



life on the edge

An assessment of ecosystem health and human wellbeing on the margins of the world's tropical rainforests



A contribution to the Millennium Ecosystem Assessment by the Alternatives to Slash and Burn Consortium

the millennium ecosystem assessment

The Millennium Ecosystem Assessment (MA) is the most ambitious study ever undertaken of the relationship between human wellbeing and the world's ecosystems. In a four-year effort involving many of the world's leading social and natural scientists, information about the world's grasslands, forests, farmlands, rivers, lakes and oceans, and about the people who depend on them for their livelihoods, has been gathered and analyzed. The focus of the MA is determined by the people whose policy and management decisions affect the health of ecosystems. The assessment will help them make better decisions.

Key components of the Millennium Ecosystem Assessment include:

- ? **Driving forces of change** to place the assessment in a dynamic context
- ? **Users' needs** to ensure usefulness and legitimacy
- ? **Multiple scales** to capture the range of interactions
- ? **Provisioning services**, such as food supply
- ? **Regulating services**, such as the effect of forest cover on water supply
- ? **Supporting services**, such as our common natural heritage
- ? **Tradeoffs** to be faced among supplies of these services
- ? **Scenarios** to anticipate challenges and perceive opportunities
- ? **Responses** to shape a better future



Many of the most important and controversial changes in ecosystem



human wellbeing depends on ecosystem services

Humans depend on healthy ecosystems for nutritious food, fresh water, clean air, and a host of other needs. Underlying the provision of these ecosystem 'goods' are supporting ecosystem 'services', such as pollination and rainfall. The provision of ecosystem services, and ultimately the natural systems and resources sustaining life on this planet, may be negatively affected by a range of human activities, including cutting forests to clear land for cultivation or grazing. Some people gain from these activities. Others may lose from resulting pollution of soil, water and air; we all lose from species extinction and greenhouse gas emissions affecting global climate. Feedbacks from ecosystem health to human wellbeing occur at scales from the village to the globe. And decisions made at various levels can influence these feedbacks in positive or negative ways, setting forces in motion either for conservation and restoration or for destruction.

services occur in transition areas, such as tropical forest margins.



tropical forest margins: asb's assessment

The interface between the tropical forest ecosystem and forest-derived agroecosystems is a transition area of global significance.

ASB's assessment, "Forest and Agroecosystem Tradeoffs in the Humid Tropics," focuses on the mosaic of land uses typical of the humid tropical lowlands of Asia, Africa and South America.

Building on a decade of work

This "tropical forest margins" (TFM) assessment builds on a decade of research results, development experience, and capacity building at ASB sites and elsewhere. The emphasis has been on identifying and testing combinations of policy, institutional and technological options that can raise the productivity and income of poor rural households without increasing deforestation or undermining essential environmental services.

Research and experience have shown that it is difficult to strike a balance between the legitimate interests of pro-poor development, on the one hand, and equally valid concerns over the environmental consequences of tropical deforestation, on the other. Intensifying smallholder production systems to increase the productivity of land and labour is essential if poverty is to be eradicated. Although there may be opportunities to alleviate poverty while conserving tropical rainforests, it is naïve to expect that productivity increases necessarily slow forest conversion or protect the environment.



ASB partners conduct research at benchmark sites spanning the humid tropics.

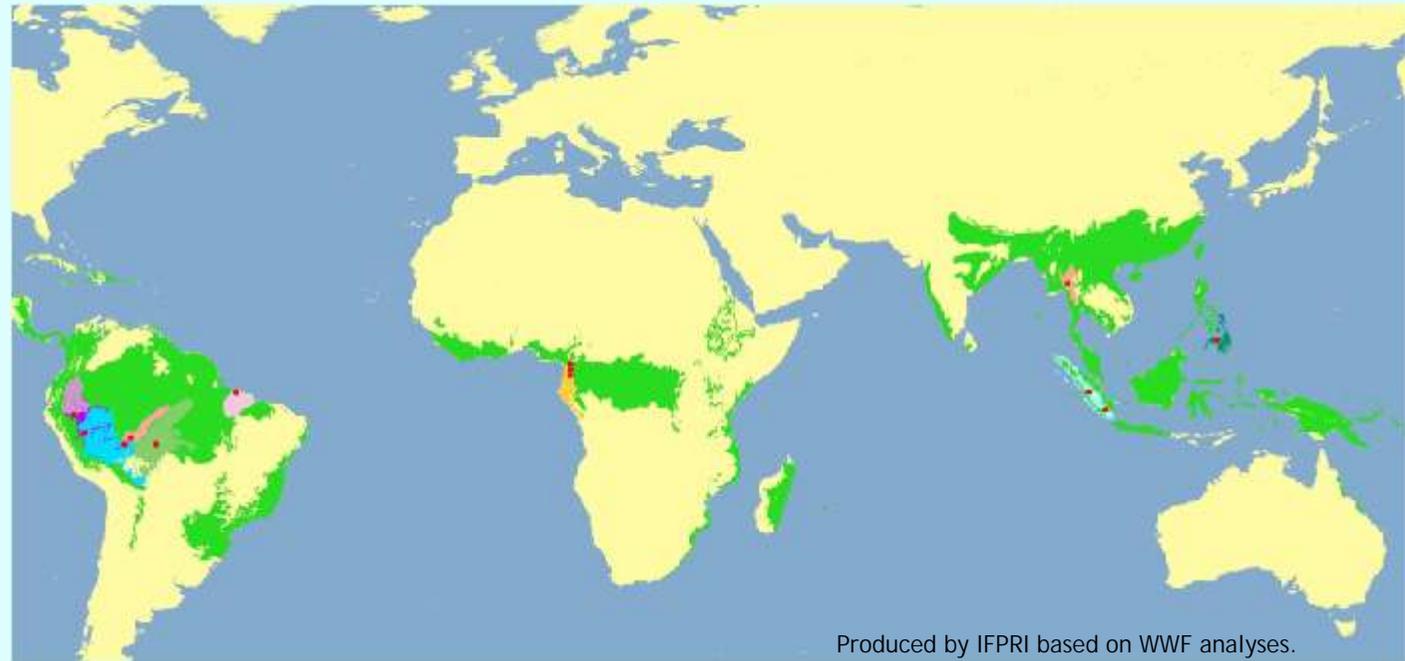


putting landscape mosaics on the map



Agroforests and other tree-based production systems are ubiquitous on farmers' plots throughout the humid tropics. Often mistakenly categorized as "forest", the ASB Consortium's assessment of the economic, social and environmental impacts of these smallholder tree systems has helped build understanding and recognition of their roles in balancing tradeoffs between local livelihoods and regional and global environmental concerns.

Land uses in the forest margins sometimes are difficult to distinguish from one another. At one end of the spectrum, natural or undisturbed forests are easy to recognize using remote sensing; so too are pastures at the other extreme. However, many intermediate forms of land use defy detection by this means, particularly when one use blends into another. Complex combinations of land use systems with portions of fields, farms and landscapes in a range of uses from natural forest, through agroforestry, to crop production or livestock grazing may be lumped together either as "agriculture" or "forest" or sometimes as "mosaics". The legends used in studies of vegetation typically do not do justice to the differences in land use intensity that occur within these mosaics. And, increasingly, the fine differences in vegetation patterns within these mosaics are seen as important in maintaining ecosystem functions. Putting mixed land use systems on the map in a literal sense is a vital first step in gaining recognition of their existence and in furthering negotiations over their roles at both the local and the national level. Scientific assessment can support these negotiations by identifying and quantifying tradeoffs in these mosaics.



Produced by IFPRI based on WWF analyses.

-  Tropical rainforest biome as delineated by WWF (World Wide Fund for Nature).
-  Benchmark sites for tropical forest margins assessment.
-  WWF ecoregions within the biome that contain benchmark sites.

natural wealth, chronic poverty

The ASB assessment focuses on a “moving target” - the dynamic border areas between undisturbed rainforests on the one hand and areas used solely for agriculture on the other. Poverty reduction and biodiversity conservation are often at odds in these frontier lands. Only by working across the full range of these land use systems can we hope to achieve an equitable balance between development and the environment.

Nature: The forests of the humid tropics are in a class by themselves because of the richness of diversity of species they contain. Their conversion leads to greater loss of species than any other change in vegetation on the earth's surface.

People: The rainforest zone of the humid tropics is home to more than 1.8 billion people. Of these, 1.2 billion live in rural areas. Most are poor and depend directly on food, timber, fodder, fuel and other resources gathered from forests or produced on land cleared from forests.



driving forces

deforestation: contexts and causes

Deforestation has no single cause but is the outcome of a complex web of factors whose mix varies greatly in time and space. Understanding the factors at work at a particular place and time is a crucial first step if policy makers are to introduce effective measures to curb deforestation while attacking rural poverty.

A common myth is that shifting cultivation for subsistence food production is the main cause of deforestation in the tropics. Subsistence-oriented shifting cultivation can be found wherever the ASB programme works, but it is not the main problem in any of these regions. Actually, ranching and other forms of agricultural expansion—practiced by smallholders and large landowners alike—tend to be much more important.

But the most significant determinant of all is how these land uses interact with and are affected by macroeconomic forces, such as a sudden economic downturn or exchange rate crisis. The building of roads, which increases access to markets, is a major driver of deforestation. And other policy and institutional factors, such as land tenure, also play a role.

There are marked regional differences in the specific causes of deforestation. In West and Central Africa, expansion of permanently-cropped land for food crops is a leading force. Profitable exports are important in the islands of Southeast Asia, while pasture creation for cattle ranching dominates in the Amazon Basin.



*Assessment grounded in local reality
ASB partners have long-standing working relationships with farming communities and policymakers.*



Amazon Basin: This region contains the world's largest remaining area of tropical rainforest. ASB works with partners at sites in the Western Amazon of Brazil and Peru and collaborates with an associated site in the Eastern Amazon of Brazil.



Congo Basin: Much deforestation in the Congo basin is the work of smallholders. ASB's benchmark site is in Cameroon.



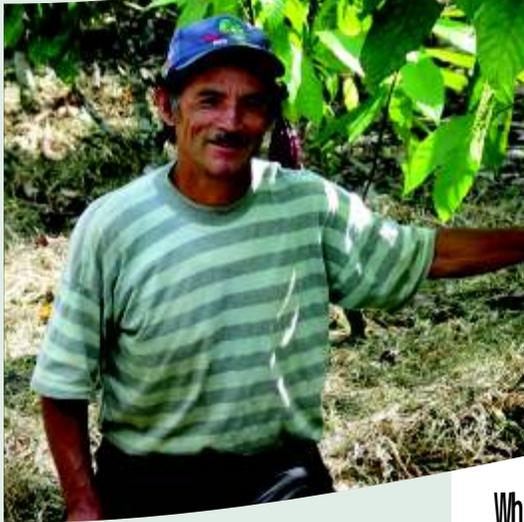
Southeast Asia: This region has the highest rate of tropical deforestation, much of it caused by large-scale operators and government-sponsored projects in addition to smallholders. ASB research is conducted in Sumatra (Indonesia), Mindanao (the Philippines) and northern Thailand.

user needs

asking the right questions

"How many people's lives depend on these forest mosaics? How many are living in the forest margins and involved in production there?" *Policymaker in Peru*

What might be the long-term effect of using chemical fertilizers on the taste of food and on the soil? What system of fertilizers can I use that will give me the best return on my money?" *Farmer in Cameroon*



What are the alternatives to burning? When does the smoke concentration become dangerous? And for whom - our children, the sick?" *Farmer in Indonesia*

How can Rp 10 trillion (approximately US\$ 1.25 billion) of national reforestation funds be spent over five years in ways that improve environmental services and livelihoods, that are politically popular at the district level and that build capacity for sustainable development at the local level?"

Policymaker in Indonesia

multiple scales

making the connections: from coffee to kofi

Only by understanding the environment and how it works, can we make the necessary decisions to protect it."

Kofi Annan, Secretary General of the United Nations, 30 March 2005.



ASB's assessment covers goods produced in the tropical forest margins that contribute to food security, human health, local livelihoods, national development, and international trade; in many cases production of these goods also affects the environment.

Goods selected for assessment include major staple foods (rice, maize, and cassava), fruit, beef and bush meat, timber and fuel wood, tropical tree products (coffee, cocoa, and rubber), rattan, and medicinal plants.

These products may be gathered from forests, produced in fields, or both. And they may be used at home, or sold in local, national or international markets.

Similarly, the regulating services of the tropical forest margins matter a great deal for the environment locally, regionally, and—in some important cases—at a global-scale. For example, burning to clear land is practiced by almost everyone in the tropical forest margins, large-scale land users as well as smallholders. Periodically, smoke from these fires causes serious air pollution on a regional scale in Southeast Asia and the Amazon Basin. This burning also releases greenhouse gases that contribute to global climate change.

Regulating services to be assessed include carbon storage and greenhouse gas emissions, water supply, and buffering of lowland flooding.

Working at multiple scales for better understanding

The ecosystem services provided by tropical forests and forest-derived land uses are influenced by activities at a range of levels from the local to the global, making it vital to carry out the assessment across different scales. Building on consultations with the assessment's users, ASB is synthesizing the evidence available on ecosystem health and human wellbeing at the different ASB sites and placing these findings in the broader context of other relevant scientific evidence.

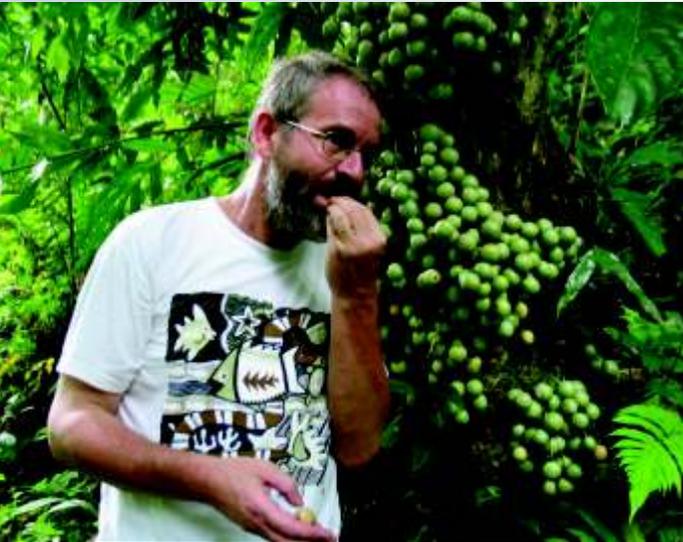
provisioning services

local needs: food and cash

Efforts to develop land use alternatives and policy options to curb deforestation are futile without careful consideration of the needs of farm families.

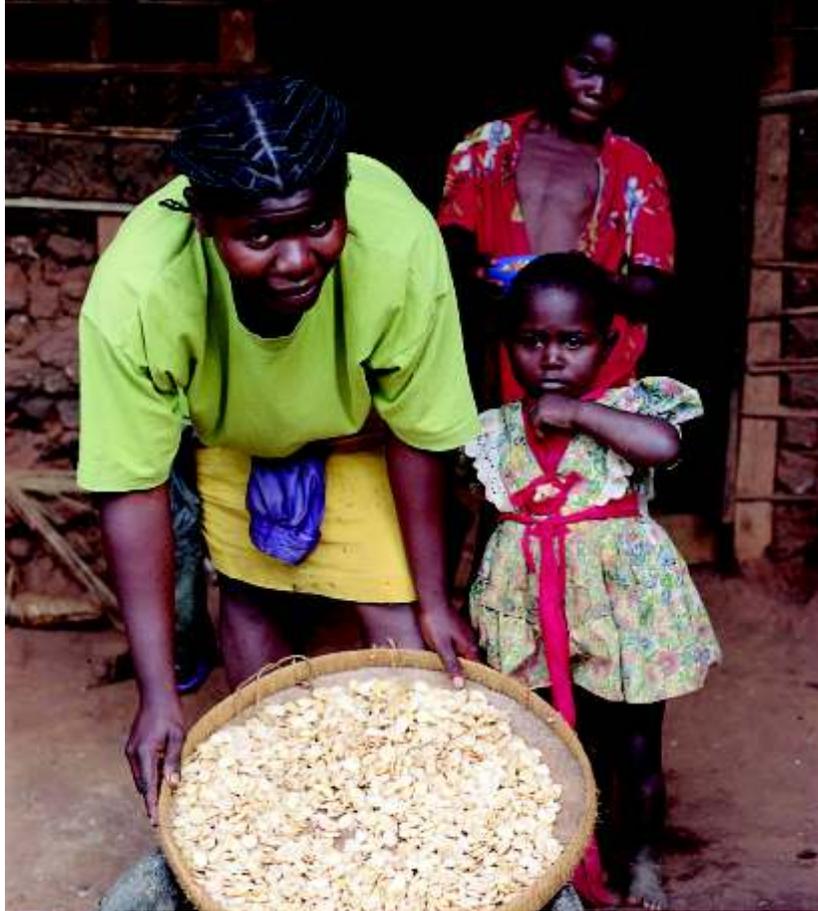
Land cleared from tropical forests and the forests themselves are sources of food, timber, fuel wood, feed for livestock and a host of other products. Although the relative importance of these goods to local livelihoods differs dramatically among ASB sites, farmers typically rank food for the family as their top priority.

Even if enough food is grown to feed the household, people still need cash to send children to school, pay for medicine, take the bus to town, or buy farm supplies. Expanding opportunities to earn extra cash is vital if households are to escape from poverty.



food comes first in cameroon

When Cameroon's sharp economic downturn and currency devaluation of the mid-1990s drove impoverished city dwellers back to the countryside to take up farming, most of the "returnees" put their efforts into growing food crops. At the same time, established farmers also grew more food crops. The resulting expansion of food crops, which was more pronounced in remote, thickly forested areas, greatly accelerated deforestation.

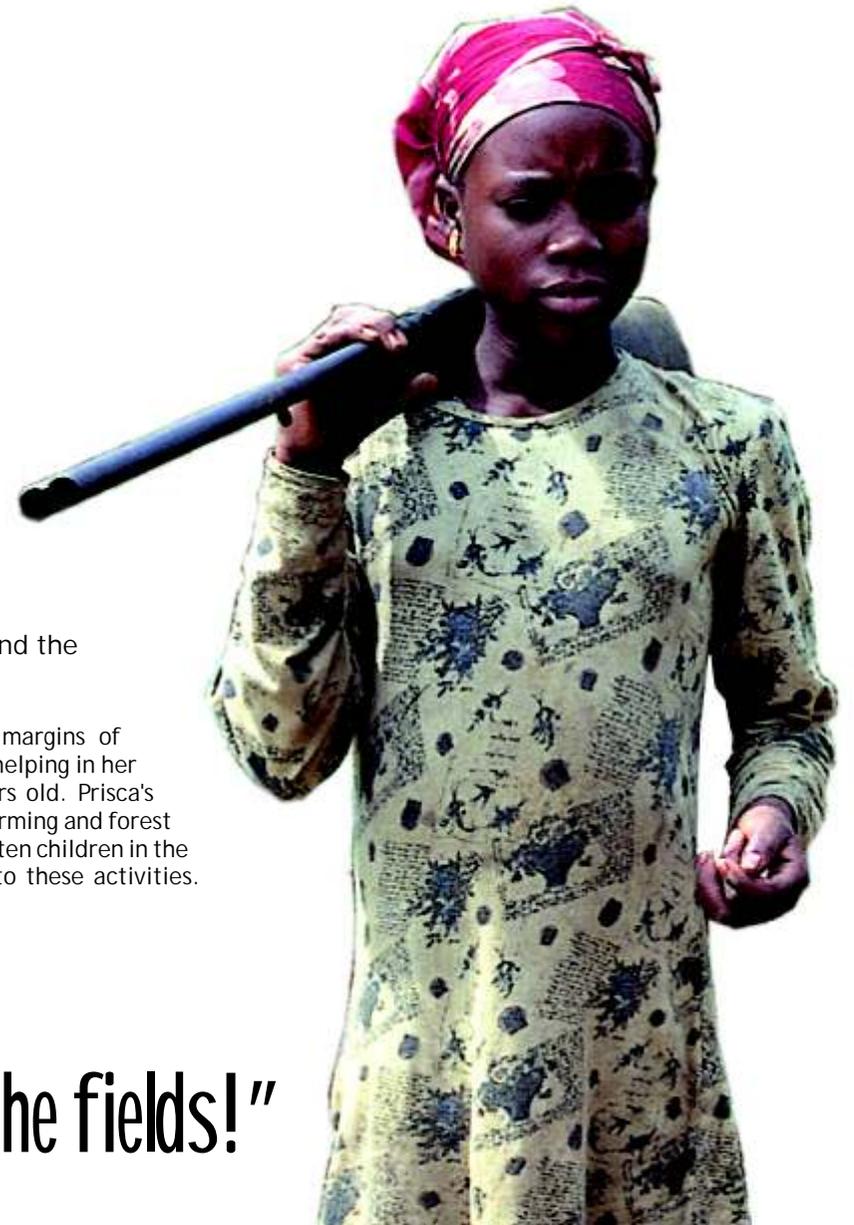


Prisca Oye: Looking to a future beyond the forests of Central Africa

Like other children living in the forest margins of Cameroon, 13-year-old Prisca Oye started helping in her parents' fields when she was about 8 years old. Prisca's family, like most in her area, depends on farming and forest gathering for its livelihood. But none of the ten children in the household plan to follow their parents into these activities. Prisca, for example, plans to be a teacher.

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"I hate hoeing in the fields!"



regulating services

regional concerns: water supply

The role of natural forest cover in sustaining a reliable water supply in the humid tropics may have been overstated. In fact, most tropical forests—the exception being cloud forests—reduce the amount of water flowing downstream because they consume more water than other types of vegetation. Agroforestry systems are capable of maintaining most, but not all, the watershed functions attributed to tropical forests. But tree planting and reforestation often can result in the further reduction, rather than the restoration, of dry-season water flows.

Similarly, the causes of downstream flooding are more complex than they seem and deforestation is not always the main culprit. Other factors, such as the distribution of rainfall across watersheds that discharge into the same river system, or the location of downstream cities in floodplains, typically are more important factors in risks of catastrophic floods than changes in forest cover far upstream.

Patterns of cause and effect differ greatly across scales. ASB partners have used a nested set of models to assess the relationships among forests, soil resources, and water flows in order to answer important policy concerns regarding land use change and water supply.





empowerment through measurement

Communities in mountainous northern Thailand are seeking to change the perception of lowlanders, who see them as destroyers of forests and water resources. Villagers are using methods that mix science and local knowledge to monitor the impact of their land use practices on watersheds. Early experiences suggest that villagers' monitoring results greatly strengthen their position in negotiations with downstream communities and with the government. Similar initiatives have produced encouraging results in Mindanao in the Philippines and Sumatra in Indonesia, where there also are tensions between upland and lowland communities.

Trees give us shade and shelter, and will provide for the next generation of our people. Water will continue to flow out of the forest, as long as the elders continue to pass on the knowledge and traditions of our culture.

Somkit Kirikumsap, village head of Phapueng, a Karen community in the hills of northern Thailand.

supporting services

global heritage: biodiversity

Agroforests as a “next-best” alternative

ASB research in Indonesia and Cameroon has found that agroforests (which combine trees and food crops planted by farmers with natural forest regeneration) often represent the next best option to natural forest for conserving biodiversity and storing carbon, while also providing attractive livelihood opportunities for poor people. Typically, agroforests can maintain almost half the carbon and perhaps more than half the biodiversity of natural forests. These indigenous systems also can be profitable for smallholders. The Krui agroforests of southwestern Sumatra, which produce a valuable resin for export, are a good example. Such systems represent a middle way: a development path that balances biodiversity conservation and poverty reduction.

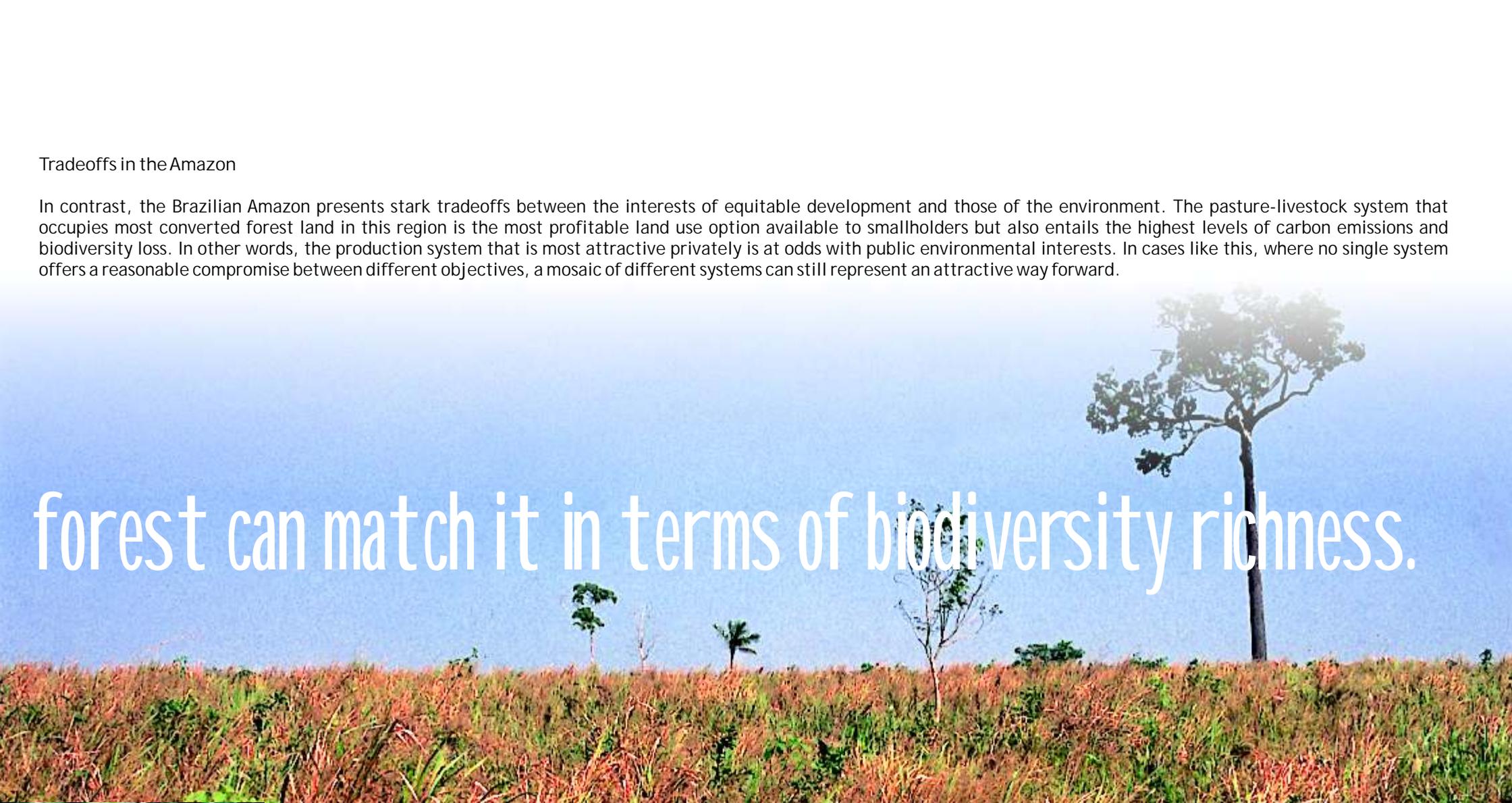
None of the land use systems that replace natural

Agroforests are complex, multistrata systems that harbor high levels of biodiversity.



Tradeoffs in the Amazon

In contrast, the Brazilian Amazon presents stark tradeoffs between the interests of equitable development and those of the environment. The pasture-livestock system that occupies most converted forest land in this region is the most profitable land use option available to smallholders but also entails the highest levels of carbon emissions and biodiversity loss. In other words, the production system that is most attractive privately is at odds with public environmental interests. In cases like this, where no single system offers a reasonable compromise between different objectives, a mosaic of different systems can still represent an attractive way forward.



forest can match it in terms of biodiversity richness.



"I want to look into ways to use the forest remaining on my farm instead of clearing it. Someday, maybe I'll even be able to reforest some of my pastures."

Virgulino da Costa Nascimento, a Brazilian farmer and cattle rancher who is well aware that his forest may contain unique and potentially valuable biodiversity. But if Virgulino and his neighbors are to make a living from managing forests instead of converting them to pasture, they need support from science to identify profitable alternatives and policy changes that will improve incentives and market opportunities.

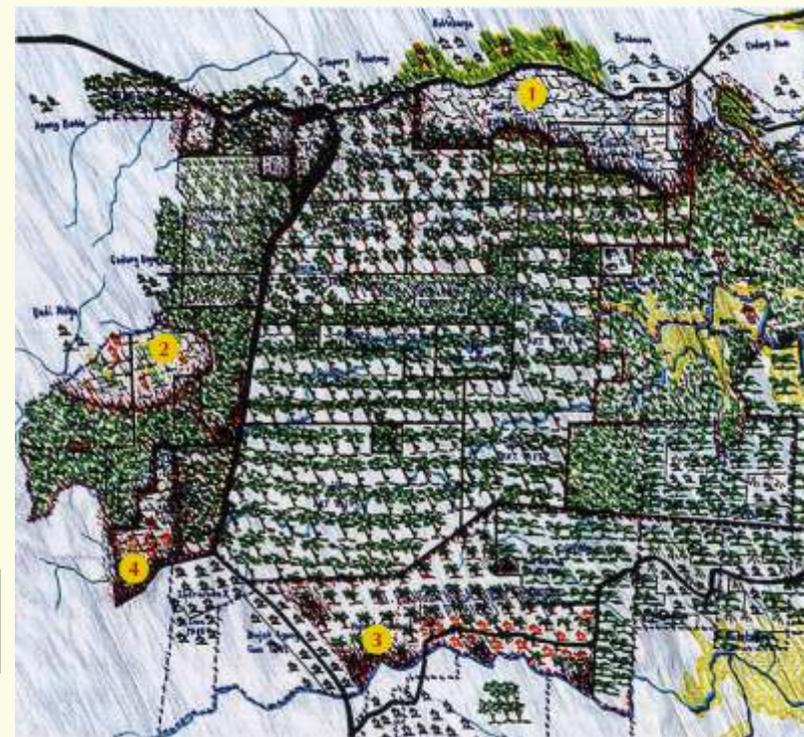
tradeoffs facing conflicts

The dominant pattern across the humid forest margins is one of tradeoffs between local development, which often involves clearing natural forest, and biodiversity conservation, which involves maintaining it. ASB has developed an assessment tool, called the ASB Matrix, for use in investigating such tradeoffs. The ASB Matrix provides methods and a framework for researchers, policymakers, environmentalists, local communities, and others to compile useful information on probable outcomes of land use options as a foundation for negotiation among groups with different perspectives and often conflicting interests.

It is the direction of change in land use, rather than the system itself, that determines whether or not the environment benefits. For example, if farmers replace unsustainable cassava production with an improved rubber agroforest, they help restore habitats and carbon stocks at the same time as raising their incomes. But if such a system replaces natural forest, incomes may rise but nature loses.

Restoration of degraded landscapes can be one of those few opportunities for win-win combinations. Revitalizing degraded landscapes can offer extraordinary opportunities to serve the interests of both conservation (by reviving habitats) and poverty reduction (by creating valuable assets for the rural poor).

Social Survey and Participatory Mapping



1. Due to land tenure conflict between the local community and an industrial tree plantation company, local people had no incentive to control a fire that spread through the plantation.
2. Transmigrants burned a logged-over timber concession in the hope of acquiring the land.
3. Smallholders burned coconut and oil palms to reclaim land appropriated by a large company.
4. Large-scale timber plantation burned by local people.



Scenarios

thinking ahead



How scenarios can help

The landscape mosaics of the humid forest margins are changing rapidly. ASB is working with local and national stakeholders to develop scenarios that they can use to understand and compare plausible alternatives for the future, including the impact of landscape changes on ecosystem services and human wellbeing. Scenarios provide a way of thinking creatively about the future in these complex, dynamic environments. Bringing together scientific information as well as insights from local experience, scenarios can help to focus attention on key issues and critical decisions in the path ahead.



Conflicts over land use in the tropical forest margins are likely to intensify in the future. The ability to create and strengthen institutional mechanisms for managing such conflicts will be vital. This requires a better understanding of governance processes, including negotiation, the identification and implementation of incentive schemes and sanctions, and the monitoring and enforcement of agreements.

1. Clarifying property rights and securing access to resources: a top priority since people's wellbeing depends on access to resources and because secure property rights are one big step toward sustainable natural resource management. But secure tenure alone is not sufficient to conserve natural habitat.
2. Rewards for environmental services: conserving biological diversity requires mechanisms for protecting natural forests, rewarding households for environmental services, or compensating them for foregone development opportunities.
3. Negotiation support: linking science with efforts to manage conflict and support the search for innovative solutions to conservation-development challenges in the tropical forest margins.

ASB Policybriefs deliver relevant, concise reading on lessons learned at the local or national level to people whose decisions make a difference to poverty reduction and environmental protection in the humid tropics. Topics include, "Deregulating Agroforestry Timber to fight Poverty and Protect the Environment," "Balancing Rainforest Conservation and Poverty Reduction," and "Forces Driving Tropical Deforestation."

BALANCING RAINFOREST CONSERVATION AND POVERTY REDUCTION

ASB **Policybriefs** FEBRUARY 2003 05

STRIKING AN EQUITABLE BALANCE between the legitimate interests of development and equally legitimate global concerns over the environmental consequences of tropical deforestation is one of the greatest challenges of our generation.

HIGHLIGHTS
 Many concerns, conflicting interests
 Lining up the facts
 Understanding the tradeoffs
 The balancing act
 Paying the price

Occasionally it is possible to conserve tropical forests while reducing poverty, but more often these two objectives conflict. Without action to resolve this conflict, tropical forests will continue to disappear.



Colonists in Roraima, Brazil.

Many concerns, conflicting interests

Everyone in the world wants something from tropical forests. Forest dwellers wish to continue their traditional way of life based on hunting and gathering. They are losing their land to migrant smallholders, who clear small amounts of forest to earn a living by raising crops and livestock. Both these groups tend to lose out to larger, more powerful interests—ranchers, plantation owners, large-scale farmers or logging concerns—whose aim is to convert large areas of forest into big money. Outside the forests is the international community, who wishes to see forests preserved for the carbon they store, that would otherwise contribute to global warming, and for the wealth of biological diversity they harbour.

Deforestation continues because converting forests to other uses is almost always profitable for the individual. However, society as a whole bears the costs of lost biodiversity, global warming, smoke pollution and the degradation of water resources.

Every year the world loses about 10 million hectares of tropical forest—an area more than three times the size of Belgium. None of the land-use systems that replace this natural forest can match it in terms of biodiversity richness and carbon storage. However, these systems do vary greatly in the degree to which they combine at least some environmental benefits with their contributions to economic growth and poor peoples' livelihoods. It is, therefore, always worth asking what will replace forest (and for how long), both under the current mix of policies, institutions and technologies and compared to possible alternatives. In other words, what can be done to secure the best balance among the conflicting interests of different groups?

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What will ASB's assessment deliver?

We envision a range of products. These include new issues in the series, *ASB Policybriefs* and *ASB Voices*, distributed by post and online in English as well as other major languages. Ultimately, the assessment results will be compiled into an attractive, highly-illustrated book. We will use other formats such as policy briefings and seminars, press releases, and audio and video media for specific audiences. This assessment will also build individual and country capacity for future ecosystem assessments, supporting a stronger scientific foundation for decision-making in the tropics. Most of ASB's partners are in developing countries, where lack of access to information, technical expertise, and other resources seriously impairs their ability to research and promote natural resource management options. Facilitating developing country scientist participation will not only improve assessment products and results but also enable and empower these scientists, providing them with leadership skills, training in assessment techniques, international opportunities, and professional recognition.

Additional materials on ASB and its contribution to the Millennium Ecosystem Assessment are available at www.asb.cgiar.org.

- ASB-MA State of the Assessment Report
- Executive Summary of ASB-MA

- ASB Policybriefs
- ASB Voices

- ASB-MA Poster
- ASB Tradeoffs Poster

- ASB Global Poster
- Country Synthesis Reports

The Millennium Ecosystem Assessment (MA) is the most ambitious study ever undertaken of the relationship between the world's ecosystems and human wellbeing. It shares information with decision makers about the state of these systems globally, as well as at the level of communities, countries and regions. The Alternatives to Slash-and-Burn Programme (ASB) is conducting the only cross-cutting assessment in the MA, working across regions in the tropics.

This assessment focuses on the landscape mosaics found at ASB's forest margin sites in the humid tropical broadleaf forest biome. ASB is a global partnership of over 80 institutions with a shared interest in two of the greatest challenges confronting the world today: conserving forests and reducing poverty in the humid tropics.

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Funding has been provided by the Government of the Netherlands, the Millennium Ecosystem Assessment, and the US Agency for International Development (USAID).

Photos by: ASB, K Harmsen, J Lewis, D Lodoen, SN Rao, LA Ribas, A Robinson, D Timmer, TP Tomich, United Nations, M van Noordwijk, Dr. P Wangpakapattanawong, Wiyono and World Agroforestry Centre.

Design by Ingrid Smit- Finline

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ASB was founded in 1994 as a system-wide programme of the Consultative Group on International Agricultural Research (CGIAR). The governing body is a Global Steering Group consisting of senior scientists appointed by the following institutions: Agency for Agricultural Research and Development (AARD), Indonesia; Center for International Forestry Research (CIFOR), Indonesia; Centro Internacional de Agricultura Tropical (CIAT), Colombia, including the Tropical Soil Biology and Fertility Institute (TSBF); Empresa Brasileira de Pesquisa Agropecuária (Embrapa), Brazil; Institut de Recherche Agricole pour le Développement (IRAD), Cameroon; Instituto Nacional de Investigación y Extensión Agraria (INIA), Peru; International Food Policy Research Institute (IFPRI), USA; International Institute of Tropical Agriculture (IITA), Nigeria; Philippine Council for Agriculture, Forestry and Natural Resources Research and Development (PCARRD), Philippines; Royal Forest Department (RFD), Thailand; and the World Agroforestry Centre (ICRAF), Kenya.

