km² of protected areas were created recently.

Roads are correlated with human pressure. In order to protect priority areas for conservation, planned investments in road infrastructure should

be accompanied by the creation of protected areas in identified priority areas for conservation. In addition, efforts must be made to shield existing protected areas within the reach of the new or improved infrastructure. In this regard, the effort by the Brazilian government to create protected areas before paving the Cuiabá-Santarém highway (BR-163) is commendable. This approach should be applied along other proposed road-paving routes.

As illustrated by the case in the State of Mato Grosso, when human pressure increases due to greater economic opportunities, the government's commitment to protection may waver. This may even lead, as it did in Mato Grosso, to the reduction of the size of protected areas. Further analysis and policy debate to foster a long-term government commitment to protected areas is needed.

The evaluation of human pressure in the Brazilian Amazon presented in this report is an initial effort that will benefit from further refinement. Data limitations prevent full and

precise analysis, and more detailed information is needed. For instance, a comprehensive map of the road network in the region does not exist. Amazon is currently addressing this limitation by digitizing from satellite imagery visible roads in the Brazilian Amazon. Likewise, an accurate and complete map of logged forests as well as other forms of forest degradation (such as burned forests) is unavailable. Existing remote sensing techniques, complemented with ground-truthing at strategic sites, will allow mapping of these features. Investment in these types of research is crucial to bring a clearer understanding of the extent and intensity of human pressures in the forests of the Brazilian Amazon.

Despite these limitations our analysis provides a more complete picture than formerly available of the dimensions of human pressures in the Brazilian Amazon and the diverse forms these pressures take. As such, it can help guide strategic actions to improve forest conservation until better information becomes available.