

Tropical Forest, Deforestation and Climate Change: The Amazon Case

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Introduction

Tropical forests are giant reservoirs of carbon that must remain largely intact if we want to bring global warming under control (IPCC 2007, Stern Review 2006¹). Around 200 PgC² are stored in the tropical forests that cover the planet (IPCC 2007). However, during the 1990s and, as a consequence of deforestation, this carbon has been released as CO₂ - a potent greenhouse gas – GHG - to the atmosphere at the rate of approximately of 0.8 ± 0.2 to 2.2 ± 0.8 PgC per year (10 - 35% of global carbon emission), (Houghton 2005, Achard et al. 2002, DeFries et al. 2002, Table 1).

Only in Brazilian Amazon, deforestation during the last decade released 0.2 PgC/year (3% of global total) (Houghton 2005), representing 70% of total Brazilian emission (carbon emissions from burning fossil fuels in Brazil represent ca. 0.09 PgC/year; reference year 2002. Santilli et al., 2005). Also, emissions from human-caused tropical forest fire can double these emissions in years of extreme drought (Nepstad et al. 2002).

The rate of Amazon deforestation was 18,165 km² during the 90's and 19,289 km² during the 2000's with a peak in 1995 (29,059 km²) and 2004 (27,379 km²) (INPE/PRODES. 2007). An area equivalent to France territory (ca. 645 000 km²) is already deforested and converted, particularly, to pasture (Figure 1). The deforestation rates of Brazil alone would result in GHG emissions equivalent to 40% of the annual reduction goals for industrialized countries listed in the Annex I of the Kyoto Protocol (Santilli et al. 2005, Moutinho & Schwartzman 2005, Table 1).

Recent studies demonstrated that Amazon deforestation will increase in the coming decades. The estimative is that 32 PgC will be emitted into the atmosphere by 2050 if deforestation follows the trend of the last two decades (Soares et al. 2006, Figure 2). The scenarios for

¹ http://www.hm-treasury.gov.uk./independent_reviews...w_economics_climate_change/stern_review_report.cfm (2 de 3) [15/2/2008 08:34:15]

² 1 PgC = 1 billion ton of carbon

increasing emissions in other tropical countries are similar. In Indonesia, for example, 17,000 km² of forests were cut down between 1987 and 1997 and 21,000 km² in 2003, adding another 0.2 PgC/year to atmosphere (Houghton et al., 2003).

There is now a consensus in the international community that to avoid “dangerous interference” in the global climate system—the primary objective of the United Nation Framework Convention on Climate Change (UNFCCC, article 2)—tropical deforestation should be greatly reduced. The Kyoto Protocol, although an important step for reducing GHG emissions, has no means of addressing tropical deforestation. In order to ensure that atmospheric CO₂ concentrations remain below 450 parts per million by volume (ppmv) by 2100 and to avoid “dangerous interference,” annual global emission reductions must be greater than 2 % per year starting in 2010. Given the inertia of global power consumption and costs of changing the energy matrix, it is likely for both developed and developing countries that large emission reductions (>2 percent per year) from fossil fuels will be unrealistic in the short term. Reductions in tropical deforestation, however, may be a bridge to technological transformation, offering a viable, cost-effective means by which to begin reducing GHG emissions before the technology needed to transform the energy and transportation sectors globally is developed.

Responding to the urgency to reduce emission from deforestation, the UNFCCC-COP 13 in Bali in late 2007 determined a two year process to design the new climate change international framework agreement post 2012 - “The Bali Road Map” - that includes Reduction Emission from Deforestation and Degradation (REDD) by the end of 2009 (COP 15). This approved “Road Map” in Bali represents the most important moment to qualify the REDD debate, finding the best alternative framework to implement REDD regimes under the UNFCCC throughout the next two years.

This paper introduces the importance of tropical forest and its deforestation to climate change, with emphasis on Brazilian Amazon. In addition, it is presented some political aspects involving the Brazilian position and proposals to reduce emissions from deforestation under the UNFCCC context and perspectives for pos-Kyoto agreement (pos-2012). Finally, it is explained some fundamental opportunities and barriers to implementation of mechanism of compensation for deforestation reduction in Brazil.

The causes of deforestation in Brazilian Amazon

As in other tropical region, deforestation in Brazilian Amazon results from the complex interaction of many factors that vary along an annual geographic and temporal axis. Indirect causes include subsidies for agribusiness, investment in infrastructure, land tenure issues,

absence of adequate surveillance by the government, demand for forest products (timber and other forest products). Direct causes include conversion of forest areas for plantation crops or cattle ranching, rural settlements, mining, and logging. More specifically, Amazon deforestation was initiated in the 1960s with investments in infrastructure, particularly in roads that connected the central and southern Brasil to the north. Large-scale colonization and mining projects (Northwest Complex, Carajás and the construction of hydro power plants and highways) combined with tax incentives for large-scale agriculture/ranching projects, played an important role to make feasible the conversion of large forested areas into extensive pastures (Mahar 1989, Sampaio 1997, Nepstad et al. 2001, Carvalho et al. 2001, 2002). Currently, the Amazon is undergoing a second phase of colonization, where tax incentives play less of a role and the profitability of logging and agriculture/cattle-raising are driving expansion and transformation of the frontier (Mattos and Uhl 1994, Margulis 2003, Alencar et al. 2004). This process is being reinforced by government and bilateral investment programs in infrastructure (Carvalho et al. 2001, 2002, Nepstad et al. 2000, 2001). Roads connect the region to the central and southern parts of the country, to the Pacific Ocean, the Caribbean and, through the Amazon River, to the Atlantic Ocean. Perhaps the difference between this new phase and former occupation is the existence of economic, demographic and political conditions for choosing a more sustainable development model for the region.

Tropical deforestation may be higher in the future

Tropical deforestation can increase in the coming decades because of three inter-related trends. First, agro-industrial expansion has shifted to the tropics in recent years, partly because there is little suitable land for agricultural expansion in the temperate zone. Second, the world's emerging economies, such as China, are also "emerging meat-eating nations", consuming increasing amounts of poultry, pork, and beef fed with ration made from imported soy meal, corn, and other grains, increasing the land area necessary to provide protein and calories for the world population (Nepstad, D. & C. Stickler in press). Finally, higher oil prices have triggered an enormous flow of investment into biofuels, increasing the competition for available agricultural land and driving up pressure to clear rainforests on land that is suitable for agriculture. In the Amazon, deforestation oscillates depending upon the prices of soy and beef and the strength of the Brazilian Real against the US dollar (Nepstad et al. 2006). For instance, in years where the Real was weak, favoring exportation, and the demand for soy in China and Europe (following "mad cow" outbreaks) and beef was high, the deforestation rates climbed to 27,400 km² in 2004, 50% above the long-term average. With the decline of soy and beef prices in 2005 and 2006, and the strengthening of the Real against the dollar, deforestation rates slowed to 18,800 and 13,100 km², respectively (INPE/PRODES. 2007). Currently, soy prices are climbing again as the demand for corn to make ethanol grows in the US, as sugar cane

production for ethanol expands in southern Brazil (displacing soy production), and as the demand for soy oil as a diesel substitute increases. But this decline was also caused by the Brazilian government's actions to curtail deforestation and govern the agricultural frontier, as described in the next section.

The potential of carbon emission reduction from deforestation in Brazilian Amazon

Reducing deforestation in Amazonia could make a substantial contribution to climate change mitigation (Table 1), and the Brazil is potentially prepared to do that. Currently, there are a number of effective mechanisms with high potential to control deforestation. The annual deforestation monitoring system (PRODES) in Amazon is one of the best in the world, and the monitoring capacity has been improved with the implementation of SIVAM project (Amazonian Vigilance System) and DETER (real time deforestation detection in Amazonia, updated every 15 days). This last one provided greater agility in identifying and preventing deforestation. Also, others fundamental elements necessary to control deforestation are available. For example, regional development plans to avoid novice impacts of new economic corridors – roads – into the Amazon before a regional plan has been established and agreed upon by local society (ex, along the Cuiaba-Santarem highway³ in Central Amazon). Through the “Deforestation Control and Prevention Action Plan for Legal Amazon”⁴, some initiative related to land tenure organization and support for sustainable productive activities (Rural Credit and Tax Incentives; Technical Assistance and Rural Extension services) has demonstrated with high potential to reduce deforestation at low cost. Also, the Brazilian government has proved to be able to implement direct actions of law enforcement, involving the Federal Police and Army in command and control of illegal deforestation. Finally, the creation of 240,000 km² of new protected areas in active frontiers by the government, between 2004 and 2005, established barriers to the advance of the deforestation (Nepstad et al. 2006). More than half of this newly-protected area will be eventually opened to commercial sustainable logging under Brazil's new forest concession policy. The government has now plans to create a further 15 million hectares of conservation units.

As the pressure for forest conversion continues and the revenue from forest products is not able to compete with other economic land use yet, preservation of large extensions of forest will only be possible if there is a mechanism capable of attributing monetary value to a standing forest. This is the greatest challenge to establishing a sustainable and environmentally sound economy in the Amazon and in other tropical regions. The most powerful economic mechanism to finance policies that seek to conserve large extensions of tropical forests is perhaps based on non yet

³ <http://www.ipam.org.br/web/programas/planejamento/br163/apresentacao.php>;
<http://www.socioambiental.org/esp/BR163/>; <http://www.ipam.org.br/web/programas/planejamento/br163/br163>

⁴ <http://www.planalto.gov.br/casacivil/desmat.pdf>;

visible commodities, such as the environmental services provided by a standing forest. Along these lines, the current carbon market created by the Kyoto Protocol is, perhaps, the most promising mechanism for valuing tropical forests, in a way that maintaining them becomes economically advantageous to tropical countries and forest people. In this track, compensating countries for their proved efforts to reduce emissions from deforestation (see detail in the next sections) may bring significant economic benefits that, if invested in policies to increase the value of forest resources, could result in significant reductions in deforestation rates and associated GHG emissions. Certainly, conditions for reducing deforestation exist in several countries, but only the adoption of mechanisms to enhance the value of standing forests will result in shifts in tropical development paradigms

The UNFCCC and the perspectives for deforestation reduction in Brazilian Amazonia

Since 2000, different groups and Brazilian NGOs have advocated the inclusion of GHG emissions from tropical deforestation in the international climate change negotiations (Fearnside 2001). During COP 13 held in Bali in December 2007, the issue of reducing emissions of deforestation and degradation (REDD), responsible for 20% of the current global GHG emissions, was finally included into the climate change negotiations. Even Brazil, reluctant to the inclusion of REDD under UNFCCC, presented a proposal^{5,6} in COP 12 and then further elaborated in COP 13 “to provide *positive financial incentives* for developing countries that voluntarily reduce their greenhouse gas emissions from deforestation”. This Brazilian Proposal was originally based on a proposal - Compensated Reduction of Deforestation, CR- launched initially by IPAM (Santilli et al. 2005, Moutinho & Schwartzman 2005).

The CP 13⁷ issues the “*The Bali Road Map*” that determines a 2 year process to design the new climate change international framework agreement post 2012, that includes REDD, by the end of 2009 (COP 15). Therefore, the approved “Road Map” in Bali represents that the most important momentum to qualify the REDD debate, finding the best alternative frameworks to implement REDD regimes under the UNFCCC it throughout the next two years. This two year period represents a demonstrative stage to evaluate and test pilot projects on REDD. For Brazil, particularly, there is a lot of opportunities to establish pilot projects for REDD. A report launched by IPAM, in collaboration with The Woods Hole Research Center and Federal University of Minas Gerais, Brazil, indicates that the cost of deforestation reduction can be very low (< US\$ 5,00/ton of Carbon), considering the cost of opportunities related to cattle (see

⁵ (http://unfccc.int/files/methods_and_science/lulucf/application/vnd.ms-powerpoint/060830_capobianco.ppt)

⁶ http://unfccc.int/files/meetings/dialogue/application/pdf/wp_21_braz.pdf

⁷ See Decision at: http://unfccc.int/files/meetings/cop_13/application/pdf/cop_bali_action.pdf

<http://www.climaedesmatamento.org.br/files/general/Amazon%20REDD.zip>). So, the reduction of deforestation can be totally feasible in economics terms.

Deforestation reduction in Brazil: the current debate and perspectives for solutions.

There is now a growing perception by the Brazilian society that the costs (economic and social) involved with of the Amazon deforestation is much higher than the cost related to its conservation. Reducing deforestation could offer a viable, cost-effective means to reduce GHG that could be used to bring benefits to tropical developing countries and effectively engage them in global efforts against climate change. Also, decreasing deforestation could contribute effectively to a robust, inclusive international emissions reduction regime after 2012, as established by the Road Map of Bali, and a substantial preservation of planetary biological diversity. However, currently, there is no consensus regarding the mechanism to be implemented. For instance, Brazil is now arguing that the historically greatest emitters (developed countries) should compensate, directly or indirectly, developing countries for reductions in emissions from deforestation, but there is no agreement on which mechanism would be more successful to sustain compensations worldwide and if these compensation would be transferred to developing countries through a positive voluntary incentives or carbon credits. Some mechanisms currently under debate in Brazil are briefly described in the following section.

The mechanisms

Compensated Reductions of Deforestation (CR) - This is a credit-based mechanism and was originally proposed during the COP9 in 2003 (Santilli et al. 2005). By CR, a baseline will be established as an average of the annual deforestation for the 90's .Developing countries that voluntarily achieve reductions in their emissions from deforestation during a period of time (five years, for example 2008-2012), would receive financial compensation for the emissions avoided based on the average market value of carbon (in 2012). Conversely, if these countries increase their deforestation rates during the first commitment period (in relation to the average of the 1990s) they wouldn't receive any compensation and would take the increment as an obligatory limit during the second commitment period. Clearly, for reasons of equity, the notion of obligatory targets in the second commitment period would only be applicable if the Annex I countries meet all of their obligations in the first commitment period. International financial institutions (as the Forest Carbon Partnership Facility of World Bank⁸) could establish programs to foment the implementation of national strategies for reducing deforestation in developing countries. Deforestation reduction will depend on the implementation of policies that combine

⁸ <http://carbonfinance.org/Router.cfm?Page=FeaturedResources&FeatResID=37318>

promotion of sustainable activities with legal enforcement in expansion frontiers. There are already GIS-based systems that allow effective control of deforestation on large landholdings and settlement projects. There are also proposed new economic instruments to add value to sustainable forest products. More developing countries will be likely to use these mechanisms if they have access to the resources necessary to pay for them.

The Brazilian Proposal on positive incentives

This is a voluntary-based mechanism and was proposed by the Brazilian government under the context of UNFCCC. By this proposal, developing countries that - voluntarily - achieve a net reduction in their GHG emissions from deforestation below a national reference point of historical emissions (established from the average of the deforestation rate during historical period of time - 5-10 years) would receive financial incentives through an international fund created by developed countries for this purpose.. The incentives would be calculated by the difference between the annual rate of emissions from deforestation and the historical emission rate. The fundamental difference between CR and this proposal, and similar ones (ex. Coalition of Rainforest Nation⁹), is that CR is based on a market mechanism of compensation (carbon credits).

The proposals of compensation for reduction emission from deforestation in Brazil have also been proposed by the Brazilian Amazon States. The Amazonas Initiative, for example, was implemented by Amazonas state involving the increment of state protected areas (from 7.4 to 17.4 million ha) and payment for environmental services to forest people (Viana & Cenamo et al. 2005, Viana et al. 2006). Even states with higher deforestation rates, like Mato Grosso, is elaborating its own initiatives to reduce deforestation, such as strengthening monitoring and controlling capacity, implementing new protected areas, and supporting a registry of producers with best practices of agriculture and ranching.

But, not only governments or NGOs in Brazil are proposing initiatives for reducing emission from deforestation. The Brazilian society has been involved with proposals like the 'Zero Deforestation Pact'. By this initiative, the zero deforestation would be reached within 7 years. An emission reduction targets would be established for each Brazilian state and each one would be compensated based on their performance.

There are other initiatives in Brazil proposing mechanisms to reduce emission from deforestation and they are described in the Table 2.

⁹ <http://www.rainforestcoalition.org/eng/>

Finding the best mechanisms is a matter of time and political will. Is also possible that different mechanisms can be used without harm each other. Nevertheless, curbing or decreasing deforestation can contribute towards strengthening a solid and broad international regime of emissions reductions after 2012 (pos-Kyoto). At this moment, nothing could be more useful to the preservation of biological diversity and traditional people life style on the planet.

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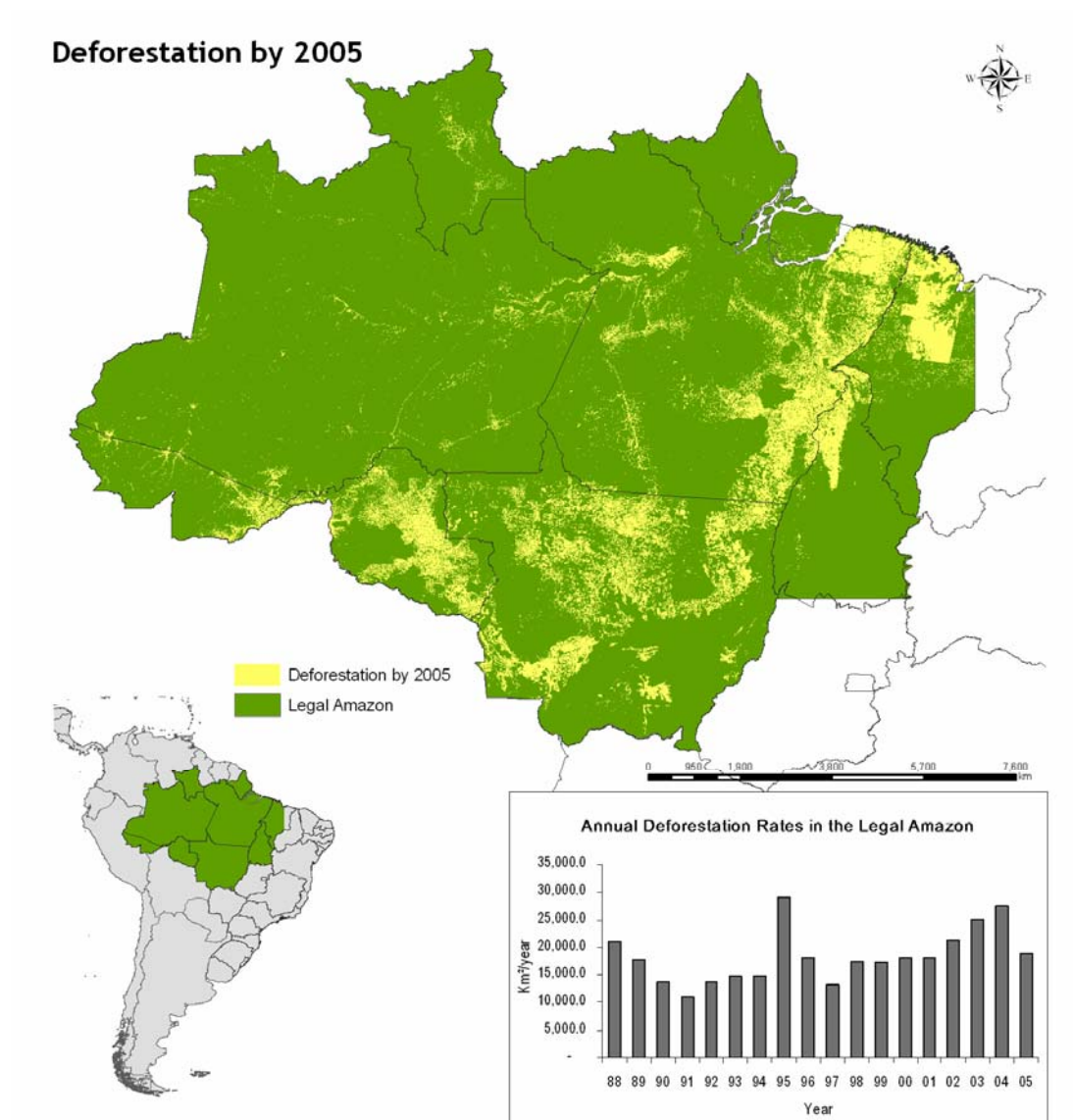


Figure 1 Arc of deforestation in the Brazilian Amazon – PRODES . The area in yellow represents deforestation until 2002 and in black from 2002 to 2003.
Data Source: PRODES/INPE (<http://www.obt.inpe.br/prodes/index.html>).

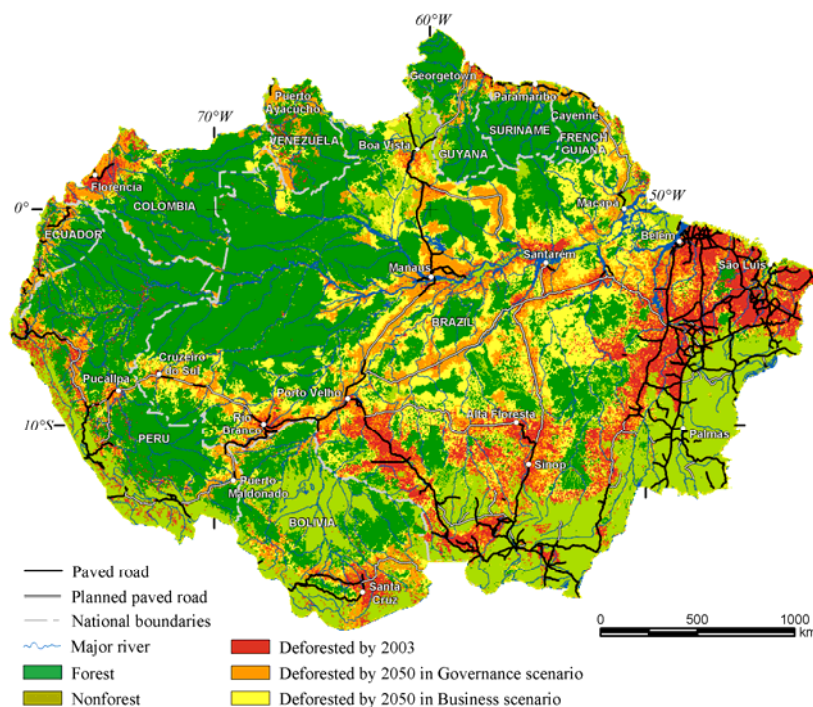


Figure 2. Estimated area deforested in Amazon Basin by 2050 (yellow) under two scenarios: governance and business-as-usual (Soares Filho et al. 2006). Under a business-as-usual scenario, 45% of current Amazon forest cover will be deforested by 2050. Additional information: www.csr.ufmg.br/simamazonia.

Table 1. Carbon emissions from fossil fuel, tropical deforestation, forest fires (Brazil and Indonesia), fires and emission reductions targeted by the Kyoto Protocol*.

Country / Source	Source	Carbon Emission	Reference
		(PgC yr ⁻¹)	
Brazil	Fossil Fuel (year: 2002)	0.09	**
	Deforestation	0.2 ± 0.2	Houghton et al. 2005
	Forest Fire (El Niño year – 1998)	0.2 ± 0.2	Mendonça et al., 2004
	Forest Fire (Non El Niño year -1995)	0.02 ± 0.02	Mendonça et al., 2004
Global	Fossil Fuel	6.3 ± 0.4	Prentice et al., 2001; Marland, et al., 2003
Tropical	Land Use Change	(0.8 ± 0.2) to (2.2 ± 0.8)	Houghton, 2003; Achard et al. 2002
Global	Fire (El Niño year – 1997/8)	2.1 ± 0.8	van der Werf et al., 2004
Kyoto Target		0.5	***

* Reproduced from Santilli et al. 2005.

** Energy Information Administration, EIA;

(<http://www.eia.doe.gov/pub/international/iealf/tableh1.xls>).

*** Carbon emissions forecast for 2010 for industrialized, Eastern European and Former Soviet Union countries (4.610 billion tons)

(http://www.eia.doe.gov/oiaf/ieo/tbl_a10.html) minus the total annual reduction target established by the Kyoto Protocol for the same year (3737 billion tons) (Energy Information Administration-EIA, DOE/EIA-0573/99, DOE/EIA 0219/99).

Table 2. Current proposals related to reduction emission from deforestation in Brazil.		
Proposal	What is it?	Comments
<u>The Brazilian Proposal on positive incentives</u>	Positive incentives to developing countries that achieve - voluntarily – a net reduction in their GHG emissions from deforestation	Financial incentives would be provided by developed countries through an international fund created for this purpose Not based on a market mechanism (carbon credits)
<u>The Amazonas Initiative</u>	State Law implementing programs to reduce deforestation through PES and compensation for reduced emissions from deforestation. Bolsa Floresta [Forest Fellowship] \$25/family; 8000 families – 17 million ha; 60.000 families by 2010	Conflict with federal government proposal. Who will be the owner of carbon? State or Federal Governments? Focus on forest people
<u>The Mato Grosso State Initiative</u>	Plan to control deforestation through PES to land owners	Conflict with federal government proposal. Focus on large landowner
<u>Zero Deforestation Pact</u>	Establish an agreement within Brazilian Amazon, for establishment of emissions reduction targets. Zero deforestation by 2015-18. US\$ 500 mil/yr to reduce deforestation	ΛFederal Government is resistant to targets. ΛLack of agreement among Amazon states on how to achieve the zero deforestation. 9Amazon governors and National Congress fully support the Pact.
<u>National Congress</u>	Bill in favor of emission reduction target (4% below 1990). National Policy for Climate Change – including RED.	Strong resistance from Federal Government Supported by 2/3 of National Congress and civil society.