CHAPTER 1 Introduction

Source: A Perfect Storm in the Amazon Wilderness: Development and Conservation in the Context of the Initiative for the Integration of the Regional Infrastructure of South America (IIRSA): 11

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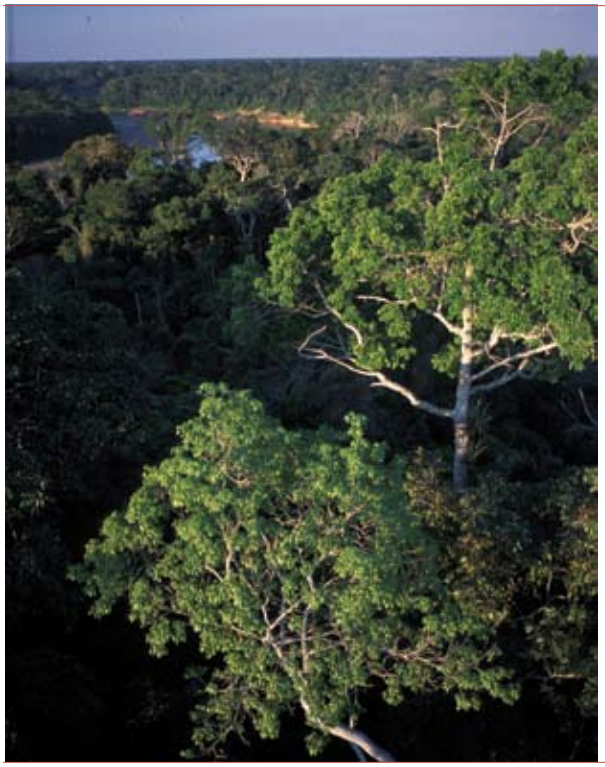
CHAPTER 1

Introduction



Despite decades of encroachment and degradation, the greater Amazon is still the world's largest tropical forest, containing over 6 million square kilometers of forest habitat (©Haroldo Castro/CI).

The Amazon Wilderness Area is the world's largest intact tropical forest. It is situated between the Tropical Andes Biodiversity Hotspot and the Cerrado Biodiversity Hotspot, two regions that are themselves characterized by an extraordinarily large number of species found nowhere else on the planet (Mittermeier *et al.* 1998, 2003). Although these three regions are linked by climates, ecosystems, river basins, and shared cultural experiences, the eight nations that share the Amazon have not succeeded in integrating their national economies. The Initiative for the Integration of the Regional Infrastructure of South American (IIRSA) was conceived to create a continental economy, forging links between all of the countries in South America. IIRSA is a visionary initiative and aspires to a level of integration that has long been an historical goal of all of the founding fathers of the continent's democracies. Its ultimate goal is to form a South American identity in which citizens see themselves as part of a single community with a common future. Although previous efforts to-

ward integration have been undertaken through treaty initiatives such as the Amazon and Andean cooperation pacts and the Mercosur customs union, movement toward a common identity has been elusive due to political differences and asymmetries in the size and internal structure of the economies of member nations. IIRSA is an eminently practical initiative meant to complement diplomatic initiatives; its goal is to undertake specific actions to link the regions of the continent physically in ways that will foster trade and social interchange among nations (Figure 1.1). IISRA is not an end in itself, nor even another treaty mechanism, but a series of well-defined investments (IIRSA 2007) that will convert South America into a community of nations.

IIRSA is motivated by the very real need to promote economic growth and reduce poverty among its member nations. However, it also threatens to accelerate the environmental degradation that is jeopardizing the natural ecosystems of South America. While it is true that the vast Amazonian Wilderness Area has acted as a barrier to cultural and economic interchange, it is arguably the world's most important biological asset, at least in terms of terrestrial biodiversity, holding a disproportionate amount of the biological resources of the planet. Many of IIRSA's development projects will directly intersect with areas that contain unique and vulnerable species (Figure 1.2).

IIRSA is being pursued with a deliberate speed that reflects the political commitment of its member states. However, the rush to integrate the economies of the region should not be made at the expense of the natural resources that are the foundation

Figure 1.1. IIRSA is composed of ten hubs that incorporate investments in modern paved highways, railroads, waterways, and grids. The upgraded road networks will span the Amazon, while waterways (hydrovias in IIRSA terminology) will open up vast areas of the western Amazon to commerce and development (map modified from IDB 2006).

of these same national economies. IIRSA will unleash economic forces that will provoke human migration into areas that are extremely important for the conservation of biodiversity, and it will do so at scales and rates of change that the designers of IIRSA have not yet considered, despite more than three decades of experience in evaluating environmental impacts. Like the initial thrust of Amazonian development in the early 1960s, many proposed IIRSA investments are heedless of the environmental consequences and indifferent to social impacts. A visionary project such as IIRSA should be visionary in all its components; most importantly, it should incorporate measures that guarantee the conservation of the region's natural resources and the social welfare of the region's traditional populations. Failure to foresee the full impact of IIRSA investments will bring forth a combination of effects that will create a perfect storm of environmental destruction, thereby degrading the greatest tropical wilderness area on the planet.

This document provides an overview of the Amazon, Andes, and Cerrado regions. It describes the processes of economic development in relationship to local, regional, and global phenomena. It also examines the nature of biodiversity in these three ecologically complex regions in order to highlight the vulnerability of their ecosystems to the impacts associated with IIRSA projects. In addition, the document highlights conservation and development initiatives that have been successful and that could be replicated. Finally, a series of policy recommendations are provided that would avoid the most deleterious environmental impacts of IIRSA. These recommendations are formulated not in opposition to IIRSA, but to provide alternatives that would consolidate IIRSA's mission to promote economic growth and development.

IIRSA GOVERNANCE AND STRUCTURE

IIRSA involves all the countries of South America and was created to promote growth and development by investing in the physical integration of three strategic economic sectors: transportation, energy, and telecommunications. Although IIRSA is not a free trade agreement, it addresses regulatory issues that are barriers to the economic and social exchange among the nations. IIRSA promotes common industrial standards and communication protocols, while facilitating border crossings for rail, maritime, and airline transport. IIRSA also sponsors meetings and studies to promote commerce, and it facilitates technological exchange, integration of markets, and standardization of regulations (IDB 2006). However, IIRSA's most important investments are focused on improving the physical infrastructure of transportation. IIRSA projects are organized within one of ten integration hubs (*ejes* in Spanish and *eixos* in Portuguese), each with several corridors composed of highways, hydrovias,[1] and railroads, as well as electrical grids and pipelines (Figure 1.1). IIRSA is not a funding agency; rather, it is a coordinating mechanism among the governments and the multilateral institutions that are responsible for financing most of the public works investments in South America. IIRSA is governed by an Executive Steering Committee (CDE) and a Technical Coordinating Committee (CCT). The CDE

[1] The term hydrovia is used by IIRSA to denote a river waterway used for transportation.

Figure 1.2. Principal IIRSA highway corridors and hydrovias are shown in the context of the Amazon Wilderness Area and the Cerrado and Andes Biodiversity Hotspots. Conservation International organizes priority action in these regions.

is charged with developing a unified vision, defining strategic priorities, and approving periodic action plans. It is composed of representatives from each of the twelve member states, usually from the planning ministries, but occasionally individuals from the foreign or financial ministries (Figure 1.3). The CCT comprises representatives from three regional financial agencies: the Inter-American Development Bank (IDB),[2] the Andean Development Corporation (CAF), and the Financial Fund for the Development of the River Plate Basin (FONPLATA). It provides financial and technical support, coordinates meetings, and is the repository for IIRSA's institutional memory. The CCT's principal functions are to identify eligible projects, involve the private sector, and organize the finances. Finally, IIRSA-approved projects for each integration hub are managed by Executive Technical Groups (GTE). These groups approve projects, review environmental and social studies, and manage IIRSA investments. Projects are selected based on the twin principals of sustainability and feasibility, with individual projects being analyzed in the context of a portfolio of investments and reflecting the consensus of the GTE (IDB 2006). In practice, approved projects are those that national planning ministries favor and present to the IIRSA executive and technical committees (Dourojeanni 2006). Currently, IIRSA's agenda contains 335 projects, with 31 priority projects totaling more than $6.4 billion to be implemented in the first phase of IIRSA, spanning the years 2005 to 2010 (Table 1; Figure 1.4).

Brazil has a complementary initiative, similar to IIRSA both in philosophy and geographic scale, in which federal, state, and municipal governments are constitutionally mandated to present a multiyear integrated development plan (Pluri-Annual Plan, or PPA by its Portuguese acronym) to their respective legislative bodies. The current PPA for 2004 to 2007, known as the "Plano Brasil de Todos," has three major objectives: 1) social inclusion and the reduction of social inequity, 2) economic growth and job creation in the context of sustainable development and the reduction of inequality among regions, and 3) strengthening democracy through participatory mechanisms. Because PPA's primary goal is to foster economic growth, many of its investments will improve the integration of the national transportation and energy networks with neighboring countries.

Most IIRSA projects are financed by loans from the three financial institutions of CCT; however, financial packages often include funds from national budgets, sovereign bond tenders, bilateral donors, and private sources arranged by the construction companies that are contracted to execute the project. PPA financing comes from different public sources; most comes from local, state, and federal budgets, but an important portion is provided by the National Social and Economic Development Bank (BNDES), a public entity associated with the Ministry of Development, Industry and Foreign Trade. In addition, BNDES finances Brazilian operating companies in neighboring countries via a program known as BNDES-EXIM that exists to promote the export of Brazilian goods and services.[3] As a result, some IIRSA contracts are awarded to consortia led by Brazilian construction companies that have access to credit provided by BNDES[4] or by other export promotion programs managed by the Banco do Brasil (Banco do Brasil 2007).

[2] Institutional titles are provided in English, but their acronyms follow those used on the IIRSA portal and by speakers of Spanish and Portuguese.

[3] In 2005, BNDES approved a total of $2.5 billion in loans to Brazilian exports; of this total approximately $1.06 billion was for exports to Argentina, Chile, Ecuador, Paraguay, and Venezuela.

[4] BNDES has also increased its participation in CAF, recently increasing its shares from 2.5 percent to 5 percent, but not enough to have the same voting privileges as the Andean countries (the so-called A shares).

Table 1. A summary of IIRSA projected investments.

Integration Axis (Eje)	Corridors Segments	Individual Projects	Estimated Investment[1] ($ millions)	Priority Financing ($ millions)[2]
Amazonia	7	91	8,027	1,215
Andes	11	92	8,400	117
Peru – Bolivia – Brazil	3	21	12,000	1,067
Interoceanic	5	54	7,210	921.5
Guayana Shield	4	44	1,072	121
Southern	2	22	1,100	n.a.
Capricorn	4	27	2,702	65
Mercosur – Chile	5	70	13,197	2,895
Hydrovia Paraná – Paraguay	1	3	1,000	1
Andes del Sur	n.a.	n.a.	n.a.	n.a.
Total	42	424	54,708	6,403

[1]Modified from IIRSA (2007) and BICECA (2007).
[2]IDB (2006).

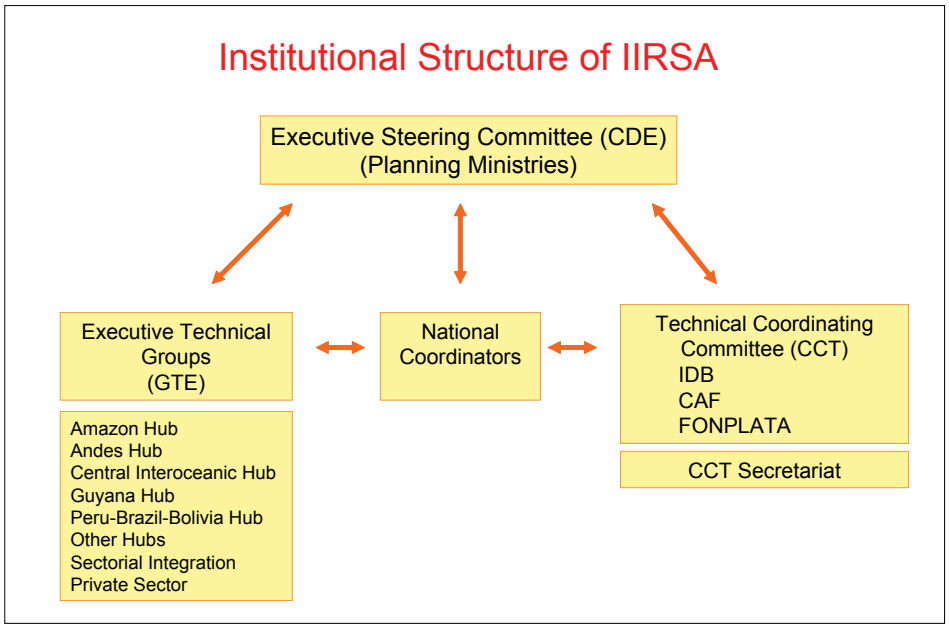


Figure 1.3. IIRSA structure. The Executive Steering Committee of IIRSA includes representatives from each South American government. Projects are administered by three multilateral lending agencies: the Inter-American Development Bank (IDB), the Andean Development Corporation (CAF), and the Financial Fund for the Development of the Río Plata (FONPLATA).

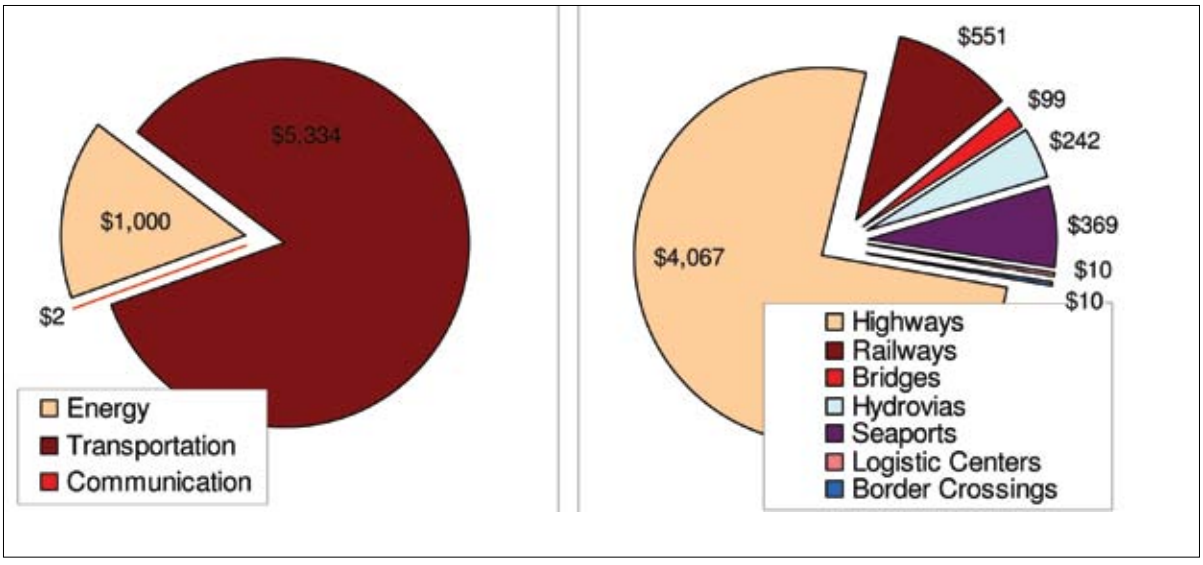


Figure 1.4. IIRSA investments are largely concentrated in highway infrastructure, but they also include other strategic transportation systems, as well as energy grids and communication systems (IDB 2006).

Figure 1.5. In a Utilitarian Scenario, an infusion of private capital would convert the Amazon into an agro-industrial powerhouse that provides the planet with food, fiber, and biofuels, while allowing for sustainable economic growth and social equity. Amazonian countries would develop technological solutions to overcome agricultural challenges such as soil infertility and weed control (© Hermes Justiniano/Bolivianature.com).

Because of the adverse impacts associated with similar investments in the past, IIRSA investments in infrastructure are viewed by many observers as a threat to the natural ecosystems of the Amazon and surrounding regions. Fortunately, most of the financial organizations involved with IIRSA have relatively high standards for environmental and social evaluation and usually condition loans on the implementation of environmental and social action plans.[5] Nonetheless, because infrastructure projects are being evaluated individually,[6] they fail to consider how the combination of projects and external forces such as global markets, transfrontier migration, or climate change might act synergistically to cause unforeseen effects.[7] The academic community has provided valuable insight into the potential future impacts and ample justification that a comprehensive evaluation procedure should be required for both IIRSA and PPA (Laurance *et al.* 2001, 2004, Nepstad *et al.* 2001, da Silva *et al.* 2005, Fearnside 2006b).

THE FUTURE OF THE AMAZON: THREE SCENARIOS

Virtually all South American societies support the conservation of the Amazon forest and — simultaneously — call for increased development that will provide residents of the Amazon a dignified life free of poverty. There are enormous differences among people as to what this vision actually entails, particularly regarding the preservation of wilderness areas, forest management, agricultural production, and land tenure. Most conservationists view IIRSA as a traditional type of development that will lead to widespread deforestation; at the same time, many economists and business people view the goals of the conservation movement as an impediment to economic growth. Regardless of these contrasting viewpoints, it will be the economic markets and the decisions of democratic societies that will ultimately decide the fate of the Amazon. It is impossible to predict this future, but it is possible, based on historical events and scientific research, to envision various scenarios that would likely follow different policy implementations. This section provides three scenarios of what the Amazon might look like after a century of human-induced change. Two are decidedly optimistic in outlook, but diametrically opposed in their philosophical underpinnings, whereas the third scenario is a more realistic view of what is most likely to occur without a radical change in current public policies.

The Amazon as Bread Basket (the Utilitarian Scenario)

In this scenario, climate change and land use change interact to create an Amazon that becomes progressively drier and warmer, and where the natural forest ecosystems are largely replaced by tree plantations and mechanized agriculture (Figure 1.5). This scenario is largely based on two assumptions: 1) the climate in the Amazon will become drier and warmer, as predicted by climate-change models, leading to a collapse of the humid forest ecosystem; and 2) there will be massive deforestation in the Amazon as a result of decisions made by national governments and local people. The remainder of the assumptions underpinning this scenario, specifically regarding agricultural systems and economic growth, reflect modern society's resilience and technological capacity to adapt to change.

5 Multilateral banks have been more progressive on environmental and social issues than commercial banks. For example, IDB and CAF have developed and adopted environmental guidelines and Strategic Environmental Assessments, although these have yet to be fully implemented. In contrast, FONPLATA requires only that projects meet the environmental norms of its member countries, and BNDES recently received poor ratings by an independent evaluation that focused on commercial banks (WWF/BankTrack 2006).

6 At the time of press, Strategic Environmental Assessments have been contracted or are underway for the corridor Puerto Suarez–Santa Cruz (IDB Project No. TC-9904003-BO0), the Corridor del Norte in Bolivia (IDB project BO-0200), and the InterOceanic Corridor in Madre de Dios, Peru (INRENA-CAF Project).

7 Only one region-wide study was commissioned before 2006, which consisted of an $81,000 consultancy contracted by IDB with funds provided by the Netherlands; the contract was made to a private consulting group, Golder Associates, of Boulder, Colorado.

Global warming is the primary driver of change. Increasing temperatures and dryness cause rainforest soils to respire at rates greater than trees photosynthesize; this shifts the Amazon ecosystem into a net source of carbon, further exacerbating global warming. The tree species of the humid forest ecosystem cannot adapt to the new climate conditions and are eventually eliminated from the forest due to increased adult mortality and lower levels of reproductive success. IIRSA's transcontinental highways increase the density of secondary roads, so that within a century eventually 70 percent of the original forest cover is replaced with pastures, crops, or tree plantations. Once it becomes clear that tree species are under physiological threat from climate change, governments adopt policies to monetize timber reserves rather than lose them to natural processes of mortality and decay. The forest ecosystem essentially collapses and is replaced by an agricultural production system that consolidates Brazil as the most important producer of agricultural foodstuffs and biofuels in the world.

Technology will allow the agricultural sector to adapt to climatic change. Archeological reconstructions in the central Amazon have revealed how Amerindian civilizations improved soil resources and sustained fertility over the long term using ceramics and charcoal to ameliorate soil acidity and increase organic matter Modern agricultural science has rediscovered these management techniques and adopted them for both perennial and annual production systems. Agriculture will become more diversified with annual crops predominating on the best soils, whereas cattle ranches and tree farms will prevail on rolling topography. The production of biofuels will become increasingly important, with plantations of sugar cane producing alcohol and oil palm for biodiesel fuel. Research will improve pest control using genetically modified organisms in combination with an ever-increasing arsenal of pesticides. Farms that specialize in highly productive perennial species will make the Amazon the most productive agricultural region in the world on a per hectare annual basis.

Although precipitation will decline, the Amazon basin will still be the world's largest freshwater hydrological system, containing the world's largest underground aquifer.[8] Irrigation technology, powered from the western Amazon's abundant natural gas reserves and from locally produced biofuels, will mitigate seasonal fluctuations in precipitation. Dams and reservoirs will contribute surface water to the irrigation system and provide affordable hydroelectric power for urban centers with an industrial economy focused on metallurgy, forest products, and food processing. There will be continued migration from rural to urban areas, particularly in cities such as Iquitos, Peru, and Leticia, Colombia, which will follow the example of Manaus, Brazil, to develop economies based on manufacturing, financial services, and technological innovation.

These radical changes to the Amazon basin will cause environmental impacts at the global, regional, and local levels. At the global level, the collapse of the forest ecosystem will exacerbate global warming. Carbon reserves of the Amazon will be released into the atmosphere; the carbon emitted from the Amazon during this century will be equivalent to about 13 years of industrial emissions.

Precipitation regimes in the Amazon and surrounding areas will be affected by both global and regional manifestations of climate change. However, moderate levels of rainfall over the central Amazon will be guaranteed by the trade winds that transport water vapor from the Atlantic Ocean. Deforestation will negatively impact the convective systems that recycle about 50 percent of the precipitation that falls on the Amazon; this will cause dry seasons to become longer and more severe. The low-level jet stream system that modulates the seasonal monsoon and transports water vapor from the Amazon to the Río Plata basin will increase in intensity but will transport less water due to the drier conditions that predominate in the western Amazon. Nonetheless, the agricultural productivity of the lower Río Plata basin will not be severely affected because other weather systems will increase the precipitation that originates over the South Atlantic.

Biodiversity conservation will be managed by a reserve system of protected areas that was established in the last decade of the twentieth century and will continue into the first two decades of the twenty-first century. Like protected areas in North America and Europe, these are island-like preserves containing a representative sample of the biodiversity that existed in the Amazon prior to the industrialization of agriculture. As predicted by conservation biologists, this level of isolation will cause the widespread extinction of many endemic species and the homogenization of many of the biota within protected areas. Ecosystem fragmentation will limit the ability of many species to migrate in response to global warming, therefore causing even more extinctions.

The economic growth from agriculture, cattle ranching, and plantation forestry will create a favorable business environment and increase employment opportunities. Prosperity will increase tax revenues and allow greater investment in education and health services. The skilled professionals needed to manage the financial, industrial, and commercial institutions will migrate into the Amazon from urban centers of South America (e.g., São Paolo, Bogotá, and Lima). Indigenous peoples will adapt to change by relying on their internal social organizations as a bulwark against the homogenization of their cultures and to protect the economic interests of their communities. However, the most important element in their success is the advantage of being granted clear title to large expanses of land. As the group with the largest land area in the Amazon, they will use this asset to engage in economic growth through agricultural production and plantation forestry.

In this Utilitarian Scenario, the Amazonian nations have successfully integrated their economies, and Brazil has evolved into one of the most prosperous and dynamic nations on the planet. Its large population and stable economy act as the economic motor for the region and provide much of the technological innovation behind the sustainable, productive systems that now characterize the Amazon. The Andean countries have close commercial ties with Brazil, and the economic growth in the Amazon is linked

[8] The dimensions of the southern part of this aquifer were recently mapped in Santa Cruz, Bolivia (Cochrane *et al.* 2007). The geology of the basin, known as the Andean foredeep, is composed of loosely consolidated sediments that have been charged with water over several million years. Because this is a nonconfined aquifer, it is recharged continuously from surface sources and has the potential for a truly sustainable irrigation system.

to Asian markets that are accessed via Pacific Ocean coastal ports. The predictions of biodiversity loss have been shown to be real, but ecological collapse has been avoided by using technology to develop sustainable production systems that provide strategically important commodities to global markets.

The Amazon as Forest Wilderness (the Utopian Scenario)

In this scenario, the dramatic decrease in precipitation predicted by some climate models does not materialize and wide-scale deforestation is avoided because the countries that share the Amazon basin make a commitment to conserve the Amazon forest as a natural ecosystem (Figure 1.6). The avoidance of deforestation depends on the creation of a system in which payments for ecosystem services subsidize the conservation of the Amazon. For example, developed nations allow payment for carbon storage in natural ecosystems and are willing to transfer significant sums of money from their domestic economies to Amazonian countries. The stability in current precipitation levels assumes that the world will avoid the worst-case global warming scenario by limiting carbon emissions and that forest conservation will maintain the convective systems that recycle water over the Amazon. The basis of this scenario is a belief that human societies have the capacity to manage growth and development in the Amazon and that Latin American societies reform their governments and establish the rule of law in frontier areas, particularly regulatory systems that govern land tenure.

National governments that agree to reduce deforestation will adopt mechanisms for using payments for ecosystem services to conserve forests in exchange for investments in health and education; a portion of these payments will be used to subsidize value-added industries that transform the region's abundant natural resources into globally competitive goods and services. Annual satellite surveys monitor land-use change, and failure to meet commitments will be reflected in the annual social service budget. This explicit link will create strong local support to comply with deforestation reduction targets, and the emphasis on social services will have immediate short-term benefits due to a surge in the construction of new schools and clinics, while longer-term impacts will result from job growth in the education and health sectors.

In line with one of IIRSA's main goals—to facilitate the export of agricultural commodities from central Brazil to the Pacific coast—intensive production will increase exports, but deforestation will be contained by adopting mixed land-use models that maintain 80 percent of the land as forest and limit land-use change to 20 percent of total cover.[9] Implementation of this model will be promoted by guaranteeing clear title and providing subsidized credit to land tenants who adopt the 80:20 land-use rules. This credit will be linked to intensive production systems that maximize the use of deforested land. Satellite imagery will monitor land use and identify farms that fail to meet the criteria; noncompliance will result in loss of credit and reversion of land tenure.

Instead of highway corridors, the Amazonian countries will adopt the transportation model "people by air and cargo by water." Low-cost barge traffic will make commodities and minerals competitive in world markets. Subsidized air transportation will facilitate a more effective health care system, allowing the sick access to health care during emergencies and allowing health care professionals to make regular visits to remote communities. Inexpensive air service across the Amazon will stimulate development of the tourist industry in remote areas. Subsidized credit will be used to foster partnerships between the private sector and local communities, ensuring the participation of local residents while improving the tourist experience.

[9] This land-use regulation is already enshrined in Brazilian law but is poorly enforced in almost all frontier areas.

Figure 1.6. A Utopian Scenario would require an international agreement that compensates Amazonian countries for reducing carbon emissions caused by deforestation. Payments for ecosystem services would be used to fund health and education, and to subsidize production that avoids deforestation and forest degradation (©Greenpeace).

Intensive production systems will include some traditional options, such as mechanized agriculture, livestock, tree plantations, and biofuels. However, because water is the most abundant and most valuable resource in the Amazon, it will also logically be the most important basis of production. Fish farming is the most efficient way to convert agricultural commodities to animal protein, especially in the warm ponds of the Amazon where herbivorous native species are fed agricultural commodities imported from nearby grain-producing regions. Aquaculture requires a small surface area and is ideally suited to the family farm; more importantly, it creates a value-added production chain that increases income for rural populations. The production model with the largest footprint, however, will continue to be timber exploitation. The forest products sector will adopt harvest guidelines that mimic natural forest processes with harvest cycles greater than 100 years. This low-intensity timber harvest model will depend upon transportation subsidies, tax abatements, and direct payments for ecological services. Instead of collecting royalties for the exploitation of timber, states will provide compensation to landholders for adopting management criteria that ensure forest conservation.[10]

Maintaining the integrity of the forest ecosystem will lead to benefits for biodiversity conservation in this optimistic utopian scenario. Farms and plantations will be dispersed over a broader geographic landscape due to the dependence on river transport; however, adherence to the 80:20 land-use rule will help avoid forest fragmentation and keep the forest matrix intact. Connectivity among protected areas will be maintained across the landscape to ensure the survival of regional endemics and rare species. Unfortunately, the dependence on river transport will lead to a degradation of aquatic systems, especially where locks and dams are installed to circumvent rapids or where dredges and dynamite are used to facilitate transit of barge convoys on smaller rivers.

[10] This will end the current perverse incentives in which forest concessionaires pay royalties on harvested timber, while cattle ranchers and farmers pay none on the timber they harvest during land clearing.

Figure 1.7. A Business as Usual Scenario assumes that existing patterns of natural resource exploitation would continue, leading to landscapes dominated by low intensity agriculture and degraded forests. Poor governance and unregulated markets would lead to boom and bust cycles that inhibit long-term investment in social services, and the region would be characterized by entrenched poverty (© Olivier Langrand/CI).

Similarly, the widespread adoption of fish farming degrades some hydrological resources due to the release of effluents from production ponds.

The Utopian Scenario provides for improved human welfare in Amazonian societies. Large cash flows from the payment for ecosystem services improve incomes and subsidize key social services. The mixed land-use model combines low-intensity timber management with high-intensity agricultural production. Indigenous groups with large land assets benefit by forming joint ventures with urban investors who provide technical expertise and access to capital. Most importantly, the use of subsidies, tax abatements, and low-interest loans for sustainable production creates new business opportunities that increase the quantity and quality of employment in both rural and urban communities. The Utopian Scenario allows the Amazonian nations to integrate their economies. Brazil's sovereign decision to conserve the Amazon ecosystem as a national heritage leads to the development of a system to compensate communities for the ecosystem services provided by the forest. The Andean countries follow suit and make special efforts to preserve the ethnic diversity that characterizes the lowlands in the western Amazon. Asian markets continue to dominate Amazonian exports but are characterized by value-added production chains that generate employment and contribute to stable economies.

The Amazon as a Degraded Forest (the Business as Usual Scenario)

Unfortunately, the most likely future scenario is "more of the same." The assumptions underlying this scenario are that individuals continue to be motivated by short-term financial gain, while national governments are unable to enforce regulations for controlling development in the Amazon, and international organizations are unsuccessful in creating market mechanisms to pay for ecosystem services. As a result, world markets and national demographic pressures continue to motivate individuals to acquire land in the Amazon and engage in agricultural and development practices that deforest landscapes, degrade soils, and interrupt hydrological systems (Figure 1.7).

The motivation for this pessimistic scenario is not unlike that underlying the optimistic utilitarian scenario; however, in this scenario, the sophisticated production systems that require capital investment and technological innovation do not materialize due to instability in land tenure and the high cost of financial capital. Nonetheless, the determination to integrate the transportation infrastructure of the continent accelerates demand for land and induces governments to open up more areas for settlement. Small farmers and peasants compete for land with industrialized agriculture, but poor soil management practices eventually lead to the predominance of low-intensity cattle ranching combined with tree plantations, a low-risk business model that provides a moderate return for affluent investors.

Deforestation has dramatic impacts on the regional hydrological cycle by decreasing precipitation and increasing the intensity of the annual dry season. Agriculture is also negatively affected in extra-Amazonian areas such as Argentina, Paraguay, and Santa Cruz and Mato Grosso do Sul, Brazil, which are the most important granaries of the continent. Landscapes are radically altered, and the once extensive forest has been reduced to

degraded patches that vary in size and composition depending on their distance from major highways. Large blocks of forest exist only in protected areas, indigenous lands, and extractive reserves, although the latter two categories will be highly degraded due to overly aggressive logging practices. Connectivity among forest patches will be minimal or nonexistent, except in areas where topography and soils inhibit the development of agriculture. Rivers and streams will suffer increased sedimentation and runoff from the use of pesticides and nitrogenous fertilizers, changing both their physical and chemical attributes. Upstream landowners will construct containment structures to provide water for livestock, while government initiatives to build dams and reservoirs for water management and hydropower will degrade connectivity in aquatic systems and impoverish them.

Biodiversity will suffer in both terrestrial and aquatic ecosystems, with massive levels of species extinction occurring at global, regional, and local scales. This millennial extinction will take place in slow motion, with many species, such as long-lived woody plants, surviving as lone nonreproducing individuals in many forest patches. The extermination of large mammals and the overexploitation of large migratory fish populations will cause dramatic changes in both the structure and composition of biological communities. The rapid rate of climate change and the fragmented landscape will inhibit the ability of many species to adapt or migrate to regions where the climatic conditions are adequate for their survival. All of these processes will lead to the extinction of many regional endemics in the Amazon lowlands and to local endemics in the Andean foothills.

The lack of investment and policy innovations will lead to the stagnation of human communities. Indigenous societies that acquired title to vast tracts of forest will have overexploited those resources and become even more dependent on subsistence agriculture due to the scarcity of fish and game. The social group most susceptible to the negative effects of poorly planned economic growth and environmental change will be the rural poor with no clear ethnic affiliation. Poverty and the scarcity of game will increase the pressure on protected areas, leading to illegal logging and hunting in the more remote and lawless regions of the Amazon. Squatters will continue to encroach on protected areas, which remain a low priority for governments that must deal with widespread poverty. Unskilled workers, both native and immigrant, will congregate in urban ghettos and compete for work in a stagnant job market. Social inequality becomes more accentuated because commercial cattle ranchers and mechanized farmers prosper by producing commodities for export markets with little value-added transformation. The lack of investment in education will result in individuals having few marketable skills, while the absence of research budgets at universities will stifle innovation in developing new production systems.

In this scenario, the Amazonian nations will not have succeeded in integrating their economies despite the massive investments in infrastructure. In the Brazilian Amazon, large-scale industrialized production predominates because of a societal decision to embrace a free market capitalist economy. In contrast, the Andean nations will have opted for a development model in which the state assumes a predominant role in economic planning. Subsequent economic stagnation causes poor people from the rural highlands to migrate to the western Amazon where, lacking capital resources, they adopt inefficient production systems. Asian markets continue to dominate Amazonian exports but are characterized by raw commodities rather than value-added manufactured goods derived from those commodities. Consequently, producers in the Amazon are subject to large fluctuations in international markets, perpetuating the boom-and-bust mentality that has characterized the region for more than two centuries.