The Changing Social Contexts of Deforestation in the Brazilian Amazon*

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Objective. This article reviews changes in the social contexts of deforestation in the Brazilian Amazon from the 1970s to the 1990s, moving from the household to the global level. *Methods.* I draw on satellite imagery, state publications, farm surveys, ethnographic field work, and policy analyses for a comparative analysis that shows how land cover, agriculture, demographics, politics, and markets have changed over time. *Results.* Alterations in the social contexts of deforestation appear on all levels considered, from household demographic evolution and new land use strategies to a regional demographic transition and the emergence of cattle and timber economies, to a "greening" of Brazilian development policy and changes in national land markets, to multilateral bank loans for new infrastructure and local-international alliances between grassroots and environmental organizations. *Conclusions.* The social contexts of deforestation are very complex and changing and call for greater attention by social scientists to land cover and land use change.

In 1998, the world's attention was again drawn to the Brazilian Amazon, where fires set by landowners destroyed hundreds of square kilometers of tropical forest. Given the role of deforestation as a contributor to global climate change (Gash et al., 1996), an international scholarly community has emerged in an attempt to provide social scientific explanations for land use and land cover change (NASA, 2001). However, the human context surrounding land use and land cover conversion in the Amazon and elsewhere has changed considerably over time. An understanding of these changes in the social context of deforestation is necessary as policymakers and donor institutions seek new approaches to mitigate environmental damage and sustain human livelihoods in tropical forests (Liverman et al., 1998; NRC, 1999).

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This article calls for greater social scientific attention to land cover and land use change by presenting a comparative analysis of past and present factors driving or mitigating deforestation, taking up the case of the Brazilian Amazon. I draw on diverse data sources and theories from several disciplines to illustrate the changes in land use practices, population demographics, political ecologies, institutional structures, and market mechanisms that affect forest conversion in the Amazon. The article first discusses deforestation in the region and then reviews changes in the social contexts of land cover conversion from the 1970s to the 1990s.

Deforestation in the Brazilian Amazon since the 1970s

Satellites provide some of the best data for estimating deforestation, because of the capacity of remote-sensing platforms to produce high-resolution images for large areas. Brazil's National Institute for Space Research (INPE) has produced a time series of satellite-based estimates of deforestation in the Brazilian Amazon from 1978 to 1998 (INPE, 2000). Figure 1 shows the states of the Brazilian Amazon, which I define (unless otherwise noted) as the Legal Amazon, a state planning region that subsumes the watershed. INPE estimates suggest that overall, the land area cleared of forest increased from 155,200 km^2 in January 1978 to 551,782 km^2 in August 1998. The 1978 estimate corresponds to 4.4 percent of the 3.5 million km^2 of land originally forested in the Brazilian Amazon, and the 1998 estimate is 15.6 percent. This rise implies an average annual increase of 6.2 percent in the land area deforested. However, the change in the land area deforested fluctuates considerably from year to year, from a moderate average around 22,000 km^2 during the 1980s to a low of only 11,000 km^2 in 1990–1991, with a major clearing event of 27,000 km^2 in 1994–1995 and moderate averages since then (INPE, 2000). The variation in annual deforestation suggests that the social context of land use has also varied over time. The remainder of this article reviews the many ways in which this has in fact occurred, through a comparative analysis of past and present factors that influence deforestation.

Conceptualizing the Social Contexts of Deforestation in the Amazon

Human actors, social groups, state agencies, and market conditions all constitute forces affecting land cover conversion, in the Amazon as elsewhere (see, e.g., Brown and Pearce, 1994; Kaimowitz and Angelson, 1998; Sponsel, Headland, and Bailey, 1996). However, through historical time in the Amazon, the motives of actors, the interests of competing groups, the policies of state agencies, and the sizes of product markets have all changed. To show how, I will draw on state data, a small farm survey I coordinated in

FIGURE 1

States of the Amazon and Brazil and Uruará Study Site, 1996

Uruará (in the state of Pará; see Figure 1), other fieldwork, and policy analyses.

The comparative analysis that follows is organized in terms of the scale on which different agents operate, for two reasons. First, competing theoretical explanations for deforestation may actually involve processes operating on different scales (e.g., rational choices among individuals as contrasted with the political ecologies of conflicting interest groups), which inhibits statistical testing to identify primary causal drivers. Second, the geographic locus of different agents and processes can differ greatly: proximate causes of deforestation are more localized, whereas distant forces may operate far from the actual site of clearing (e.g., Turner et al., 1995).

I draw on a hierarchical conception of environmental change (e.g., Ahn and Allen, 1996), in which proximate drivers operate on a micro level, subject to the latitude they have in their social context, which is constituted by ever more distant meso- and macro-level processes (e.g., Gibson, Ostrom, and Ahn, 2000). Individual decisions to clear vegetation, a micro-scale process that occurs in the context of a household or firm, constitute the proximate cause of deforestation, whereas state policies to support Amazon colonization by farm families, a macro-scale process in Brazil's national

arena, is a more distant driving force that affects land cover through its effect on the latitude of action among farm households in the Amazon (Wood et al., 1996). A hierarchical conceptualization provides the means to organize a wide array of driving and mitigating forces in a systematic fashion, relating them proximally or distantly to deforestation. It also identifies potential mechanisms linking those forces to each other by situating micro-scale processes within meso- and macro-level contexts. A hierarchical conceptualization can also include feedback effects, in which the act of deforestation bears consequences for households, communities, countries, and the global arena. This is crucial, for feedbacks from deforestation can change the decisions of actors operating on different levels over time, providing a mechanism that partially accounts for historical alterations in the forces affecting land cover change, in addition to emergent influences from previously unrelated sources.

A useful way to approach the complex hierarchy of social processes influencing land clearing is to proceed inductively, by beginning with an observation of the decision of a land user to clear or retain vegetation, and looking to the user's immediate social context, a household or firm, to identify incentives, resources, and constraints that account for the decision. In turn, by "progressive contextualization" (Vayda, 1985), one can observe household characteristics and look to the local community context for explanations as to why households have certain incentives and constraints. Beyond the community, one can imagine regional, national, and global scales in which populations, institutions, and markets, operating in ever larger and more distant contexts, can impinge upon local communities in ways that can alter household resources and needs and thus indirectly influence land use decisions and deforestation. Progressive contextualization thus provides a means of identifying features of the proximate social context of deforestation and relating them to larger-scale actors operating on higher levels of a hierarchy of driving forces.

Household-Level Changes in the Social Context of Deforestation in the Amazon

Having observed variation in deforestation over time in the Amazon, I now focus on the household level to review proximate, micro-level changes in the social context of land cover conversion in the region. Specifically, I compare past and present in land use practices and the demographic structure of farm households.

Changes in Land Use Practices

Since the 1970s, when colonists to the Amazon began large-scale forest clearing, land use practices have changed substantially. Upon arrival on the

frontier, migrant farm families had limited knowledge of locally appropriate agricultural techniques, and this resulted in a cycle of forest removal, land degradation, poor crop yields, relocation, and further deforestation (e.g., Moran, 1981). Since then, in accordance with adaptation theories from ecological anthropology, households that stayed on their land and survived have experimented and learned more appropriate agricultural techniques (Moran, 1989). There is now a growing literature that points to diversification and intensification as options for sustaining production on land already in use, thereby forestalling further deforestation while ensuring livelihoods for farm families (e.g., Almeida et al., 1996; Hall, 1997). These land use strategies constitute rational choices in the tradition of bounded rationality, in that such strategies reflect limited information and resources and a need to minimize risk (Pichón, 1996; Simon, 1997).

Diversification refers to the use of crops that return complementary nutrients to the soil, the use of soil-conserving perennial (tree) crops, and the incorporation of livestock into farming systems, all of which spread risks and can mitigate land degradation. Early on in colonization projects in the 1970s, farmers largely cultivated annual crops (e.g., Moran, 1981). However, household data from the 1996 survey in Uruará, Pará (see Figure 1) show averages of 3.5 ha under annuals, 17.5 ha under pasture, 23.3 cocoa trees, 84.7 coffee trees, 56.8 black pepper vines, and smaller numbers of orange, coconut, banana, and other fruit trees (Perz, 2001a). Diversification is also evident from other farm surveys in Pará (Almeida et al., 1996; Walker and Homma, 1996).

Intensification, or the adoption of technological inputs to sustain production on a given plot of land, has also increased. In 1985, only 3.5 percent of rural establishments in the Brazilian Amazon used fertilizers, but by 1996, this figure was 7.3 percent (IBGE, 1990, 1998a). Uruará survey data show that 26.8 percent of farm households use fertilizers. Other research also indicates the emergence of intensive dairy operations among cattle ranchers, which generates income to help pay for pasture recuperation (Almeida et al., 1996).

Household Demographic Evolution

Consistent with Chayanovian theory of peasant household production (Thorner, Kerblay, and Smith, 1986), changes in land use among Amazon farm households reflect the effects of evolving demographic structures of farm families (Walker and Homma, 1996). Colonists tend to arrive on the frontier as young couples with small children. As a result, they minimize risks by planting annual crops to ensure a food supply. A survey of colonist households in the Amazon in 1972 indicated that the average age of the male household head upon arrival was 37 years (Tavares, Considera, and Castro e Silva, 1979:69). In 1980, rural populations of the Amazon were

very young, with 47 percent under age 15 (IBGE, 1983a). As children grow old enough to take on farm labor, families becomes less risk averse and may invest in tree crops and cattle (Walker and Homma, 1996). Diversification of land use thus reflects the aging of rural populations in the Amazon, which show declines in the proportion of persons under age 15, to 44 percent in 1991 and 41 percent in 1996 (IBGE, 1996, 1998b). The 1996 Uruará survey indicated a mean household head age of 47 years, and showed that only 40 percent of household members were under age 15, a finding similar to other recent surveys (e.g., Ozório de Almeida and Campari, 1995:100).

Local and Regional Changes in the Social Context of Deforestation in the Amazon

If household-level changes comprise proximate factors that influence decisions to deforest, the local context of a community and the regional context of the Amazon provide a meso-level frame of more distant or indirect determinants of land use. It is on these scales that comparative analysis reveals especially rapid changes in the Amazon, many of them unexpected, concerning population growth and composition, cattle and timber economies, and property rights.

The Amazon's Demographic Transition

The Amazon is well-known as a region of rapid population growth. Large-scale migration of populations with high fertility rates into the Amazon are intermediate determinants of deforestation in the region, as these demographic processes led to many new settlements populated by groups seeking to clear land. As Table 1 shows, this was indeed the case between 1970 and 1980, when the population grew at nearly 4 percent per year. In 1970, the total fertility rate was 7.58, and though life expectancy at birth was only 52.5 years (IBGE, 1993), the actual 1980 population exceeded projected populations, indicating net migration gains of almost 20,000 people per year during the 1970s (Perz, 2001b). However, population growth slowed during the 1980s to 3 percent per year, because of declining fertility and the onset of negative net migration. The total fertility rate in 1980 was 5.65, and though life expectancy had risen substantially to 64.2 years (IBGE, 1993), the actual 1991 population was smaller than projections, indicating net migration losses of almost 40,000 persons per year, twice the size of the gains in the previous decade (Perz, 2001b). In the 1990s, the Brazilian Amazon has experienced relatively slow population growth at 2 percent per year, because of a total fertility rate of only 3.56 in 1991 and continued net migration losses of nearly 100,000 persons per year, despite a higher life expectancy (IBGE, 1996; Perz, 2001b). Moreover,

TABLE 1

Population, Net Migration, Total Fertility, and Urbanization in the Brazilian Amazon, 1970–1996

	Year			
	1970	1980	1991	1996
Population size (thousands)	11,132.2	16,244.5	22,768.6	25,192.2
Annual growth rate		3.78	3.07	2.02
Total fertility rate	7.58	5.65	3.56	nd
Life expectancy at birth	52.5	64.2	71.1	nd
Net migration (thousands/year)		+18.95	–38.06	–93.46
Percentage urban	38.6	50.9	61.7	67.2

SOURCES: Population size: IBGE (1993:206, 1998b); Total fertility: IBGE (1993:231, 1996); Net migration: population projections in Perz (2001b); Percentage urban: IBGE (1993:207, 1998b).

NOTE: The Amazon as defined here includes the states of Goiás and Mato Grosso do Sul, in addition to Rondônia, Acre, Amazonas, Roraima, Pará, Amapá, Tocantins, Maranhão and Mato Grosso. Defining the Amazon in this way was necessary to present data for the same areas for all indicators. nd = No data available.

the population of the region has urbanized in the last three decades, rising from 40 percent in towns in 1970 to nearly 70 percent in 1996 (IBGE, 1973, 1998b). Between 1991 and 1996, the Amazon's rural population declined by 1 percent per year, whereas the urban population grew at nearly 4 percent annually (Perz, 2001b). In light of this rapid demographic transition, the continued deforestation in the Amazon in the 1990s suggests that population growth, overall and in rural areas, no longer accounts for land cover conversion.

The Growing Timber and Cattle Economies

One explanation why deforestation has continued in the Amazon despite the slowdown in population growth lies with the expansion of timber extraction and cattle ranching among households and firms that arrived in the region before the 1990s.

During the 1980s, Brazilian markets for high-quality hardwoods expanded, and Amazon timber has increasingly been extracted to meet this demand (e.g., Stone, 1997). The volume of timber extracted in the region rose from 13.1 million m^3 in 1980 to 52.1 million m^3 in 1995 (IBGE, 1983b, 1998c). The land area logged between 1996 and 1997 was between 9,730 and 15,090 km^2 (Nepstad et al., 1999), an area comparable in size to the area completely deforested the same year (INPE, 2000). Although timber extraction generally does not involve wholesale removal of vegetation, landowners often allow sawmills to extract timber to pay for forest clearing or pasture remediation (Almeida et al., 1996). Timber extraction also opens canopy gaps in forests and drops substantial leaf litter on the ground. This

TABLE 2

Distribution of Cattle by Rural Establishment Size, Brazilian Amazon, 1985–1996

	Establishment Size (ha)					
	<10	10 – <100	100 – <1,000	1,000 – <10,000	10,000+	Total
Cattle						
1985	585.6	2,121.7	6,071.6	6,767.0	3,188.2	18,734.1
1996	652.2	5,327.7	12,454.7	12,503.9	4,557.3	35,495.7
Row percentage						
1985	3.1	11.3	32.4	36.1	17.0	100.0
1996	1.8	15.0	35.1	35.2	12.8	100.0
Change (1985–1996)	–1.3	3.7	2.7	–0.9	–4.2	
Establishments						
1985	551.2	345.0	139.5	14.9	1.1	1,051.7
1996	416.7	313.5	128.2	16.4	1.2	876.0
Row percentage						
1985	52.4	32.8	13.3	1.4	0.1	100.0
1996	47.6	35.8	14.6	1.9	0.1	100.0
Change (1985–1996)	–4.8	3.0	1.4	0.5	0.0	
Cattle per establishment						
1985	1.1	6.2	43.5	453.9	2957.5	17.8
1996	1.6	17.0	97.2	761.7	3663.4	40.5
Change (1985–1996)	1.47	2.76	2.23	1.68	1.24	2.27

SOURCES: IBGE (1990, 1998b).

NOTE: All absolute values are in thousands.

creates drier conditions as sunlight penetrates the gaps, which increases risks of the spread of destructive fires propagated by the leaf litter. Although the 1998 fires in the Amazon were not in heavily logged areas, the chance of large-scale forest destruction is now believed to be very high in logged forests along the region's southeastern fringe (Nepstad et al., 1999).

Important as the timber sector may be, perhaps no segment of the regional economy has had an impact on land cover equal to that of cattle ranching. For landowners, cattle constitute a high-value product, they can be herded to market at most any time, they constitute a capital reserve that can serve as an "insurance substitute" to cover unforeseen costs, and they require less labor, appropriate for aging households or those seeking to free labor for wage work (Walker, Moran, and Anselin, 2000). At the regional level, running cattle has expanded because of persistent difficulties with crop diseases, an emergent regional demand for beef among the Amazon's growing urban population (Faminow, 1998), and improvements in the availability of credit in the 1990s (Toni, 1999). Under these conditions, even smallholders have increased their herds, joining the large ranchers who have traditionally dominated beef production in the Amazon (Walker, Moran, and Anselin, 2000). Table 2 presents distributions of cattle by size of rural

establishment in the Amazon in 1985 and 1996. Overall, the herd nearly doubled in that period, from 18.7 to 35.5 million (IBGE, 1990, 1998a). However, the percentages of cattle held in two of the middle size categories (10–1,000 ha) rose, whereas those of the smallest and two largest size categories declined (<10 ha and 1,000+ ha). Table 2 shows a similar pattern of changes in the number of establishments, so I also present data on the number of cattle per establishment by size category. Overall, the number of heads of cattle per establishment rose from 17.8 in 1985 to 40.7 in 1996, a twofold increase. The only establishment size category with a value higher than the overall increase is the 10–100 ha group. Thus, the rapid expansion of cattle ranching was in relative terms fastest among small to medium-sized landholders. The meteoric rise in the Amazon's cattle herd is reflected in changes in the region's agricultural land use. Between 1985 and 1996, the land area under annual and perennial crops actually declined from 5.9 to 5.7 million ha, but during the same period, the area under planted and natural pasture rose from 42.3 to 51.0 million ha (IBGE, 1990, 1998a). This is a worrisome trend for, as Serrão and Homma (1993:317–18) note, approximately 50 percent of the Amazon's pastures are degraded, implying 25 million ha degraded in 1996. Intensification of cattle operations remains limited (Almeida et al., 1996), and timber extraction as a means of financing pasture recuperation may cause much damage to forests in the event of a major fire (Nepstad et al., 1999).

The Formalization of Property Rights

The Amazon frontier is notorious for rural violence in conflicts over property rights, a fact highlighted in political ecological theorizing (Rudel and Horowitz, 1993; Schmink and Wood, 1987, 1992). In accordance with privatization theories of resource use, conflicts occurred because of a lack of legal institutions to provide clear private property rights (Alston, Libecap, and Mueller, 1999). Without clear property rights, colonists and ranchers faced tenure insecurity and responded to this by rapidly clearing land to establish claims by demonstrating land use (Schmink and Wood, 1992:chap. 6). As a result, deforestation was particularly pronounced in the "parrot's beak" region around northern Tocantins, where rural violence over contested land claims has been common (Almeida, 1995). The state responded by handing out land titles to selected contestants (Schmink and Wood, 1992) or by resettling smallholders in other areas (Hall, 1989). These policies helped change the composition of landholdings with respect to tenure status. Whereas the overall number of rural establishments in the Amazon declined from 1985 to 1996 (Table 2), the number of formal property claims rose from 456,700 to 541,400, as claims lacking legal rights declined precipitously from 603,800 to 351,400 (IBGE, 1990, 1998a). The percentage of landholders with private property rights therefore rose from

43 percent in 1985 to 61 percent in 1996. Although proportionally more landholders have legal claims, the relative increase in formal ownership also resulted from selective rural out-migration of squatters, implied by the decline in the number of squatters' establishments overall (Table 2), and the rural population of the Amazon (Table 1). It is likely that many of these out-migrants went to towns and cities in the Amazon (judging from the region's rapid urban growth) or left the region altogether (given the Amazon's highly negative net migration in the 1990s). However, contrary to the expectations of privatization theory (Alston, Libecap, and Mueller, 1999) and in contrast to previous tenure conditions in the Amazon, the increase in formal property rights proceeded during a period of continuing deforestation in the 1990s. This historical shift suggests that improved tenure security may encourage deforestation, most likely through expanded investments in cattle pasture.

National and Global Changes in the Social Context of Deforestation in the Amazon

Operating outside the Amazon are other actors in the Brazilian national arena and the international scene, where macro-level mechanisms have worked to alter the place of the Amazon in federal policies, environmental movements, and the globalizing economy. At the national and global levels, political ecologies are particularly dynamic and complex. This section takes up two key changes in Brazil and three important international/global phenomena that together have had indirect impacts on the Amazon landscape. At the Brazilian national level, these changes are the "greening" of development policies and the effects of inflation reduction on land markets. At the global level, three key changes are new projects supported by multilateral banks, robust foreign demand for Brazilian agricultural exports, and the emergence of global environmental politics.

The "Greening" of Brazilian Development Policies

In the 1970s, Brazil's then-military government sought to economically integrate the Amazon into the national economy by constructing new highways, offering fiscal incentives for investment in the frontier, and directing colonization (Browder, 1988). It is well known that such policies facilitated in-migration, land settlement, and deforestation in the Amazon (Binswanger, 1991). The military handed control of the state back to civilian politicians in 1985, and in 1988, in response to international criticism over the major deforestation event of the previous year, Brazil announced an environmental policy directive, Our Nature (Nossa Natureza), which instituted the creation of a forestry agency (IBAMA) in 1989 (Hall, 1997:chap. 2). It also led to the creation of state-level environmental agencies, which

now include one in Acre supported by a new "forest government" with a goal of stabilizing total deforestation at 14–18 percent of the state's land area (Estado do Acre, 2000). In addition, Brazil altered its 1965 forestry code to increase the legal requirement for the amount of private land to be left forested from 50 percent to 80 percent (Hall, 1997:chap. 2). In the mid-1990s, the state instituted further environmental policies for the Amazon, such as the National Integrated Policy for the Legal Amazon in 1995. This plan formalized "ecological-economic zoning" as a policy for preserving forests in ecologically sensitive areas while developing land with high economic potential (Mahar, 2000).

Although Brazil's democratization and recent environmental legislation suggest policy turns toward forest preservation in the Amazon, some account of military activities and other projects in the region is also necessary. In 1996, the Amazon Protection and Vigilance Service (SIVAM) was approved by Brazil's legislature, creating a US$1.77 billion surveillance system consisting of radar dishes, radio stations, remote-sensing platforms, planes, and air force personnel to anticipate foreign aggression and monitor forest clearing and drug trafficking (Brigagão, 1996). Although the military in part justified SIVAM on the grounds of protecting the Amazon forest, other recently approved state projects may undermine conservation measures. Brasil Avança is a federal program to add or improve roads to increase access to forests. This, alongside new waterway transport systems (*hidrovias*) and the extension or paving of roads to the Caribbean (from Amazonas north to Venezuela) and the Pacific (from Acre west through Bolivia and Peru), will make Amazon forests more accessible, more valuable, and potentially more prone to clearing (Lovejoy, 2000:56). It is unclear whether the "greening" of state policies, including military activities, can reduce deforestation in the presence of new federal infrastructure projects.

Brazilian Inflation Reduction and the National Land Economy

The role of the Amazon in Brazil's national economy has historically been that of an extractive periphery in the world system, a region of rich natural resources that were exported for processing elsewhere (Bunker, 1984). That changed with frontier agricultural expansion during the 1970s as demand for land in the Amazon rose, increasing land values and thereby driving deforestation, as farmers and ranchers sought to secure claims. This process accelerated with the onset of Brazil's economic crisis in the 1980s, which increased inflation and made investments in land a good means of preserving the value of liquid capital (Ozório de Almeida and Campari, 1995). By the late 1980s, the crisis had deepened, and the state was forced to freeze bank assets, prohibiting withdrawals to prevent capital flight. This made capital for Amazon land purchases scarce, reducing deforestation around 1990 (INPE, 2000). In 1994, the Real Plan, a fiscal stabilization plan that

pegged the value of the new currency (the "Real," or R$) to the U.S. dollar, reduced Brazilian inflation and stimulated new investment. This in turn drove up land prices in the Amazon and helps explain the spike in deforestation observed in the region in 1994–1995 (Fearnside, 2000).

The Role of Multilateral Banks and International Loans

Since 1980, Amazon development has increasingly reflected the influence of large projects funded in part by loans from multilateral banks. Two early examples are the Grande Carajás Project (PGC) and the Northwest Development Pole (Polonoroeste), both from the 1980s. The PGC involved US$61.2 billion for construction of extraction, processing, and export facilities for the world's largest iron deposit, located in the Carajás range in southeastern Pará. The iron mine and an 890 km railroad to the coast raised land values and led to deforestation amid land speculation and conflicts (Hall, 1989). Polonoroeste was a US$1.5 billion project, with $500 million from the World Bank, that sought to pave BR-364, a key highway in Rondônia and Mato Grosso, and regularize land settlement via accelerated titling and credit programs. Polonoroeste led to a massive influx of population and rapid deforestation in both states (Millikan, 1992).

I select two examples among several others from the 1990s that involve state support of foreign investment in large infrastructure projects in the Amazon. First, the Northern Corridor Highways (ECN) is a US$603 million project, with US$220 million from the World Bank, approved by Brazil's congress in 1994 for new or improved highways in Maranhão and Tocantins to open "unsettled" land for soybean cultivation along the Amazon forest margins. The ECN led to new land conflicts, forest removal, and soil erosion (Hageman, 1996:chap. 2).

Second, the Agricultural and Forestry Plan for Rondônia (Planafloro) is a US$229 million successor to Polonoroeste, with US$167 million from the World Bank, to help the state aid agriculture and agroforestry activities via improved infrastructure, with ecological zoning to focus development on already settled areas. Implementation of Planafloro began in 1993, and by 1994, local nongovernmental associations (NGOs) organized a forum to criticize the lack of participation by local groups, the lack of demarcation of indigenous and conservation territories against encroachment, the lack of support for agroforestry projects, and the emphasis on spending for road improvements and credit for cash crops (Hageman, 1996:chap. 4). Implementation of ecological zoning was impeded by the fact that many local governments would have reduced revenues if such zoning was implemented, because most of their land was zoned for conservation rather than deforestation and agricultural production. Although the state government later included representatives of NGOs and local groups in recognition of social mobilization, there has been increasing pressure to change zoning guidelines

to allow for more deforestation (Mahar, 2000). Prodeagro, a similar project in Mato Grosso, has yielded similar results and political pressures (Hageman, 1996:chap. 4).

International Demand for Brazilian Agricultural Exports

In the 1990s, Brazilian agriculture contributed substantially to national economic growth and servicing of the national debt through the expansion of exports of processed goods in demand by international markets, particularly the European Community (OECD, 1997). Crucial to Brazil's increased export earnings is the expansion in exports of soybeans, in part due to new production in the Amazon. This is one reason why multilateral banks, which receive funding from Organisation for Economic Cooperation and Development (OECD) countries, have been keen to make loans for infrastructure projects in the Amazon. Such projects, driven by the political economies of international soybean prices and multilateral lending, create pressures for new forest clearing. As a result, soybean cultivation in the Amazon has increased dramatically, from 33 ha in 1975 to 858,000 ha in 1985 to 1.66 million ha in 1996 (IBGE, 1979, 1990, 1998a). Most of the increase since 1985 has occurred in Mato Grosso, where deforestation has proceeded especially rapidly since 1990 (INPE, 2000).

The Emergence of International Environmental Politics

In the international arena, deforestation in the Amazon has become a political issue as much as an environmental question. International concern over the Amazon emerged when satellite-based estimates of land cover conversion became widespread in the late 1980s, leading to Group of Seven meetings and mobilization by environmental groups in OECD countries that generated pressure on Brazil to manage its forests more responsibly (Kolk, 1996). This political pressure stimulated debate over the question of Brazil's sovereignty to continue forest conversion in the pursuit of national development (Hurrell, 1991). By the early 1990s, Brazil's handling of the Amazon was no longer merely a question of national development, but also a diplomatic stumbling block that arose in all manner of foreign affairs (Hurrell, 1991). The debate over management of Amazonian forests arose at the UN Conference on Environment and Development in Rio de Janeiro in 1992 (Kolk, 1996).

In addition, international and Brazilian environmental and human rights NGOs formed alliances with grassroots groups in the Amazon to press for tenure rights and forest conservation. Such alliances proliferated after the military stepped down, particularly after the 1988 murder of rubber tapper–turned–environmentalist Chico Mendes. Local grassroots groups needed

national and international NGO support to protect forests on which their livelihoods depended because they faced powerful adversaries who were better financed, organized, and connected to state actors. The Association of Amazon Entrepreneurs (AEA) and the Rural Democratic Union (UDR), who represented the interests of southern Brazilian capitalists and ranchers, respectively, were highly effective in blocking proposals for agrarian reform and forest conservation during the 1980s (Hurrell, 1991). The international alliance altered the Amazon's political ecology and helped to provide the means for grassroots groups to be heard by national legislators, international donors, and commercial firms. This in turn provided opportunities for local peoples to maintain their claims to forested land and to engage in extractive activities that preserve forests while generating livelihoods by selling to outside markets (Schmink, 1992).

Conclusion

The foregoing comparative analysis implicitly delineates linkages from global driving forces to household decisions that all influence changes in deforestation in the Amazon. The "soybean story" is one example, in which high prices in OECD countries (at the global level) and new bank loans to Brazil, an emergent international soybean exporter (the national level), fund new infrastructure projects in the Amazon to open up new land for soybean cultivation (at the regional level), raising roadside land values that stimulate investment (at the local level) and prompt rural property owners to clear more land for the prospective returns (the household/firm level). Another example, the "cattle story," begins at the Brazilian national level, where growing middle-class populations, including the Amazon's large urban population, increase demand for beef and milk, prompting new credit programs for investment in cattle that even smallholders can take advantage of, leading households with a need for insurance substitutes to clear more land for cattle pasture. A final example concerns social movements, which have benefited from feedbacks generated by rural violence and deforestation (local level) that attracted support from foreign and Brazilian NGOs (national and global levels), which helped mobilize grassroots groups (local level again), which in turn have organized into state- and region-level confederations for mutual support to preserve forests. These examples make it clear that the social driving and mitigating forces of deforestation in the Amazon are extremely complex, and the foregoing discussion establishes that the importance of these forces varies through historical time. In consequence, deforestation (among other forms of land cover and environmental change) deserves more interdisciplinary research with a strong social science component, as well as work on the shifting social, demographic, political, and economic contexts within and outside of the Amazon.

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