ISSN 15169111

PAPERS DO NAEA Nº 296

CONTROLLING DEFORESTATION IN THE BRAZILIAN AMAZON

Luis E. Aragón

Belém, junho de 2012

NAEA

Núcleo de Altos Estudos Amazônicos (NAEA) é uma instituição de Pós-Graduação vinculada à Universidade Federal do Pará, fundada em 1973 com o objetivo de estimular e produzir projetos de pesquisa sobre a Pan-Amazônia.

Tem como objetivos fundamentais o ensino em nível de pós-graduação, visando em particular, a identificação, descrição, análise, interpretação e solução dos problemas regionais amazônicos; a pesquisa, notadamente em assuntos de natureza sócio-econômica relacionados com a região; e a informação, através da coleta, elaboração, processamento e divulgação dos conhecimentos científicos e técnicos disponíveis sobre a região

Desenvolve seus trabalhos priorizando a interação entre as atividades de ensino e pesquisa, por meio de ferramentas de planejamento, de elaboração de projetos, no âmbito das modalidades de gestão.

As atividades de ensino estão organizadas no Programa de Pós-Graduação em Desenvolvimento Sustentável do Trópico Úmido (PDTU), que integra os níveis Doutorado e Mestrado e no Programa de Pós-Graduação Lato Sensu, no nível de Especialização.

Baseado no princípio da interdisciplinaridade, realiza seus cursos de acordo com uma metodologia que abrange a observação dos processos sociais, numa perspectiva voltada à sustentabilidade e ao desenvolvimento regional.

Setor de Editoração

Coordenação:
E-mail: editorao_naea@ufpa.br
Telefone: (91) 3201-7696

PAPERS DO NAEA

Os Papers do NAEA publicam textos de professores, alunos e pesquisadores associados da UFPA para submetê-los a uma discussão ampliada e que possibilite aos autores um contato com a comunidade acadêmica.

CONTROLLING DEFORESTATION IN THE BRAZILIAN AMAZON[1]

Luis E. Aragón[2]

Abstract:

In Brazil, the Amazon is defined in the Law. *Legal Amazônia* is located in the north and consists of the entire territories of the states of Acre, Amazonas, Rondônia, Roraima, Amapá, Pará, Mato Grosso, Tocantins and the portion of the state of Maranhão west of longitude 44 (Figure 1). Defined in this way the region has an area of 5,034,740 km^2 which represents more than 59% of the Brazilian territory (Rocha, 2005). The region is mainly covered by tropical forest, 80% of it still unexplored or preserved. According to the 2010 census, the population of the Amazon (including the entire state of Maranhão) reached more than 25 million people (13% of the country), mostly located in areas considered urban.

Key-word: Legal Amazônia; Brazilian territory; Controlling deforestation.

[1] Paper presented at the 2nd International Workshop on South-South Cooperation for Sustainable Development in the Three Major Tropical Humid Regions in the World. Pekanbaur, Indonesia, 4-8 October, 2011.

[2] Professor and researcher of the Center for Advanced Amazonian Studies of the Federal University of Pará, Belém, Brazil, and chairholder of the UNESCO Chair in South-South Cooperation for Sustainable Development. E-mail: aragon_naea@ufpa.br.

1. Introduction

In Brazil, the Amazon is defined in the Law. *Legal Amazônia* is located in the north and consists of the entire territories of the states of Acre, Amazonas, Rondônia, Roraima, Amapá, Pará, Mato Grosso, Tocantins and the portion of the state of Maranhão west of longitude 44 (Figure 1). Defined in this way the region has an area of 5,034,740 km^2 which represents more than 59% of the Brazilian territory (Rocha, 2005). The region is mainly covered by tropical forest, 80% of it still unexplored or preserved. According to the 2010 census, the population of the Amazon (including the entire state of Maranhão) reached more than 25 million people (13% of the country), mostly located in areas considered urban.

2. Deforestation

The National Institute for Space Research (INPE) monitors, via satellite, the deforestation in the Brazilian Amazon since 1988. Table 1 shows a cyclic process of deforestation. In the first period, the deforested area fell from 21,050 km^2 in 1988 to 11,030 km^2 in 1991, starting from this year an upward cycle that culminates in 1995 with a record of annual deforestation in the region so far recorded (29,059 km^2). Then, there is another period of decline until 1997 (13.227 km^2) and then another of increase, being it more intense since 2002, arriving in 2004 to levels close to those found in 1995 (27,772 km^2). From this year, deforestation decreases substantially and continuously (except for slight increase in 2008), arriving in 2011 to the lowest value of the series (6,238 km^2). In seven years (between 2004 and 2011), a decline in deforestation was thus more than 77%.

INPE data also reveal that deforestation is not distributed homogeneously in the region. It is concentrated in an area that extends from southeast of Maranhão, northern Tocantins, south of Pará, northern Mato Grosso, Rondônia, southern Amazonas and southeast of Acre, an area known as the arc of deforestation or consolidated settlement (Becker, 2004). Over 70% of the deforested area occurs in this area. In 2004 the largest increase occurred in Mato Grosso, Rondônia and Pará. This year, about 90% of deforestation was concentrated in these three states, considered the champions of deforestation in the region. But from that year (2004), deforestation enters a downward trend until this day (2011), and the most spectacular falls occurred in the states considered the champions of deforestation.

For some, the causes of deforestation in Brazil and Latin America in general are rooted in the history of the country and the region: deep social and regional inequalities, ignorance, inefficient judicial system and corruption, among others (Dourojeanni, 1999). In Brazil, in addition, other specific causes of deforestation in the Amazon are well known: expansion of cattle ranching and soybean farming, predatory extraction of timber, building infrastructure, failure of rural settlement programs, fires associated with the expansion of agriculture, lack of physical and human infrastructure to monitor deforestation, and lack of effective mechanisms to enforce environmental laws, among others (PR, 2004). The reasons for the substantial and sustained drop of deforestation over the past seven years are less known, but some of them can be pointed out such as better monitoring of deforestation and predatory exploitation of timber,

ISSN 15169111

environmental law enforcement, stimulus to agricultural development in deforested areas, improvement of soils for soybean cultivation in the savannah areas, restricted expansion of livestock production in new areas, encouraging productive arrangements that promote the maintenance of standing forest, control of the invasion and land speculation along existing and planned roads, implementation of ecological-economic zoning, and implementation of protected areas and demarcation of indigenous territories. Those measures are already envisaged in the Sustainable Amazon Plan, in progress since 2003 (Brasil, 2006).

3. UN-REDD Programme

One of the most promising initiatives to maintain the current downward trend of deforestation in the Brazilian Amazon is the implementation of actions within the framework of the UN-REDD Programme (Reducing Emissions from Deforestation and Forest Degradation). The UN-REDD Programme is a collaborative initiative of the United Nations to reduce emissions of greenhouse gases to the atmosphere, and promote forest conservation in developing countries. The programme was launched in September 2008 to help developing countries to prepare and implement actions and strategies aiming at these goals. REDD is therefore a Clean Development Mechanism (CDM), which seeks to reduce substantially and sustainably the emission of greenhouse gases in the atmosphere to mitigate global warming.

The recognition of the impact of the accumulation of carbon dioxide (CO_2) emissions in the heating of the earth generated at the United Nations the Kyoto Protocol, adopted in June 1997, determining that the industrialized countries, that are the major responsible for air pollution, would have to reduce in 5.2% all their emissions according to the levels of 1990 by 2012. Because of the high costs of generation and adoption of clean technologies and the necessary changes in consumption habits in these countries to achieve this goal, emerged the mechanism of marketing carbon credits, now widely known and used as a way of sponsoring projects for carbon sequestration in developing countries. Through this mechanism countries with excess of CO_2 emissions (industrial) could compensate for this excess by buying carbon credits through the sponsorship of projects of sequestration of CO_2, including reforestation. As a result, carbon credits have become an important international market. During the first five months of 2004, 64 million tons of CO_2 were exchanged in the world, similar to the amount of the entire year of 2003 (Santilli and Moutinho, 2006). Certainly it is a business that could benefit the Amazon. Only in the Brazilian Amazon are estimated to exist approximately 200,000 km^2 of degraded areas with the possibility of implementing reforestation projects that would generate at least US$ 150 million a year by selling carbon credits (Noble and Noble, 2005). This possibility, however, offers limited contribution to controlling deforestation, because the mechanism does not include the sale of CO_2 already retained in the forest, keeping it standing. But this is not its only limitation. Reforestation can help to expand monoculture, diminishing, as a consequence the biodiversity and, depending on the species used, it would require extensive plantations to absorb significant amounts of CO_2, thus reducing the possibility of involvement of poor communities because of high operating costs, and therefore, producing limited social

ISSN 15169111

impacts. Moreover, for the sale of CO_2 credits have a significant impact on reducing global warming should be accompanied by measures to reduce emissions in developed countries such as the implementation of new technologies for clean energy generation, and in turn, that these innovations were transferred quickly to be also implemented in less developed countries (Aragón, 2007a).

Brazil contributes with the emission of 80 million to 90 million tons per year of CO_2 from burning fossil fuels and 200 million to 250 million tons per year of changing land use, especially deforestation (3/4 of total) (Noble and Noble, 2005). The annual deforestation in the Amazon rain forest represents the emission of about 200 million tons per year of CO_2 (Santilli and Moutinho, 2006); if deforestation was completely controlled, and avoided deforestation compensated, it would prevent that amount of CO_2 of being emitted to the atmosphere, giving, in turn, significant economic value for keeping the forest standing, conserving biodiversity.

The REDD Programme is a mechanism to complement marketing of carbon credits, choosing to establish forms of compensation for the preservation of tropical forests through the elimination or control of deforestation and promotion of economic activities that keep the forest standing. In order to implement the REDD programme in Brazil, the government established the Amazon Fund in 2008. The Fund seeks to raise funds for investments in projects to prevent, monitor and combat deforestation and to promote conservation and sustainable use of Amazonian forest. The Fund is managed by the National Development Bank (BNDES), which is also responsible for fundraising and evaluation and approval of projects. It is expected to supply the Fund with national and international donations; the Norwegian government has already committed US$ 1 billion and Germany another US$ 28 million. The Brazilian petroleum company Petrobras has also donated R$7,3 million[3]. Until 31 October 2011, 16 projects had been contracted with support from the Fund in the total amount of R$201,6 million and approved in contracting process four more projects in the amount of R$33 million. Until that date R$63,6 have already been disbursed[4].

The projects are diverse, involving NGOs, state government agencies, municipalities, universities, foundations and other institutions, with values ranging from R$133,900 to R$60 million in implementation periods ranging from 12 to 72 months. Two of these projects are particularly innovative: The *Bolsa Floresta* (PBF) (Forest Allowance Project) and the Project Incubator of Public Policy in the Amazon.

The PBF Project[5] is a pioneering initiative of payment of environmental services for the populations living in protected areas of the Amazon and committed to reducing deforestation. It was established by the Government of the State of Amazonas in 2007 to economically value and to compensate environmental conservation efforts of families living in protected areas of the state of Amazonas. All beneficiaries of the PBF Project participate in a training workshop on climate change and sustainability, after which they sign voluntarily a commitment term of zero deforestation.

[3] 1 US$ is equal to about 1.84 Real.
[4] Fundo Amazônia. http://www.fundoamazonia.gov.br. Consulted in 07/12/2011.
[5] www.fas_amazonas.org/. Consulted in 28/11/2011.

ISSN 15169111

The project consists of four components that operate in an integrated manner: The Forest Allowance Income, the Forest Allowance Social, the Forest Allowance Association and the Forest Allowance Family.

The first component (Forest Allowance Income), amounting to R$ 145 thousand per year for each Conservation Unit (protected area), seeks to promote productive arrangements and certification of products that enhance the value received by the producer, by supporting activities that do not cause deforestation, which are legalized, and that value the standing forests, including sustainable production of fish, vegetable oils, fruits, honey, nuts, among others.

The second component (Forest Allowance Social), with an investment of R$ 140 per year for each Conservation Unit (protected area), is aimed at improving education, health, communication and transportation, considered basic factors for the building of citizenship. Actions are developed in partnership with governmental agencies responsible for those policies and other collaborating institutions.

The third component (Forest Allowance Association) is designed to strengthen the organization and social control of the Project. The investment is equivalent to 10% of the sum of all Forest Allowance Family. The aim of this component is to promote participatory management by strengthening community organization, community empowerment, and social control of the whole PBF, contributing to the exercise of associational leadership in protected areas of the state of Amazonas.

The fourth component (Forest Allowance Family) aims to promote the involvement of families living in state protected areas to reduce deforestation and valuation of standing forest. In practice, consists of a monthly reward of R$50 paid to mothers of families living within protected areas that are willing to assume a commitment to environmental conservation and sustainable development. It is an important mechanism to involve people in activities to combat deforestation. The Forest Allowance Family is not a salary and not intended to be the main source of family income, it's just an income supplement paid as a reward for forest conservation.

By October 2011, the PBF Project had included 15 Conservation Units of the State of Amazonas, covering an area of 10 million hectares, 7,971 families and 34,810 people registered, and 7,203 families and 31,818 people benefited.

The Project Incubator for Public Policy in the Amazon, on the other hand, was designed by the Center for Advanced Amazonian Studies of the Federal University of Pará (NAEA), and represents a response to the social commitment of universities in the region. Through the Forum for Research and Graduate Studies in Sustainable Development, researchers in the region formulate proposals for sustainable development in scientific research bases, making such proposals available to the society and governments. The Forum for Research and Graduate Studies in Sustainable Development of the Amazon was created in June 2009 and is integrated by Graduate Programmes implemented by the Universities of the Amazon. This forum aims to "contribute to the formulation of public policy focused on the economic

ISSN 15169111

and social development of the people living in the Amazon, through the construction of a prospective vision of the region, based on growing knowledge of regional problems, and respect of the environment"[6].

The Incubator Project for Public Policy in the Amazon[7] is an institutional mechanism for coordination between universities, research institutes, governments, and the productive sector of the Amazon, whose mission is to contribute to the design, formulation, monitoring and evaluation of public policies for sustainable development for the region, its states and municipalities, supported by scientific and traditional knowledge, and participation of qualified regional actors. The project seeks to reconcile, integrate, and consolidate studies of the socio-economic, political, institutional, and environmental phenomena of the Amazon, at the macro, meso, and micro-regional levels, in order to contribute to the discussion of the economic, social and environmental aspects of the Amazon, the systematization of the information produced within the research groups affiliated with the Forum for Research and Graduate Studies in Sustainable Development for the Amazon, the monitoring and evaluation of public policies in the Amazon, its states and municipalities, the formulation of regional development policies and other policies public; the generation and transfer of modern methods and techniques of public management; and the production and transfer of social technologies for urban and rural communities excluded from the formal labor market in the Amazon.

The Incubator of Public Policy in the Amazon is structured into three operating centers linked to the Forum Secretariat: the Center for Systematization, Monitoring and Evaluation of Public Policy, the Center for Generation and Transfer of Technologies of Public Management, and the Center for Generation and Transfer of Social Technologies. The actions carried out within these centers try to join the production of knowledge about the economic, environmental and socio-political-institutional reality of the Amazon, with processes of diffusion and transfer of technologies for public organizations and rural and urban communities in the region, as well as subsidize the governments in the elaboration of plans, programmes and development projects grounded in scientific knowledge as well as in the traditional knowledge of the Amazonian populations.

4. Protected Areas

In 2000, Brazil established the National System of Nature Conservation Units (SNUC), defining and classifying the preservation and conservation practices in the country in a single system, integrating

[6] http://www.amazonia.ufpa.br. Consulted in 28/11/2011. The Forum for Research and Graduate Studies in Sustainable Development is integrated at the moment by the following Graduate Programmes: Reginal Development (Federal University of Amazonas, Manaus, Amazonas); Society and Culture (Federal University of Amazonas, Manaus, Amazonas); Urban Development and Environment (University of Amazônia, Belém, Pará); Regional Development (Federal University of Amapá, Macapá, Amapá); Regional Development and Agribusiness (Federal University of Mato Grosso, Cuiabá, Mato Grosso); Sustainable Development of the Humid Tropics (Federal Universitry of Pará, Belém, Pará); Regional Development and Environment (Federal University of Rondônia, Porto Velho, Rondônia); Geography (Federal University of Pará, Belém, Pará).

[7] For further information and references consult: http://www.amazonia.ufpa.br. Consulted in 28/11/2011.

ISSN 15169111

public and private initiatives. The SNUC is integrated by two main categories of Conservation Units: a) units of full protection, and b) sustainable use units. Each category includes several types of protected areas. The Units of full Protection are: Ecological station, biological reserve, national park, natural monument, wildlife refuge. The Units of sustainable use are: environmental protection areas, areas of relevant ecological interest, national forest, extractive reserve, fauna reserve, sustainable development reserve, private reserve of natural heritage. According to the Sustainable Amazon Plan, at least 1.71 million km^2 (35.5% of the Brazilian Amazon) are protected in conservation areas (full protection or sustainable use), indigenous lands, *quilombola*[8] lands, or military areas (Brasil, 2006, p. 19).

Several studies show that deforestation in the Brazilian Amazon is significantly lower in protected areas than outside (Aragón, 2007b). According to Ferreira et al. al. (2005) only 2.0% of the area covered by protected areas and indigenous lands jointly in the Amazon had been deforested by 2003, compared to 23.6% of the area outside, a difference of 12 times. However, the government itself acknowledges that the "extensive model of exploitation of natural resources in some places, like in Rondônia, is leading to pressure from illegal loggers, cattle ranchers and land speculators on protected areas and indigenous territories" (Brasil, 2006, p. 19).

One of the harshest criticisms related to the practice of protected areas, especially in developing countries, is the tendency of these initiatives over valorize the ecological aspects. Often the criteria upon which they based their design do not originate from the affected population or meet their most urgent needs. However, the change in focus of the ideas of conservationists in modern times for a new paradigm where conservation and development are seen as interdependent processes has led to the formulation of schemes that seek to reconcile the demand for the preservation of ecosystems with the need to sustainably meet the good living of the populations affected.

The Biosphere Reserves Program of UNESCO is one of the most promising initiatives to integrate in a sustainable manner ecosystem preservation and promotion of well-being of populations in specific areas. Biosphere Reserves (BR) were established within the Man and the Biosphere (MAB) Programme of UNESCO in 1976, and are defined

> As places that seek to reconcile conservation of biological and cultural diversity and economic and social development through partnerships between people and nature, they are ideal to test and demonstrate innovative approaches to sustainable development from local to international scales. Biosphere reserves are thus globally considered as sites of excellence where new and optimal practices to manage nature and human activities are tested and demonstrated, tools to help countries implement the results of the World Summit on Sustainable Development and, in particular, the Convention on Biological Diversity and its Ecosystem Approach, [and] learning sites for the UN Decade on Education for Sustainable Development. After their designation, biosphere reserves remain under national sovereign jurisdiction, yet they share their experience and ideas

[8] Q*uilombolas* lands are territories delimited according to the Constitution whose property belongs to communities descendent of black slaves.

ISSN 15169111

> nationally, regionally and internationally within the World Network of Biosphere Reserves (WNBR)[9].

Under this concept, RB are places of learning and practice of sustainable development initiatives in specific areas which may include within the same RB various protection units, integrating management strategies with the participation of different actors, including local people, private sector, government, NGOs, and the scientific community. The Biosphere Reserves include territorial zoning that defines core zones (protected areas), buffer zones, and transition zones.

The experience of RB for over three decades of existence, then, represents an important asset for implementing sustainable development projects in areas of extreme importance in the world like the Amazon. This huge area is characterized by being rich in natural resources, but with low levels of development, including large segments of its population living in poverty.

The pressure on protected areas in the Amazon stems mainly from the conflict of interests between different actors, hence the need to integrate the population in environmental conservation initiatives. There will not be conservation if the living necessities of the people living in protected areas and outside them are not met. People should be an ally and not an obstacle for conservation; in fact people should be the central focus of any initiative.

In the Amazon, the Project "Sustainable Rural Development and Biodiversity Conservation in the Amazon Biosphere Reserves", is being carried out since 2010, involving 12 BR[10] located wholly or partially in this region, in Bolivia, Peru, Ecuador, Colombia, Venezuela, and Brazil. Within the framework of the Madrid Action Plan and mission of the UNESCO Chair in South-South Cooperation for Sustainable Development, this project focuses on the population of the Amazon BR, to identify ways to improve their quality of life and conservation of biodiversity through actions to strengthen their capabilities to implement rural development activities that add value to their products, conserving biodiversity. The project will allow the understanding of the capabilities and limitations of BR in the Amazon as mechanisms to improve the integration of environment and development through activities developed by local communities. The project will develop a geo-referenced database of the 12 participating BR, identify best practices of the rural development and biodiversity conservation carried out in each reserve and the

[9] http://www.unesco.org/new/en/natural-sciences/environment/ecological-sciences/biosphere-reserves. Consulted in 30/11/2011.

[10]The BR integrating the Project are: In Bolivia: 1) Apolobamba (Ulla Ulla), 2) Pilón Lajas, 3) Beni; in Peru: 4) Manu, 5) Oxapampa-Ashaninka-Yanesha; in Ecuador: 6) Yasuni, 7) Sumaco, 8) Podocarpus-El Cóndor; in Colombia: 9) El Tuparro; in Venezuela: 10) Alto Orinoco-Casiquiare, 11) Delta Orinoco; in Brasil: 12) Amazônia Central. The project is financially supported by UNESCO, the Ministry of Environment of Spain, and other institutions.

ISSN 15169111

implementation of 24 pilot projects of sustainable rural development and conservation of biodiversity in these RB.

5. Conclusion

To conclude, it seems that the measures taken in Brazil have been able to sustain the recent fall in the rates of deforestation in the Amazon. However, it is important to consider that sustainable development is not restricted just to diminish deforestation, and that serious threats remain that can counteract the current downward trend of deforestation, and commencing, as has happened in the past, a new upward cycle. The eventual adoption of a new forest code, which encourage deforestation; the progress of the program of building dams in the Amazon, including of the Belo Monte, despite the many protests; and inconsistencies frequently pointed out between the Plan for Accelerated Growth and the Sustainable Amazon Plan, are some of the threats that can change the course of deforestation in the Brazilian Amazon.

The evidences presented here also demonstrate that, until now, protected areas are serving as important measures for the prevention of deforestation in the Brazilian Amazon, but the question is, for how long? The existence of illegal deforestation within the areas protected by law is of concern and serves as a warning to expand the control measures of this process. At the end it is plausible to think that the law alone cannot stop deforestation. The implementation of protected areas, to be effective, must be accompanied by other measures such as (1) recovery of deforested areas to control the expansion of agriculture into new areas, (2) greater involvement of local actors in the processes of formulation and implementation of regional development policies, (3) valuation of forest environmental services, (4) economic valuation of standing forest and adding economic value to forest products that do not compromise biodiversity, (5) to comply with stricter environmental legislation, (6) intensified surveillance, and (7) control of corruption. Such measures are already being taken by the Brazilian government and the current decline in deforestation largely conforms to these measures, but should warn that the experience shows that government policies are sustainable only when the local population endorse them and consider those policies beneficial for themselves.

ISSN 15169111

Referencie:

Aragón, Luis E. (2007a). Novos temas regionais para o estudo da Amazônia no atual contexto internacional. In Feldman, Sarah; Fernandes, Ana (Ed). *O urbano e o regional no Brasil contemporâneo: Mutações, tensões, desafios*. Salvador: Editora da Universidade Federal da Bahia, p. 153-174.

Aragón, Luis E. (2007b). Deforestación en la Amazonía brasileña: Áreas indígenas y unidades de conservación como mitigadoras del proceso. In Halffter, Gonzalo; Guevara, Sérgio; Melic, Antonio (Ed). *Hacia una cultura de conservación de la diversidad biológica.* Zaragoza: Sociedad Entomológica Aragonesa, p. 237-243.

Becker, Bertha K. (2004). Amazônia: Mudanças estruturais e tendências na passagem do milênio. In Mendes, Armando (Ed). *Amazônia: Terra e Civilização.* Belém: Banco da Amazônia, p. 115-140.

Brasil – Casa Civil da Presidência da República (2006). *Plano Amazônia Sustentável.* Brasília.

Dourojeanni, Marc (1999). *The future of Latin American forests.* Washington, D.C.: Inter-American Development Bank (Environmental Division Working Paper).

Ferreira, L. V.; Venticinque, E.; Almeida, S. (2005). O desmatamento na Amazônia e a importância das áreas protegidas. *Estudos Avançados.* V. 19, N. 53, p. 157-166.

Nobre, Antonio Donato; Nobre, Carlos Afonso (2005). O carbono e a Amazônia: O incerto conhecimento atual e estratégias de mitigação de emissões. *Ciência & Ambiente.* V. 31, p. 39-47.

PR – Presidência da República/Brasil (2004). *Plano de ação para a prevenção e controle do desmatamento da Amazônia Legal.* Brasília: Grupo Ministerial para a Redução dos Índices de Desmatamento da Amazônia Legal.

Rocha, Gilberto de Miranda (2005). Aspectps recentes do crescimento e distribuição da população da Amazônia brasileira. In Aragón, Luis E. (Ed). *Populações da Pan-Amazônia.* Belém: Núcleo de Altos Estudos Amazônicos, p. 141-175.

Santilli, Márcio.; Moutinho, Paulo (2006). O desmatamento na Amazônia e a efetividade do Protocolo de Quioto. *Ciência & Ambiente.* V. 32, p. 61-71.

ISSN 15169111

Table 1 – Deforested area (km^2) by year in the Brazilian Amazon, by state, 1988-2011.

Year	Acre	Amapá	Amazonas	Maranhão	Mato Grosso	Pará	Rondônia	Roraima	Tocantins	Total
1988a	620	60	1510	2450	5140	6990	2340	290	1650	**21050**
1989	540	130	1180	1420	5960	5750	1430	630	730	**17770**
1990	550	250	520	1100	4020	4890	1670	150	580	**13730**
1991	380	410	980	670	2840	3780	1110	420	440	**11030**
1992	400	36	799	1135	4674	3787	2265	281	409	**13786**
1993b	482		370	372	6220	4284	2595	240	333	**14896**
1994b	482		370	372	6220	4284	2595	240	333	**14896**
1995	1208	9	2114	1745	10391	7845	4730	220	797	**29059**
1996	433		1023	1061	6543	6135	2432	214	320	**18161**
1997	358	18	589	409	5271	4139	1986	184	273	**13227**
1998	536	30	670	1012	6466	5829	2041	223	576	**17383**
1999	441		720	1230	6963	5111	2358	220	216	**17259**
2000	547		612	1065	6369	6671	2465	253	244	**18226**
2001	419	7	634	958	7703	5237	2673	345	189	**18165**
2002	883		885	1085	7892	7510	3099	84	212	**21651**
2003	1078	25	1558	993	10405	7145	3597	439	156	**25396**
2004	728	46	1232	755	11814	8870	3858	311	158	**27772**
2005	552	33	775	922	7145	5899	3244	133	271	**19014**
2006	398	30	788	674	4333	5659	2049	231	124	**14286**
2007	184	39	610	631	2678	5526	1611	309	63	**11651**
2008	254	100	604	1271	3258	5607	1136	674	107	**12911**
2009	167	70	405	828	1049	4281	482	121	61	**7464**
2010	259	53	595	712	871	3770	435	256	49	**7000**
2011[c]	271	51	526	365	1123	2870	869	120	40	**6238**

Source: Instituto Nacional de Pesquisas Espaciais (INPE). *Projeto PRODES: Monitoramento da floresta amazônica brasileira por satélite.* http://www.obt.inpe.br/prodes/index.html. Consulted in 04/01/2012

a. Average between 1977 and 1988
b. Average between 1993 and 1994
c. Estimate

ISSN 15169111

Source: Aragón (2007b, p. 238)

Figure 1: The Brazilian Amazon

ISSN 15169111