Fearnside, P.M. 2012. Brazil's Amazon Forest in mitigating global warming: unresolved controversies. *Climate Policy* 12(1): 70-81.

doi: 10.1080/14693062.2011.581571

ISSN: 1469-3062

Brazil's Amazon forest in mitigating global warming: unresolved controversies

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12 April 2011

Abstract

Brazil's Amazon rainforest provides an important environmental service with its storage of carbon, thereby reducing the impacts of global warming. A growing number of projects and proposals intend to reward carbon storage services. Reducing Emissions from Deforestation and Forest Degradation (REDD) is currently a key issue for negotiations on an international agreement to take effect in 2013. Various issues require decisions in the international negotiations, which will have substantial impacts on both the effectiveness of mitigation and the scale of Amazonia's potential role. These decisions include: What the effects that the money generated from payments can have; what the spatial scale of mitigation is (e.g. projects or countries and sub-national political units); whether to have voluntary or mandatory markets; and whether these reductions will generate carbon credits to offset emissions elsewhere. It is argued that national-level programs, combined with a national target under the United Nations Framework Convention on Climate Change, are the best solution for Brazil in terms of both capturing international funding and stimulating the major cuts in global emissions that are needed to minimize climate risk to the Amazon rainforest. The high likelihood of passing a tipping point for maintaining the Amazon rainforest implies the need for urgency in altering current negotiating positions. The above unresolved questions require rapid resolution if the worst impacts of global warming are to be averted.

Keywords: carbon; ecosystem services; environmental services; mitigation; payments for environmental services (PES); REDD; rainforests

1. Introduction

Environmental services in the Amazon rainforest are of global importance and can form the basis for substantial monetary flows to Brazil. Such funds, in turn, can be the basis for payments for environmental services (PES) programs and other measures that both reduce the rate of deforestation and help sustain the human population in the Amazonian interior. While the mitigation of global warming is the environmental service that is closest to generating significant monetary flows in the Amazon rainforest, biodiversity maintenance and water cycling are also important services (Fearnside, 1999a, 2004). While the focus of the present article is on Brazil, many of the concerns raised here also apply to both its neighbouring countries (which together contain approximately one-third of the Amazon rainforest) and, to a lesser extent, to tropical-forest countries across the world.

The Amazon rainforest has an important role in mitigating global warming due to its large stock of carbon, in both biomass and soils (e.g. Fearnside et al., 2009; Nogueira et al., 2008). If deforested, much of this carbon is released to the atmosphere as greenhouse gases (GHGs) such as carbon dioxide and methane (Fearnside, 2000a, 2000b). Logging and forest fires also release carbon (Asner et al., 2005, Alencar et al., 2006). Although most of the world's carbon emissions are from burning fossil fuels, deforestation is the main source of emissions in Brazil. Since most deforestation is for low-productivity cattle pasture, this emissions source could be greatly reduced without significantly harming the country's economy (Fearnside, 2008a; Nepstad et al., 2009). At the same time, soybean cultivation and capital-intensive ranching are increasing in the region (Fearnside, 2001a; Walker et al., 2009). The forest's role in avoiding global warming can benefit Brazil financially through the sale of environmental services. This also holds the key to financing measures to reduce deforestation, replacing the current destructive economy with one based on environmental services (Fearnside, 2008b, 2000c). The value that can be captured depends heavily on the decisions made in the international negotiations regarding carbon accounting. The Fifteenth session of the Conference of the Parties (COP 15), held at the United Nations Climate Change Conference in Copenhagen, December 2009, did not resolve these issues.

New proposals and on-the-ground projects have been appearing at a rapid rate. Lobbying and speculation by entrepreneurs is evident. Beyond the tactical manoeuvres of interested parties, ways need to be found to translate the societal value of environmental services into monetary flows that achieve the objective of maintaining both these services and the region's human population. In the following sections, two issues and their implications for the Amazon rainforest are discussed, both of which have been systematically ignored in the extended debate over the proper role of tropical forests in combating global warming. These are, first, the effects of money from environmental services and, second, the role of the Brazilian Amazon rainforest in international negotiations. (In addition to these, PES involves many other issues; see Pattanayak et al. (2010) for a review.) While none of the issues treated in the present article will, of course, be resolved here, the objective is to present an agenda that can serve as a first step.

2. Effects of money from environmental services

2.1. Political use

A key area of controversy is what is done with the money generated from the environmental services of the Amazon rainforest. One major problem is that the distribution of the financial (and other) benefits that reward environmental services can be used by governments or politicians for political gains, essentially becoming a way of obtaining votes. Indeed, some grassroots groups are opposed to 'sustainable development reserves' (RDS) in the state of Amazonas for this very reason (See Fearnside, 2003a). Creation of RDS gives political influence to the state government, which obviously runs counter to the interests of opposition political groups.

Lessons should be learned from considering the Brazilian federal government's *Bolsa Família* (family stipend) program (Hall, 2006, 2008; da Silva e Silva, 2007), which was established in 2003 to subsidize poor families on the condition that they keep their children in school. The *Bolsa Família* program has played a critical role in lifting millions of families out of poverty, and has been justly praised around the world. Nevertheless, it has also had an influential role in determining the 2010 presidential elections (Abensur et al., 2007; de Moura, 2007). With the campaign for Brazil's October 2010 presidential election underway, opinion polls in March 2010 indicated that the leading opposition candidate was slightly ahead of the governing party's candidate among the electorate at large. By contrast, amongst *Bolsa Família* recipients the polls had the governing party leading by almost two to one (Salomon, 2010). The number of families receiving the stipend is 12.4 million, with each extended family normally containing several voters. These families account for an estimated 25% of the Brazilian population. Hence, the effect of the stipend might easily have been a determining factor in a close election. Furthermore, in December 2009, the Ministry of Social Development and Combating Hunger extended this stipend for 1.5 million families, who had either exceeded the maximum permitted income for eligibility or not declared their circumstances as required to maintain the benefit. This extension expired on the exact date of the second round of the presidential election (Diniz, 2010).

A similar situation on a smaller scale can be observed with the Amazonas state government's *Bolsa Floresta* (forest stipend) program, which currently benefits 5000 families and is part of the 'Amazonas Initiative' program for PES in state protected areas (Government of the State of Amazonas, 2009). As with the *Bolsa Família*, while the programme may be laudable, it also has an undeniable role to play in electoral politics. The danger is that the pressure to maximize electoral rewards can lead to either non-compliance in PES programs being ignored or paying for exaggerated or fictitious environmental benefits.

At the level of individual participants in PES programs, it is important to emphasize that the main reason for beneficiaries receiving payment is the provision of environmental services. Beneficiaries have a tendency to think that subsidies of all types are given simply as a right or as a benefit in exchange for political support. Such benefits include not just cash payments but also preferential access to funds for health centres, schools and other investments. It should be made clear to beneficiaries that there are penalties for non-performance in their role as environmental stewards. Essential ingredients of PES programs include: decision rules that define minimum standards of performance, a monitoring system that is capable of detecting violations, and the political courage to cut payments when non-performance is detected (Honey-Rosés et al., 2009).

2.2. Moral hazard

One of the problems that is frequently raised is the 'moral hazard' of blackmail, wherein landowners threaten to clear their land if not paid. Where the threat is real, it must be resisted because not doing so will exacerbate more instances. However the relevance of the problem is inflated. Wunder (2007) reviewed this controversy and concluded that it is not a great impediment to PES programs.

Another objection often raised is that many proposed PES programs provide payment for complying with extant legal requirements. As is well-known in Brazil, many laws exist that are never enforced, a tradition that has continued since colonial times when it served to buffer the colony against unrealistic edicts from Portugal (Rosenn, 1971). Brazil's 1965 Forestry Code has for many years been minimally enforced, with the result that most properties have cleared more than the permitted amount in the traditionally agricultural parts of the country (e.g. Menezes, 2001). Recent campaigns to enforce the forestry code in the Amazon rainforest have had some effect (Fearnside, 2003b), but even in the case of the enforcement programme in Mato Grosso (where command and control has been greater than in other states) the actual result is substantially less than claimed (Azevedo, 2009). The simple assumption that the extant laws are enforced and obeyed here cannot be sustained.

Moral arguments against payment for an environmental service such as avoiding emissions from deforestation are often given in lieu of addressing the pragmatic issue of finding something that works to maintain the Amazon rainforest. The argument that nature is sacred, and therefore governments and individuals should preserve it without payment, has often been made by Brazilian diplomats. (This was especially the case prior to 2007 when Brazil's diplomatic position began to shift from the absolute rejection of linking monetary flows with reducing deforestation.) These and other arguments offered against there being international payments to maintain the Amazon rainforest have generally served as a smokescreen to hide the underlying concern of a perceived threat to sovereignty (Fearnside, 2001b).

2.3. Payments for whom?

A major problem in paying for environmental services is the conflict that arises between efficiency in the use of funds and fairness in rewarding different types of actors. Since funds are always limited, choices must be made regarding the locations and types of projects that will receive support, and within any given location, which actors will receive benefits. Another issue is how much will be paid: is the full market value of the carbon and other benefits to be rewarded, or only the opportunity costs of the local actors? This problem applies at the level of both local actors and competing governments in international negotiations.

A continuum exists between areas with high risk of environmental losses in the immediate future, such as remaining patches of forest in Brazil's 'Arc of Deforestation' in the southern and eastern parts of the Amazon rainforest, and areas with little risk on short time scales, such as remote areas in the central and western parts of the Amazon rainforest in the state of Amazonas. If additionality over a short time scale is the criterion, then the decision will inevitably be to reward major deforesters. Large ranchers in the state of Mato Grosso, for example, would in this case be richly rewarded, while traditional extractivists in the state of Amazonas would receive almost nothing. The efficient use of funds requires restricting payment to those who represent 'credible threats to the environment' (Wunder, 2007). A continuum of opportunity costs is also often present and is (by contrast to environmental threat) lowest in the remote interior and highest in the 'Arc of Deforestation'. Balancing the needs of the areas at risk of environmental losses and

the associated opportunity costs will determine which options are most attractive as PES projects (Wunder, 2007). The value given to time will determine the area selected for priority, and differences in time preferences when considering biodiversity (as e.g. compared to carbon) will inevitably result in different priorities for biodiversity and carbon (Fearnside and Ferraz, 1995).

An additional criterion for selecting the location and actors for PES projects might be the risk of not delivering environmental benefits, even though the payments themselves would presumably be based on benefits that have already been achieved and confirmed through monitoring. Non-compliance would have both financial and political costs, as well as causing the loss of the opportunity to apply scarce environmental funds and personnel in more beneficial projects.

A key issue is whether PES programmes, including those focused on Reduction of Emissions from Deforestation and Forest Degradation (REDD), will be carried out on private or public land. In Mato Grosso especially, the 'ruralist block' (i.e. political representatives of large landholders) is a significant force in favour of creating PES programs to pay for the services of the 'legal reserves' of private properties. The 'legal reserve' is a portion of each property that must be kept under forest in accordance with Brazil's Forestry Code. The extent to which private properties could be included in PES depends very much on the volume of funds available. If funds are limited, as is likely if only 'voluntary' markets are eligible for raising the money, then reserve creation in public land would be a higher priority because much larger areas of forest could be included in the programmes at lower cost. In many parts of the Amazon rainforest, especially outside the state of Amazonas, the option of using public land depends on resolving the question of carbon tenure.

Private properties have been proposed as the priority focus for REDD in the Amazon rainforest, especially in Mato Grosso and Pará (Nepstad et al., 2007, 2009; Stickler et al., 2009). This has the advantage of being clear as to who owns the carbon. However, in the state of Amazonas the priority has been for projects in state-level protected areas such as RDS. The legal uncertainty over the right to sell the carbon was resolved in the state of Amazonas by a state 'climate law' passed by the legislature in 2008. This granted the state government the right to sell the carbon in the state's protected areas. Similar laws have not yet been enacted in the other eight Amazonian states.

One of the problems of PES is that the complexity of preparing and monitoring the projects is such that only the rich can get through the bureaucracy. This problem has often been raised for the PES programme in Costa Rica, which it has had since 1996. Indeed, many of those able to overcome the bureaucratic hurdles to gain access to the subsidy are wealthy absentee landowners living in the capital city, rather than small farmers who live on the land (Grieg-Gran et al., 2005; Zbinden and Lee, 2005; Karaousakis, 2006, 2007; Sánchez-Azofeifa et al., 2007). Separate but overlapping concerns include favouring large-scale projects and/or highly educated proponents with strong urban ties.

PES will not work with land that has an undefined ownership, nor (in the absence of legal ownership) with effective control that includes the power to exclude other actors. Areas cannot be used for REDD projects if they are undefined, as is the case over wide areas in the Amazon rainforest (Wunder et al., 2008). These problems are rapidly evolving and pose a certain risk for the environment. In 2009, the '*MP da grilagem*', or provisional measure for landgrabbers (MP 458, subsequently Law No. 11,952) was enacted by Brazil's National Congress, allowing legalization of claims up

to 1500 hectares (ha) in area. The objective is to legalize 67 million hectares, an area half the size of the state of Pará. Most important, the measure creates the expectation among invaders of all sizes that future 'legalizations' will also take place. Sooner or later a way must be found to put an end to invasions and landgrabbers (Fearnside and Graça, 2006; Caldas et al., 2010). The resolution of this problem has now been postponed even further; the issue requires shock treatment if the environmental services of Amazon rainforest are to be maintained (Fearnside, 2001c).

An additional risk from REDD projects are their potential role as justification for granting land titles, which was the basis of initial discussions between PES proponents and ranchers in Apuí, Amazonas. Land titles in the Brazilian Amazon rainforest are often 'irregular', a designation that includes fraudulent titles, titles containing honest mistakes in describing a property's location and area, legal titles in the name of a previous owner, and receipts for sale without proof that the seller owns the land and has the right to sell it. Brazil's legal system does not include informal or *de facto* land tenure, such as *adat* tenure in Indonesia, although public land can be passed to private ownership based on proof of occupancy for a specified period (*usocapião*). Landholders are frequently desperate to obtain a legal title, including many of those in settlement areas established by the National Institute for Colonization and Agrarian Reform (INCRA) where only one lot per person is allowed. In reality, however, wealthier individuals have often bought multiple lots in order to form ranches. These actors will therefore promise virtually anything that might be asked as a precondition for gaining a title, including their participation in a PES scheme. However, a benefit such as granting land tenure loses its motivating power for the continued compliance of actors with their environmental commitments as soon as the title is received (Wunder, 2005).

The state of Amazonas is at a moment in its history when the creation of new protected areas is the highest priority for conservation. In allocating scarce (especially human) resources, among different possible lines of action, protected areas have much greater environmental returns than investing in projects in private properties. For example, in October 2008 the 589,612 ha Juma Sustainable Development Reserve (RDS Juma) became the first protected area to have a certified REDD project (IDESAM, 2008). It would take ten huge ranches of 59,000 ha each to equal this area. If one assumes that 50% of each ranch is converted to a Private Reserve of Natural Patrimony (RPPN), the number of such ranches would increase to 20. Since ranches of this size are rare, the number of ranches needed to equal the Juma reserve would in reality be much greater: 118 ranches of 5,000 ha each or 236 ranches of 2,500 ha each. The amount of technical and legal work by qualified professionals would be tremendous compared to a single government reserve. Transaction costs therefore strongly favour reserves, such as Juma, over private properties. Although governments usually have higher transaction costs than those of the private sector, the advantage of government protected areas lies in their much greater area, which may be two to four orders of magnitude larger than a private property.

Other factors weighing against projects in private land holdings include the greater danger of the projects being used to legalize dubious land titles. The projects also carry greater risk of failing to protect the forest over the long term as owners change due to the sale of property or death and inheritance. While the RPPN provides a legal commitment to permanent protection, this guarantee may be insufficient in practice if the future owners of the properties are intent on deforestation. A lack of enforcement constitutes an additional danger.

Another important consideration is the social context of the REDD projects. In the case of 'sustainable development' protected areas, such as RDS and extractive reserves (RESEX), the carbon project and much of its revenue serves to benefit disadvantaged populations of traditional extractivists (such as rubber tappers and Brazil nut gatherers). In the case of large private properties, most of the financial benefits accrue to the wealthiest stratum of Brazil's highly unequal social hierarchy. Payments to traditional populations are not enough to guarantee they are better off, as this depends on the percentage of revenue passed on to them as well as the opportunity costs of the project.

The above considerations indicate that a rapid expansion and reinforcement of government reserves should be the priority for conservation, including REDD projects, in the state of Amazonas today (Nepstad et al., 2006; Fearnside, 2008d; Ricketts et al., 2010; Soares-Filho et al., 2010). If at some future time deforestation has advanced to the point where virtually all the forest outside protected areas has already been destroyed, then this strategy would need rethinking. Until such a time, action is needed based on today's priorities.

One of the major benefits of projects such as Juma is the possibility of generating local support for creation of other reserves in public land throughout the state of Amazonas (which is larger in area than France, Germany and the United Kingdom combined), rather than the amount of carbon avoided within the reserve itself. Unless such reserves are created quickly, the opportunity is likely to be lost (e.g. Fearnside and Graça, 2006).

3. The rainforest in international negotiations

3.1. Project-based versus higher-level mitigation

'Project-based' mitigation (such as the Clean Development Mechanism, defined in Article 12 of the Kyoto Protocol) differs greatly from mitigation based on the national inventories of emissions (such as an Emissions Trading system, as set out in Article 17 of the Kyoto Protocol). Differences include the fact that individual projects, such as the creation of a reserve (even for projects that embrace several municipalities), are much more vulnerable to leakage and other drains on carbon benefits than mitigation at the state or national level (Fearnside, 1995; Schlamadinger et al., 2007). National or state-level mitigation has the additional advantage of minimizing sovereignty issues as objections. This is because the relevant country or state is free to reduce its emissions in whatever way it sees fit, without project proponents being perceived as picking and choosing among possible recipients of support. However, unlike project-based mitigation, those providing international funding have no influence over the choices made to reduce emissions, and choices based solely on carbon may lack social or other (non-carbon) environmental benefits and may cause untoward social and environmental impacts (Fearnside, 1996).

One major problem in this area is how to avoid the double counting of carbon if national-/state-level mitigation is funded at the same time as project-level mitigation. If payment is made to both a land owner or to a traditional community (for reducing deforestation by a given amount) and to or through the government (for reducing the total emissions in the country or state), then the same avoided emission is being paid for twice. This is a significant problem if the reductions are generating carbon credits that can offset fossil fuel emissions. A system of registering and accounting for project-level mitigation is therefore necessary in order to make the appropriate adjustments at other levels.

3.2. Voluntary versus mandatory markets

Several voluntary markets already exist for carbon projects, but they lack the capacity to generate carbon credits to offset fossil fuel emissions under the Kyoto Protocol. Some of these markets can offset such emissions under other legally binding requirements internal to different countries, such as industries that would otherwise have to pay a fine or tax in the absence of an acceptable offset. Although the voluntary markets are in the process of adopting standardized criteria for their carbon accounting and monitoring, tremendous variation still exists in the carbon benefits offered for sale. For example, an advertisement claiming that a pair of tennis shoes is 'carbon neutral' generally offers no indication of how this neutrality is calculated or guaranteed. The price of carbon within the voluntary market varies significantly due to the fact that, as yet, there is no standard methodology used by the voluntary carbon markets to account for and monitor carbon.

Brazil created the Amazon Fund (*Fundo Amazônia*) to receive voluntary donations from interested countries. Norway has promised US$1 billion in instalments based on reductions in deforestation, and has so far contributed $0.1 billion, while Germany has promised $0.025 billion. No other countries have given, or promised, donations yet. Donating countries have the right to audit the deforestation and carbon data. The Amazon Fund, administered by the *Banco Nacional do Desenvolvimento Econômico e Social* (BNDES), is for activities in some way related to reducing deforestation, such as research on sustainable means of production, creation of protected areas and strengthening of state-level environmental agencies. While direct payment of private land owners is not part of the current plan, this may be done in the future. In December 2009, BNDES approved an initial grant of $10 million from the Amazon Fund for PES under the *Bolsa Floresta* programme in RDS in the state of Amazonas.

Brazil's Foreign Ministry has proposed a voluntary scheme as the basis for payments to the country for REDD. Under this scheme, Brazil would receive payments through the Amazon Fund if the clearing of the rainforest goes down, but would not incur a symmetrical penalty if clearing goes up — only a suspension of the payments. Deforestation rates in the Amazon rainforest go up and down as a 'natural' result of economic cycles, thus permitting a profitable generation of credit without any real reduction in deforestation.

A mandatory approaches can be of two types: an obligatory contribution to a fund that is to be used for reducing emissions (for example, by reducing tropical deforestation), or a market where carbon credit can be purchased for use in meeting legally binding commitments (i.e., the "assigned amounts" of countries in Annex I of the Climate Convention and Annex B of the Kyoto Protocol). Brazil's access to this official market for carbon credit generated by reducing its national emissions depends on whether the country accepts a limit on its national emissions. Accepting such a limit - by joining Annex I of the United Nations Framework Convention on Climate Change (UNFCCC) and Annex B of the Kyoto Protocol - is, arguably, in Brazil's best interest (Fearnside, 1999b, 1999c). This would greatly affect the volume and price of carbon and the size of potential monetary flows to Brazil. Brazil's Ministry of External Relations currently opposes those options that would capture the most environmental value from the Amazon rainforest's role in avoiding global warming.

3.3. Exchangeable carbon credit for offsets *versus* a separate fund

A key decision for environmental services in the Amazon rainforest is whether any funds coming to Brazil for carbon services will generate a carbon credit that is 'fungible' or whether these monetary transfers to Brazil will come from a separate fund without generating credits (as currently preferred by Brazil's Foreign Ministry). (In the present context, 'fungible' means that the credit may be used by any country with a national quota ('assigned amounts') in order to meet its commitments under the Kyoto Protocol.) This decision will have a great effect on the scale of the monetary flows that may result. If tropical rainforests are kept out of an agreement on carbon trading and confined to a separate fund, the scale of effort devoted to stopping deforestation will be much less, regardless of the particular discourse accompanying the creation of the separate fund. This is not because of the vast area of the world covered by tropical rainforests, but rather because, if the countries of the world really become serious about controlling global warming, they will have to make much larger reductions in their emissions than they have been willing to consider to date, and meeting commitments for these reductions will be very expensive. There simply won't be money left over for voluntary funds. The same applies to mandatory funds for which the level of contribution is to be negotiated simultaneously with the emissions quotas (assigned amounts) for the various countries. This is because the countries will only agree to a total expense that they judge to be within their financial means. In other words, if a greater contribution is demanded to a mandatory fund, then the country will only agree to a smaller reduction quota.

At COP 15 in Copenhagen, December 2009, the government of Brazil announced a 'voluntary objective' to reduce the rate of deforestation by 80% by 2020, with respect to a projected baseline (rather than a fixed amount from a past year such as 1990). A 'voluntary objective' is different from a target ('*meta*') or quota, in that the latter implies a binding commitment with consequences if it is not met. In the case of the UNFCCC, having a target entails that the participating country would have to buy carbon credits at the appropriate time from elsewhere at the going price in order to fulfil the target (assigned amount). A 'voluntary objective', by contrast, would have no such consequences. Given that Brazil will have several different presidential administrations between now and 2020, the chances are high that future administrations will simply ignore the promises made at Copenhagen.

It has become fashionable, especially in Europe, to oppose offsetting developed country emissions by exploiting mitigation in developing countries, including REDD. This opposition is usually justified by an appeal to the historic responsibility that developed countries bear for global warming. For example, Greenpeace states that REDD 'takes the focus off of the need for countries historically responsible for the climate crisis to reduce emissions at home' (Greenpeace, 2008, p. 14*).* Two very different issues are being conflated here: who should pay for the bulk of the cost for mitigating global warming and whether developed countries should mitigate global warming entirely within their own borders. Regarding the first issue, few would disagree that the rich countries should pay the bulk of the cost of mitigation. Regarding the second issue, the cost per tonne of carbon in a particular developed country may be double or triple the cost per tonne than elsewhere. Insisting on the more expensive solution may 'feel good' as a means of punishing the rich countries for their environmental sins, but it makes little sense from the perspective of solving the environmental problem, which is what matters in a vulnerable place like the Amazon rainforest. If each tonne of carbon kept out of the atmosphere is more expensive because of the insistence that all mitigation must be domestic, then the rich developed countries will simply agree to smaller cuts in their national emissions. As

of 2011, no country has agreed to any binding limit on its emissions after 2012. There is a limit to how much countries will spend to fight climate change, and the problem of global warming is so huge that, even under the best of circumstances, the world's financial resources will be strained to their limits in order to contain it. If tropical rainforests are ruled out, as mentioned above, then global temperatures will simply be allowed to rise higher than they otherwise would. This would put the Amazon rainforest at an even greater risk (Cox et al., 2008; Nepstad et al., 2008; Fearnside, 2009).

In the end, it is a matter of attitude as to what the role of environmental services should be, including the place of REDD. There are many problems, and faced with the same set of facts, some (especially in Europe) conclude that the entire idea should be torpedoed, whereas others, including this author, conclude that we should get to work and fix the problems.

4. Conclusions

Rewarding the environmental service supplied by Brazil's Amazon rainforest in avoiding GHG emissions faces a long list of unresolved controversies, including those related to the use of money derived from these services and the role of the forest in ongoing international negotiations. These obstacles are not insurmountable, but overcoming them will require a concerted effort.

Mitigation measures can be taken at various levels, from individual projects to state- or national-level programmes. National-level programmes combined with a national target under the UNFCCC would be the best solution for Brazil both in terms of capturing international funding and for stimulating the major cuts in global emissions that are needed to minimize climate risk to the Amazon rainforest.

Brazil should throw its weight behind efforts to include avoided deforestation as a mitigation option that generates a credit that is fully 'fungible', that is, one that can be sold to offset emissions from fossil fuel combustion in the developed countries. Indeed, Brazil should accept a formal limitation on its national emissions under the UNFCCC (i.e. not a mere 'voluntary objective').

The numerous outstanding issues surrounding the Amazon rainforest's environmental services must be addressed without delay in order to maintain such services and the region's own rural population. The immanence of critical 'tipping points', both in ecological terms and in the social dynamics of deforestation, means that there is no time to lose.

Acknowledgements

I thank the *Conselho Nacional do Desenvolvimento Científico e Tecnológico* (CNPq: Proc. 305880/2007-1; 573810/2008-7; 575853/2008-5) and *Instituto Nacional de Pesquisas da Amazônia* (INPA: PRJ13.03) for financial support. A Portuguese-language review of environmental services will include a portion of this discussion, and is expected to appear in W. Grau Neto, M. Fujihara & D.B. Gomes (eds), *forthcoming*, *Serviços Ambientais*, Lex Editora, São Paulo, Brazil. I thank P.M.L.A. Graça and three anonymous *Climate Policy* reviewers for comments.

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