



Reducing forest emissions in the Amazon Basin

A review of drivers of land-use change and
how payments for environmental services (PES)
schemes can affect them

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Acronyms and abbreviations

AD	Avoided deforestation
CEDERNA	Corporation for the Development of Renewable Natural Resources (Ecuador)
CIFOR	Center for International Forestry Research (Indonesia)
CONAFOR	State Forestry Commission (Mexico)
FAO	Food and Agriculture Organization
ICDP	Integrated Conservation and Development Project
IIED	International Institute of Environment and Development (UK)
NK-CAP	Noel Kempff Mercado Climate Action Project (Bolivia)
PES	Payments for environmental services
PSA-H	Payments for Hydrological Services (Mexico)
REDD	Reducing emissions from deforestation and forest degradation
WRI	World Resources Institute

Executive summary

Land-use change and deforestation in Latin America generally, and in the Amazon Basin specifically, are driven primarily by economic profitability (agricultural expansion and logging) and governance weaknesses (notably, lenient law enforcement), and only to a much lesser extent by deterministic poverty cycles. Nevertheless, poor forest dwellers (indigenous communities, smallholders, rubber tappers) have the potential to be important stakeholders in stabilising Amazonian land use. Changing incentives for big deforestation actors will likely have indirect effects also on these poor people, to the extent that they might gain or lose from deforesting and degrading activities. Large-scale strategies to reduce emissions from deforestation and degradation will thus require social impact assessments that account for leakage and perverse incentive scenarios.

Latin America has been a pioneer in testing and implementing PES schemes in developing countries, and these experiences are of high value to regional REDD policy design. However, ideological resistance against PES/REDD in Amazonia also exists due to fears that such schemes will lead to the loss of land rights or of sovereignty. In these situations, intermediaries whom both service buyers and sellers trust can play an important role in mediating and catalysing initiatives. In addition, a significant share of deforestation in the Amazon (and in other tropical forest frontiers) happens through private illegal – but often tolerated – occupation and clearing of government-owned forestlands. This type of deforestation cannot be stopped through landowner payments of the PES type since there are no legitimate landowners available to compensate for their conservation efforts.

This paper suggests the following messages:

Importance of performance-based incentive schemes with a focus on ‘conditionality’

Among the variety of elements for enhanced PES adoption that also merit attention with regard to REDD, the conditionality criterion is of particular relevance. Although it is the key feature of performance-based arrangements, PES schemes across Latin America (and elsewhere) have been reluctant to apply ‘hard’ conditionality in practice. Further experiments with enforced conditionality criteria in different local circumstances will aid assessment of their implications, and provide information on appropriate design (e.g., insurance for cases of accidental non-compliance etc.).

Need for governance investments with a focus on effective law enforcement

REDD schemes will have to rely strongly on functioning government institutions and effective law enforcement. So far, however, forest governance in Amazonia, where most Latin American deforestation occurs, remains weak. A key element for REDD-related investments in governance consists in effective law enforcement. To this end, crucial measures include strengthened institutional capacity for effective control and policing (manpower, vehicles, helicopters, other equipment) and enforcement (including functioning judiciary systems), but also institutional accountability (institutions must be held accountable across sectors for wrongdoings). REDD will likely have to deal with plenty of resistance across various economic sectors – not only because of the idea of REDD *per se*, but because effective law enforcement with respect to land use (‘closing the agricultural frontier’) will become a central requirement.

1. Introduction

Each year during the 1990s, tropical deforestation and forest degradation released 2.2 (+/- 0.6) billion tons of carbon to the atmosphere, of which about 35 per cent was from tropical America (Houghton 2003). Data from the United Nation's Food and Agriculture Organization, FAO, (2006) reports a total of 55.8 million hectares deforested in the Amazon countries during 1990 and 2005, which corresponds to a release of about 4.8 million tons of carbon (Table 1).

deforestation found in many parts of Africa. Experience with payments for environmental services (PES) schemes can provide further insights into the design of REDD strategies, mainly as regards the institutional set-up and contractual arrangements.

This paper reviews current drivers of deforestation and forest degradation in the Amazon Basin and assesses experiences with performance-based schemes, especially PES schemes in the Amazon region. It is

Table 1: Deforestation in Amazon countries, 1990-2005 (Sources: FAO 2006; FAO 2007; IPCC 2006, as cited in Gibbs et al. 2007).

Country	Forest cover 2005 [1000 ha]	Average annual change in forest area 1990 – 2005 absolute [1000 ha]	Average annual change in forest area 1990-2005 relative [%]	Forest carbon stock above-ground [MtC]	Forest carbon stock (above- and below-ground) [MtC]	Average annual carbon emissions 1990-2005 [MtC]
Bolivia	58,740	-270.33	-0.46	5,236	9,189	-24.33
Brazil	477,698	-2,821.80	-0.59	49,335	82,510	-290.65
Colombia	60,728	-47.40	-0.08	8,062	1,222	-6.30
Ecuador	10,853	-197.60	-1.82	n/a	2,071	-
Guyana	15,104	0.00	0.00	1,722	3,354	0.00
Peru	68,742	-94.27	-0.14	n/a	13,241	-
Suriname	14,776	0.00	0.00	5,692	2,330	0.00
Venezuela	47,713	-287.53	-0.60	n/a	7,886	-
Total	754,354	-3,718.93	-0.49	70,047	121,803	-321.28

Emissions can double during El Niño periods, when severe drought affects large areas of the Amazon forests and augments the incidence of forest fires (Alencar et al. 2006).

Brazil, which contains 63 per cent of the Amazon biome, is responsible for by far the largest share of deforestation and associated carbon emissions in the Amazon region (see Figure 1) – with the bulk occurring in the federal states of Pará and Mato Grosso. Nepstad et al. (2007) estimate that if current trends continue, a total of 55 per cent of the forests of the Brazilian Amazon will be cleared, logged, or damaged by drought by the year 2030, releasing 20 (+/-5) billion tons of carbon to the atmosphere.

Reducing emissions from tropical deforestation and degradation (REDD) is currently being discussed as an additional strategy to mitigate climate change. Information on the drivers of deforestation and land-use change presents important elements to improved design of local/regional REDD strategies. For example, agricultural expansion due to economic profitability – as in the case of cattle-ranching in Latin America and oil palm plantations in Southeast Asia – requires different REDD strategies than the poverty-driven

organised as follows: Section 2 describes the drivers of land-use change and deforestation; Section 3 reviews current PES experiences in the region; and Section 4 comprises concluding remarks.

Figure 1: Map of Amazon Basin countries



2. Drivers of land-use change and deforestation

Tropical deforestation occurs mainly because non-forest uses are more profitable than forest uses. A recent review of incentives to deforest summarise the following immediate causes (Chomitz et al. 2006):

- Own assets and access to credit markets (compared to capital-intensive largeholders, a poor household can't afford to clear much forest).
- High agro-ecological suitability (forestlands with good soils are cleared first).
- High profitability of farm output.
- High timber prices (can put pressure on old growth forests, but also induce tree plantations).
- Low off-farm wages in marginal areas.
- Roads.

The effect of agricultural technology on deforestation is ambiguous: improved technologies reduce the size of land required to produce a certain income, but they can also reinforce incentives to

replicate a more profitable technology in larger areas (Angelsen and Kaimowitz 2001). For example, increased mechanisation in southern Brazilian agriculture during the 1970s released numerous workers to engage in deforestation at the Amazon frontier. The effect of land titling is also uncertain: safe titles may favour management of the standing forest, but they could also accelerate forest clearing, e.g., if the landowner sees cattle ranching as the long-term most profitable land-use option (Chomitz et al. 2006).

Agricultural expansion, infrastructure development, and selective logging are among the most frequently cited drivers of Amazon deforestation, while public policies and international market demand are reported as important underlying causes (see Table 2).¹ During the early stages of Amazon colonisation in the 1970s-1980s, government policies presented important

¹ Broadly speaking, the underlying causes determine the effect of the above-mentioned incentives to deforest, which shape the drivers of deforestation.

Table 2: Drivers of land-use change, deforestation and degradation in Amazon countries 1990-2008 (Sources: Armenteras et al. 2006; Fearnside 2005, 2008; Camara et al. 2005; Naughton-Treves 2004; Pacheco 2006; Butler 2006, Kaimowitz and Smith 2001; Kaimowitz et al. 1998; Wunder 2000, 2003)

Country	Key drivers	Underlying causes
Bolivia	<ul style="list-style-type: none"> • Agricultural expansion (cattle ranching, soybean, sorghum, sunflowers, illicit crops). 	<ul style="list-style-type: none"> • Public policies (the World Bank's Structural Adjustment Program Project in the 1990s, fiscal and credit policies). • International demand for soybeans.
Brazil	<ul style="list-style-type: none"> • Agricultural expansion (cattle ranching, soybean cultivation). • Infrastructure extension. • Selective logging. 	<ul style="list-style-type: none"> • Public policies (credits, roads, resettlement). • International demand for soybeans. • National, and recently global, beef demand. • Institutional factors (weak law enforcement in frontier zones, weak property rights).
Colombia	<ul style="list-style-type: none"> • Agricultural expansion (cattle ranching, soybeans, illicit crops). • Infrastructure extension (roads to forest frontier). 	<ul style="list-style-type: none"> • Public policies (currency devaluation, low export tariffs, easy access to land). • International demand for soybeans. • Domestic demand for beef. • Demographic factors (population pressure).
Ecuador	<ul style="list-style-type: none"> • Cattle ranching. • Oil exploitation. • Logging. • Infrastructure extension. 	<ul style="list-style-type: none"> • Increased incomes raise demand for meat and dairy products. • International demand for oil. • Domestic timber demand for construction.
Guyana	<ul style="list-style-type: none"> • Logging. 	<ul style="list-style-type: none"> • International timber demand.
Peru	<ul style="list-style-type: none"> • Agricultural expansion (cattle ranching, soybean cultivation shifting cultivation). • Logging. 	<ul style="list-style-type: none"> • Public policies (subsidised tax policies in frontier zones). • Institutional factors (land speculation).
Suriname	<ul style="list-style-type: none"> • Logging. 	<ul style="list-style-type: none"> • Public policies (logging concession policies).
Venezuela	<ul style="list-style-type: none"> • Cattle ranching. • Logging. • Mining. • Oil exploitation. 	<ul style="list-style-type: none"> • Domestic demand for beef, timber. • Weak governance with respect to private land appropriation

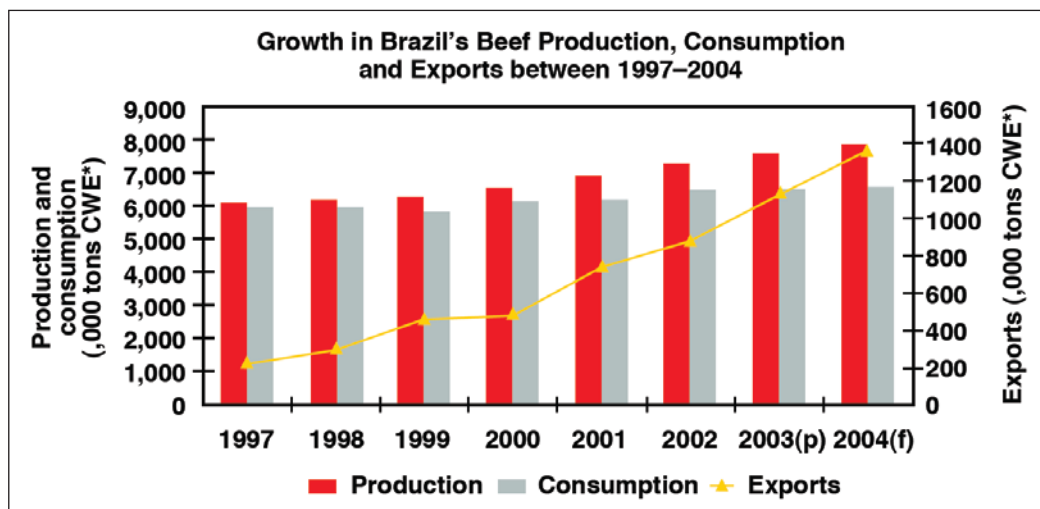
underlying causes of deforestation. But since the 1990s, market factors (international agrarian prices) – including renewable energy policies and agricultural health improvements – have become more influential in shaping the drivers of Amazon deforestation (Butler and Laurance, forthcoming). Poverty, although present across Amazonia, only marginally contributes to deforestation: in the Brazilian Amazon, small-scale farmers are estimated to account for about one fifth of deforestation (Chomitz et al. 2006).

2.1 Agricultural expansion

Agricultural expansion for large-scale cattle-ranching activities is the key driver of Amazon deforestation and associated emissions.² Chomitz and Thomas (2001) estimate that by 1995 almost 90 per cent of newly deforested Brazilian Amazon land was used for extensive pasture use. Brazil, where Amazonian cattle ranching is concentrated, has emerged in recent years as the largest beef exporter in the world, surpassing the U.S. in 2003 and Australia in 2004 (Peel 2008). Domestic beef consumption used to drive the expansion of Brazil's cattle ranching activities between the 1970 and 1990s, but international drivers have gained far greater importance since 2000 (Figure 2). Kaimowitz et al. (2004) explain the skyrocketing international demand for Brazilian beef by the devaluation of the Brazilian currency and eradication of animal diseases such as foot and mouth disease, as well as the outbreaks of 'mad cow disease' (BSE) and the avian flu that negatively affected livestock production in many other parts of the world.

Soybean cultivation is also growing in the Amazon region. Expanding primarily on degraded pasturelands (Brandão et al. 2005), its share in Amazon clearing – at least in Brazil – is considered low relative to clearings for new pastureland (Chomitz and Thomas 2001). Nonetheless, soybean production can function as an important indirect driver as it induces land sellers (e.g., cattle ranchers and smallholders) to advance further into the Amazon forest to open up new lands

Figure 2 – Growth in Brazil beef production (Source: Kaimowitz et al. 2004)



Source: United States Department of Agriculture (USDA), Foreign Agricultural Service (FAS), 2004.

*CWE = carcass weight equivalence in ,000 of metric tons (p) = preliminary (f) = forecast

(FBOMS 2005, Naughton-Treves 2005, Fearnside 2001). Soybean farming also provides key economic and political impetus for new infrastructure projects, which accelerate deforestation by other actors (Camara et al. 2005). This tendency is likely to increase as the demand for soy for agro-fuel is also rising. Although some countries have started refraining from the promotion and use of bio-fuels (e.g., those of the European Union), planting bio-fuels (soy, sugar cane, oil palm, etc.) continues to be profitable, inducing rapid agricultural expansion, including in the Amazon Basin.³ The recent announcement by the Malaysian Government in July 2008 that 100,000 hectares of oil palm plantations will be established in the Brazilian Amazon (Butler 2008) is just one indication that agro-fuels remain on the rise.

2.2 Logging activities

In recent years, logging has emerged as an additional, though still minor, driver of land cover change in Amazonia. Although rarely directly leading to deforestation, it contributes indirectly by leaving debris that makes it easier for forests to repeatedly catch fire, and by building roads that enable farmers to move into forested areas (Kaimowitz et al. 2004). Logging causes forest degradation (due to collateral damage to remaining trees, sub-canopy vegetation, and soils) and associated carbon emissions. Asner et al. (2005) estimated that logged areas in the Brazilian Amazon ranged from 12,075 to 19,823 km²/year (+/- 14 per cent) between 1999 and 2002, equivalent to 60-123 per cent of the areas deforested during the same period (see Table 3). The associated regional carbon emissions were estimated up to 0.08 gigatons of carbon (GtC) per year

² According to estimates from the FAO, the livestock sector alone is responsible for nine per cent of global anthropogenic CO₂ emissions, the largest share of this coming from land-use changes – especially deforestation (Steinfeld et al. 2006).

³ For example, although the Brazilian president has informed journalists that no sugarcane is being planted in the Amazon region, this is not true – at least in the Amazon state of Acre (see: www.amazonia.org.br, 23 June 2008).

for logging, which increases total annual anthropogenic carbon flux from the Amazon forest by up to 25 per cent over carbon emissions from deforestation alone (Asner et al. 2005). Although significant methodological challenges remain to measure the impact and extent of logging (DeFries et al. 2007; Krug 2008), logging already stands out as a key driver of change in vegetation cover.

2.3 Infrastructure extension

New or improved roads into forested areas tend to strongly promote deforestation (Chomitz et al. 2006). One analysis of 78 case studies from Latin America found that road access was a driver of deforestation in 75.6 per cent of the cases (Geist and Lambin 2002). Road development is often promoted in terms of rural development objectives, e.g., during the early stages of Amazon colonisation with the construction of the TransAmazonian highway, built in the 1970s. Improved accessibility to markets or intermediate processing centres (e.g., slaughterhouses, sawmills) increase land-use profitability and tend to induce more deforestation. For example, the immediate realisation of all road projects proposed under 'Avança Brasil' – a large-scale Amazon infrastructure development programme of the Brazilian government to be implemented during 1999–2020 – would result in an estimated 28–42 per cent deforestation of the Amazon forest by 2020 (Laurance et al. 2001).

In addition, oil and gas development is emerging as a threat of access-provision in the western Amazon, particularly in Colombia, Ecuador, Peru and Bolivia, and to a lesser extent, Brazil. Finer et al. (2008) found that 688,000 km² of the western Amazon is presently under concession for oil and gas development, partly

inside indigenous reserves and protected areas. Oil and gas development in the western Amazon can potentially have direct and indirect effects on deforestation and forest degradation (Finer et al. 2008). Direct impacts include deforestation for access roads, drilling platforms and pipelines, and are typically minor 'point impacts' that in and of themselves affect relatively small forest areas (see Wunder 2003: ch.7).⁴ Indirect forest-cover effects arise from the easier access to remote primary forests being provided by new oil roads, facilitating uncontrolled logging, hunting, and squatting. For example, extensive deforestation in the northern Ecuadorian Amazon followed colonisation along the oil access roads (Sierra 2000; Bilsborrow et al. 2004).

2.4 Public policies

Government policies, as an underlying cause of deforestation, were especially influential in the early phases of Amazon colonisation, from the 1960s to the 1980s. In Brazil, for example, agricultural colonisation – both large-scale and small-scale – was widely supported by public policies, especially in the form of tax reductions, credit subsidies, and technical assistance. Since the 1990s, however, the underlying cause of deforestation in Amazonia has shifted from public policies to market forces. The demand for beef and soybeans – and more recently renewable energy sources – has skyrocketed since the 1990s. Whereas public policies therefore provided an important impetus for land colonisation in the early phases, in later stages this trend proved to be largely self-sustained in economic terms (Kaimowitz 2002).

⁴ Oil operations also cause forest degradation from contamination from oil spills and wastewater discharges, although these do not have a direct influence on forest cover and carbon stocks.

Table 3: Selective logging rates from 1999–2002 in five major timber-producing states of the Brazilian Amazon, with comparisons to the deforestation rates reported by the Brazilian National Institute for Space Research (INPE) (Source: Asner et al. 2005)

State	1999–2000 rates (km ² year ⁻¹)		2000–2001 rates (km ² year ⁻¹)		2000–2001 rates (km ² year ⁻¹)	
	Logged	Deforested	Logged	Deforested	Logged	Deforested
Acre	64	547	53	419	111	727
Mato Grosso*	13,015	6,176	7,878	7,504	7,207	6,880
Pará	5,939	6,671	5,343	5,237	3,791	8,697
Rondonia	773	2,465	923	2,673	946	3,605
Roraima	32	253	55	345	20	54
Total	19,823	16,112	14,252	16,178	12,075	19,963

Only the northern 58% of Mato Grosso containing forested lands was included in the analysis.

3. Experience with payments for environmental services (PES) schemes

Payments for environmental services (PES) schemes can provide important insights for the design of performance-based REDD arrangements. PES are based on the principle of contractual conservation, with a strong emphasis on conditionality where payments occur only when the requested environmental service (or land use assumed to secure the service) has actually been delivered – a requirement that in practice has often remained weakly implemented (Wunder 2007; Wunder et al. 2008).⁵

The link between PES and REDD occurs at two levels. One is that nations states are likely to receive ‘international PES’ transfers through REDD – independent of how they eventually will spend the money. Second, the modality of landowner compensation PES is one of the ways that governments will be able to spend their money to make sure they achieve reductions in deforestation on the ground.

PES can be implemented at local and national level, with the latter corresponding to the likely scale of REDD transactions. National or government-financed schemes – where governments, on behalf of the actual service users, pay for the provision of environmental services – are insightful regarding their institutional framework for channelling payment flows from national to local levels. Local schemes can provide information

⁵ Wunder (2005, p.3) uses a five-criteria definition, where PES are described as i) voluntary transactions where ii) a well-defined environmental service or land use likely to secure the environmental service is iii) being bought by at least one service buyer from (4) at least one service provider (5) if, and only if, the service provider secures service provision (conditionality).

on conditional payments to providers of environmental services that may be applicable in national schemes.

Latin America has been a forerunner in implementing and experimenting with PES. The region supports numerous PES schemes, including the first national-level scheme implemented in a developing country, initiated in Costa Rica in 1996 (Pagiola 2008). Carbon and watershed protection have been the two dominant services focused on, with biodiversity and recreational services of secondary prevalence. The spatial focus has also been differentiated. Watershed schemes have emerged in the drier mountainous areas of the Andes and of Central America, where water increasingly becomes a key constraint to development. In the Amazon water is plentiful, but the carbon value of large forested areas with low population densities (and thus relatively low conservation opportunity costs) has favoured the implementation of a series of mitigation and reforestation projects (Southgate and Wunder 2007).

The following subsection describes four selected case study PES schemes in Latin America in terms of their efficiency, effectiveness and equity outcomes, and lessons for REDD design in the regional context. Distinguished by the number of people involved, these include two small-scale schemes in Bolivia and Ecuador, and two larger-scale schemes in Mexico and Brazil. All these schemes involve payments for forest environmental services, including avoided deforestation. Reasons for the selection of these four schemes are given in Table 4.

Table 4: Selected case studies in Latin America and reasons for their selection

PES scheme	Justification as case study
1. Noel Kempff Mercado Climate Action Project (NK-CAP), Bolivia.	<ul style="list-style-type: none"> • First scheme paying for ‘avoided deforestation’ (AD) (= relevant as the pioneer of REDD-type schemes). • Government is seller of AD services to international donors (= relevant as it corresponds to one likely design form of the international REDD scheme).
2. Bolsa Floresta, Brazil.	<ul style="list-style-type: none"> • State-level scheme paying for REDD services in Amazon forest (= early starter in implementing schemes in view of later connection with international REDD markets). • Strong livelihood considerations (= relevant as in many tropical forest areas, forest stewards are smallholders).
3. Pimampiro, Ecuador.	<ul style="list-style-type: none"> • One of the few PES cases that successfully applies the ‘conditionality’ criterion (= important for REDD transactions where payments only occur after measurable and verifiable results).
4. PSA-H, Mexico.	<ul style="list-style-type: none"> • National-level scheme paying for forest conservation (= relevant as REDD schemes will likely contain a national implementation level). • Individual and collective landowners as service providers (= relevant as in many tropical forest areas, traditional communal land ownership remains important). • Poverty considerations explicit (= relevant as in many tropical forest areas, forest stewards are poor).

3.1 Four PES case studies

The Noel Kempff Mercado Climate Action Project in Bolivia

(Sources: Brown *et al.* 2000; Asquith *et al.* 2002)

The Noel Kempff Mercado Climate Action Project (NK-CAP) originally comprised 642,458 ha but was later, as one project objective, extended to 832,000 ha that are now located inside the Noel Kempff National Park in north-eastern Bolivia. It was established in 1997 with the objective of mitigating CO₂ emissions from deforestation. This was realised via i) compensations to forest concessionaires for giving up their logging rights on government owned lands to expand the area of the National Park, ii) effective enforcement of the deforestation ban in protected areas within the park by reducing slash-and-burn agricultural and iii) initiating alternative income-generation programmes for surrounding communities to compensate for lost forest access rights and lost salary employment with timber companies. The government is the main provider of the avoided deforestation service, although three local communities also contribute and are being rewarded through benefits from integrated conservation and development projects. Co-funded by three American companies, (American Electrical Power System, BP-Amoco and Pacific Corp), with two NGOs (The Nature Conservancy and Fundación Amigos de la Naturaleza) as intermediaries, the project has a total duration of 30 years and is now in its third phase (2007–2010). The NK-CAP has been reported as successful since the start, but it should be remembered that the area has not witnessed strong deforestation pressures. Between 1997 and 2005, 989,622 tons of CO₂ emissions were avoided.

The Forest Stewardship Program (Bolsa Floresta) in Amazonas State, Brazil

(Source: Government of the State of Amazonas 2007)

Bolsa Floresta is a public programme of the state of Amazonas, the largest state in the Brazilian Amazon. It has been implemented since September 2007 by the Amazonas Sustainable Foundation and two other Brazilian institutions – the public Secretariat for the Environment and Sustainable Development and Bradesco, the largest private bank in Brazil. The key objectives are improved forest conservation (avoided deforestation) and livelihood improvements of traditional and indigenous communities in state protected areas and sustainable use reserves. Specifically, the programme rewards indigenous communities and long-term settlers for their commitment to avoid deforestation. Eligible to participate are families, communities or family associations. Families are required to participate in a two-day training course on sustainable land-use management prior to joining the programme. Payments differ depending on participant

type (families, communities or family associations). For example, a family can receive about R\$50 (US\$30) per month (ideally paid to the wife), while a community association can receive R\$4,000 (US\$ 2,500) per year. A penalty is applied when participants deforest beyond a maximum limit or render their land uses unsustainable. Presently, the programme covers six reserves/protected areas and 2,102 families in six conservation units of Amazonas state. The objective is to expand to 4,000 families by the end of 2008. It is still too early for an assessment of programme impacts.

The PES scheme in Pimampiro, Ecuador

(Source: Echavarría *et al.* 2004; Wunder and Alban 2008)

This watershed PES scheme is located in the Andean municipality of Pimampiro in northern Ecuador. It has been implemented since 2000 in the upper watershed of the Palaurco River, which serves the 13,000 inhabitants of the municipality, in order to secure water quality and dry-season quantity through forest conservation – and thus avoided deforestation – in an uplands community with latent agricultural land colonisation. The establishment of the scheme cost \$38,000 and was implemented by CEDERENA (Corporation for the Development of Renewable Natural Resources), a local NGO. The target recipients are 27 households in Nueva América Cooperative, located just above the water intake of the Palaurco watershed. In the beginning, PES contracts lasted for five years, but since the end of 2005 participants have renewed the contract for an indefinite period. The quarterly payments are conditional on contract compliance and vary depending on the type of forest: US\$6/year/ha for intervened forest; US\$9/year/ha for mature secondary forest; and US\$12/year/ha for primary forest. The funds for recurrent PES transfers originate from a 20 per cent water consumption surcharge on the 1,350 families with metered connections in Pimampiro, plus the interest generated by a water fund, which initially held US\$15,000. The current challenge for the municipality is to maintain a credible monitoring system under budgetary constraints. The programme shows ample success: deforestation has stopped and the native vegetation cover has regenerated markedly.

Payments for Hydrological Services (PSA-H) in Mexico

(Source: Muñoz-Piña *et al.* 2008; Southgate and Wunder 2007)

PSA-H is a national-level PES scheme that has been operating since 2003, when there were increased water shortages in many parts of the country. To secure water flow and water quality, the programme aims at conserving those natural forests under greatest threat. Funds are managed by CONAFOR (Comisión Nacional Forestal), the State Forestry Commission.

Payment levels were derived from opportunity cost assessments, and differentiated by forest type (cloud forests received a higher payment than other forest types). The funds for PSA-H increased from US\$18 million in 2003 to US\$30 million in 2004, derived from charges paid by federal water users. Service providers are both individual landowners and communities ('ejidos'), contracted for five years with payment and with limited possibility of contract renewal. One key eligibility criterion consists in effective control over natural forests of good quality. The programme was well-received by landowners, with the number of requests to participate grossly exceeding its existing financial means. Weaknesses of the programme include likely low additionality due to insufficient spatial targeting (insufficient funds are allocated to the places with highest deforestation risks), and inefficiencies arising from largely undifferentiated payment levels, paying probably too much to those who

financed schemes are fully voluntary for both service buyers and sellers, and focus on one environmental service (e.g., water, carbon); government-financed schemes are generally only voluntary on the supplier side and often aim at more than one environmental service (Wunder et al. 2008). Of the selected four case studies, the Bolivian and Ecuadorian cases are user-financed schemes; the Brazilian and Mexican cases present government-financed schemes (see Table 5).

All selected case studies evolved over the last 11 years and involve some form of forest protection as a means to secure hydrological functions or abate emissions from deforestation (see Table 5). The obstacles to implementation vary among the selected schemes and indicate the type of difficulties REDD may encounter, emphasising in particular the relevance of appropriate payment design.

Each scheme has an intermediary between service seller and buyer, but differs in its selection of sellers,

Table 5: Characteristics of PES case studies (adapted from Wunder et al. 2008)

PES scheme	Environmental service	Who buys?	Who sells?	Start year	Spatial scale	Obstacles
User-financed						
NK-CAP, Bolivia.	Reduced emissions from deforestation and degradation (REDD).	3 American companies.	Bolivian government and local communities.	1997	642,458 ha.	Continued logging and deforestation at park boundaries.
Pimampiro, Ecuador.	Forest conservation/restoration for hydrological services.	Urban water users with meters.	Members (81%) of a cooperative residing in upper target watershed.	2000	Palaurco watershed, left side (496 ha).	Monitoring costs, free riders, land-use/service link.
Government-financed						
Bolsa Floresta, Brazil.	REDD.	State of Amazonas + private bank.	Forest stewards living in protected areas.	2007	Conservation units (CU): 6 reserves (> 2,000 families) in 6 CUs.	Low payment levels, low conditionality.
PSA-H, Mexico.	Avoided logging and deforestation for hydrological services.	Water users and state forestry agency.	Individual landholders and communities.	2003	National, priority areas: 600,000 ha (2005).	Rent-seeking by communities with timber firms, low conditionality.

would have conserved their forests anyway, and too little to those who face really significant opportunity costs. The monitoring system has also revealed some weaknesses, so that conditionality does not always apply (i.e., some deforestation has been ignored). An in-depth assessment of programme effectiveness is not yet possible, but it seems that deforestation in PES enrolled areas is half the national average (C. Muñoz-Piña, pers. comm. Sept. 2008).

3.2 Characteristics of case study schemes

The case studies are grouped into user-financed and government-financed schemes to express the nature of the actual service buyer – the end user, or a third party (typically the government) on behalf of end users. User-

monitoring, severity of sanctions and degree of conditionality (see Table 6). Intermediaries between buyers and sellers of environmental services generally play an important role in PES schemes, and are often the main drivers of the schemes. Very often non-governmental organisations play this role, especially in user-financed schemes. In government-financed schemes, as in Mexico and Costa Rica, this role is usually taken by government agencies.

Seller selection or spatial targeting can improve the cost-effectiveness of PES schemes, for example by targeting high deforestation risk areas (as is done in the Ecuadorian and Mexican schemes). Seller selection and spatial targeting is especially relevant when the scope of the PES/REDD scheme is large and available resources constrained, i.e., where prioritisation is needed.

Monitoring is a key requirement for verification

Table 6: Design features of PES case studies (adapted from Wunder et al. 2008)

PES scheme	Intermediary	Seller selection	Monitoring	Sanction	Conditionality
User-financed					
NK-CAP, Bolivia.	Local and international NGOs.	Macro-level: Bolivian gov't. Locally: people using the protected area extension.	Remote sensing analysis with ground-truthing.	Not applied.	Only in the initial government deal: paying for protected area extension.
Pimampiro, Ecuador.	Local NGO.	High threat and strategic service site.	Quarterly site inspection, now deteriorating.	Temporary or permanent PES exclusion.	High, lately some decline.
Government-financed					
Bolsa Floresta, Brazil.	Local NGO and association.	Forest dwellers in conservation units.	Remote sensing analysis with ground-truthing.	Yellow and red cards (contract withdrawal).*	Designed to be high, but with some loopholes.
PSA-H, Mexico.	Several state agencies.	2003: almost random. Since 2005: multi-criteria grading.	Yearly remote sensing analysis; very few site visits.	Intentional: cancel current + future payments; unintentional: no payment for affected area.	Designed to be high, but with some monitoring problems.

* Families who have deforested a crop area up to 50% larger than the crop area in 2007 (when the Bolsa Floresta Program was implemented) will receive a 'yellow card' and must explain to the association the reasons for having increased deforestation. Those with a yellow card who continue deforestation in the following year will receive a 'red card' and the payment will be suspended. If the new crop area is extended more than 50% (compared to the 2007 crop area) a red card will be given immediately and payments cease. The families given either two consecutive yellow cards or three in alternate years will be excluded from the programme. (See: www.florestavivaamazonas.org.br/bolsa_floresta.php).

of land use and contract compliance, and should ultimately decide whether payments are made or not. The method used for monitoring depends on the size of the area to be monitored. For large areas, remote sensing tools are necessary, combined with selective ground-truthing, (e.g., for the Mexican and the State of Amazonas case study areas). In a small scheme like Pimampiro, the investment in remote sensing is not worthwhile.

In order to assure genuine conditionality, it is necessary not only to monitor non-compliance, but to sanction it appropriately. Sanctions may differ according to the frequency or severity of the detected infraction (e.g., in Pimampiro and Bolsa Floresta), or according to whether or not the infraction was intentional (e.g., in Mexico PSA-H). No sanction mechanism was applied in the Bolivian case, since the deal with the government was a one-off, while the local communities are receiving non-conditional benefits from integrated conservation and development projects.

Conditionality is a key criterion for performance-based schemes, i.e., payments are only made if service delivery can be verified. Rigorous implementation of conditionality substantially improves the efficiency of PES, although the ethical and public relations consequences of denying and/or retracting payments from poor communities often mean it is not implemented. The success of the Pimampiro scheme, for example, is to a large extent attributed to its high conditionality criterion: various families were temporarily excluded from the scheme when sanctioned for non-compliance, but most rejoined the scheme later

on, having accepted its *quid pro quo* approach (Wunder and Alban 2008). Conditionality has been a concern also for the Bolsa Floresta scheme (with rules being crafted somewhat loosely) and the Mexican programme (with monitoring and sanctions working imperfectly).

3.3 Payment design

Payments are typically made in cash, but sometimes combined with technical assistance or in-kind compensation (see Table 7). The decision on the mode of payment depends on the local circumstances and needs. In the case of Bolsa Floresta scheme, for example, where service providers are smallholders and often poor, cash payments are complemented with capacity-building and technical assistance.

An efficient payment scheme would pay an amount only marginally above the individual costs of providing the service faced by each landowner. This corresponds to the opportunity costs and transaction costs involved in shifting from the current land use to a more sustainable one. In addition to political-economic concerns (sellers may feel discriminated against by seeing their rents squeezed to the last cent), the implementation of such efficient payment forms requires more effort, because these spatially varying costs need to be revealed. For the sake of political-administrative ease, many implementers opt for uniform per-spatial-unit rates.

Payment differentiation generally increases the cost-effectiveness of PES (Engel et al. 2008). In our case studies, it has been undertaken in Mexico and

Table 7: Payment design features of PES case studies (adapted from Wunder et al. 2008; Porras et al. 2008)

PES scheme	Mode of payment	Amount [US\$]	Determination of payment level	Timing of payment	Differen-tiation	Contract duration
User-financed						
NK-CAP, Bolivia.	Cash, in-kind, and technical assistance.	1.6 million (total) for concessions; total gross gains for communities: 358,380.	n/a	<i>Ex ante</i> .	n/a	Programme lasts 30 years.
Pimampiro, Ecuador.	Cash.	6-12 US\$/ha/year.	Negotiated.	Monthly, post monitoring.	Higher for primary vegetation.	Initially 5 years, now unlimited.
Government-financed						
Bolsa Floresta, Brazil.	Cash transfer, technical assistance.	Total: US\$300 (families); US\$ 2,000 for community associations.	Administrative.	Monthly, (not clear whether <i>ex post</i> or <i>ex ante</i>).	No.	Not clear.
PSA-H, Mexico.	Cash.	27-36 US\$/ha/year.	Administrative.	Annual, <i>ex post</i> .	Higher for cloud forests.	5 years, conditional renewal.

Ecuador, but through payment of a premium for high-service areas, not for higher risk or higher opportunity costs. Potentially, payment differentiation with respect to each of these factors can optimise the effectiveness and cost efficiency of a PES scheme (Wünscher et al. 2008). However, due to equity concerns and for ease of administration, large-scale government-run variants – in particular – have so far preferred uniform payments (Wunder et al. 2008).

In accordance with the principle that applies to performance-based measures, the timing of payments is supposed to be *ex post* (after verification) and only in cases of actual contract compliance. With the exception of NK-CAP in Bolivia, this applies to the selected case studies. One reason why payments are made *ex ante* in NK-CAP is that a number of economic activities were completely bought out, thus making it necessary to compensate up front for a series of productive investments.

Contract duration among the selected schemes varies between 5 and 30 years with the exception of Pimampiro, where an unlimited timeframe was adopted. The NK-CAP 30 years' duration was defined by the duration of the logging concessions that were bought for conservation purposes. Although in theory longer term arrangements allow for better long-term planning, five year contracts (such as in Mexico and initially in Ecuador) can provide a practical trade-off between security and flexibility – because conditions, preferences and budgets change over time.

3.4 Effectiveness considerations

Effectiveness refers to whether a certain target – in the context of PES, the delivery of environmental services (in REDD, the realisation of avoided

deforestation) – has been achieved. Factors affecting the effectiveness of PES schemes include: baselines (reflecting the 'business as usual' scenario), payment design, additionality, leakage control, and permanence (see Table 8). Although baselines are important references to measure results against, in most of PES schemes they are not studied in great detail and very often results are based on the implicit assumption of a continuation of current trends (Wunder et al. 2008). Implicit baselines are, for example, used in the cases of Pimampiro and Bolsa Floresta.

Additionality is closely related to the overall effectiveness of a programme. It is high where payments make an actual difference compared to the business as usual scenario. In the cases of NK-CAP and Pimampiro, additionality is high because deforestation and forest degradation would likely have continued in the absence of payments, but were in fact halted following the introduction of the schemes. Additionality is less certain in the cases of Bolsa Floresta and PSA-H where for many of the enrolled areas the *a priori* risk of deforestation was low, which means that deforestation was already unlikely to occur even in the absence of payments. This observation fits with the general perception that user-financed schemes tend to have higher additionality than government-financed schemes (Wunder et al. 2008).

The degree to which a clear link between a certain land use and the environmental service it provides is established also determines the effectiveness of payments. While there is strong scientific evidence for some links (e.g., between forest conservation and water quality, biodiversity conservation, and carbon storage), it is less clear or highly site-specific for others (e.g., forest conservation and yearly or seasonal run-off and flood control). Effectiveness may be improved through

Table 8: Factors affecting efficiency and effectiveness of PES case studies (adapted from Wunder et al. 2008)

PES scheme	Baselines and scenarios	Opportunity costs	Additionality	Land-use/service link	Leakage	Permanence	Transaction costs [US\$]
User-financed							
NK-CAP, Bolivia.	Studied – projection of timber demand.	Partially studied.	High, for land use: degradation would have continued.	High (studied) for forest conservation.	Studied, and controlled.*	Likely secured by law.	~\$9.5 million (total project cost in 2002).†
Pimampiro, Ecuador.	Implicit – likely forest decline.	Not studied.	High, for land use: clear trend change to conservation.	Assumed, not proven	Zero.	Not secured beyond contract period.	\$38,000 (startup); \$3,600/yr (recurrent).
Government-financed							
Bolsa Floresta, Brazil.	Implicit – current deforestation trends.	Not studied.	Likely low (low deforestation risk).	High.	Not studied.	Unclear (depends on governance structures).	Not clear, (initial fund counts \$20 million).
PSA-H, Mexico.	Explicit – static forest-cover baseline, threat area modelling.	Studied.	Unknown – but evidence that some low-threat areas are offered.	Extensive research, but not explicitly modelled.	Not yet evaluated.	Unclear beyond contract period.	Recurrent: 4% of payments (defined by law).

* Two types of leakage were assessed: leakage associated with avoided deforestation and leakage associated with averted logging. No leakage from averted deforestation upon project implementation was identified since appropriate leakage prevention measures were undertaken. Leakage from avoided logging, however, was estimated to range between 14–44 per cent (of timber savings), with the more realistic scenario (where export demand is perfectly elastic and prices are insensitive to changes in timber supply due to reduced logging concession areas) being 14 per cent (Winrock 2002).

† Note that part of these funds were used for payments: US\$ 1.6 million was used to indemnify logging concessionaires, another small portion was used to buy out private property owners in the project area, and US\$ 1.25 million was used for community development projects in the three communities at the park border and three other small communities (Robertson and Wunder 2005; Asquith et al. 2002).

site-specific assessments to clarify such links. However this can be costly, especially for small-scale schemes, so that in practice payments are often based on assumed links (such as in the case of Pimampiro).

Leakage prevention is another important element in securing effectiveness. Because leakage is difficult to measure in practice, especially for avoided deforestation (Wunder et al. 2008), not many schemes conduct in-depth assessments. The NK-CAP is one scheme that has invested heavily in leakage prevention measures (Brown et al. 2000). Part of the motivation is probably related to testing methods for measurable, additional emission reductions to be sold in international carbon markets (voluntary markets).

Permanence is another key factor in ensuring effectiveness. Very often, permanence is unclear or not secured beyond the contract period (e.g., in the Ecuadorian and Mexican case studies). Permanence may be more likely to be secured in the cases of NK-CAP and Bolsa Floresta as these schemes are implemented within protected areas with *de jure* protection. However, *de facto* protection and permanence will largely depend on the strength of public law enforcement, and on *ex ante* unpredictable changes in the economic environment and in private land-use incentives.

Normally, one cannot expect a forest conservation/REDD scheme to have generalised protection benefits that go beyond the contract/payment period.

3.5 Efficiency considerations

Efficiency refers to the costs made to achieve a certain target – the lower the costs, the more efficient a scheme is. Information on conservation opportunity costs can help in the design of more cost-effective payments. Yet as mentioned before, analysing opportunity costs can be costly and many schemes, as in the majority of the selected case studies, therefore opt not to do this. Nonetheless, the literature on PES emphasises that payments based on the costs of providing a given environmental service (or land use likely to provide them) can strongly improve the efficiency of a scheme. One way to reveal such costs for PES schemes is procurement auctions⁶, as already used in two PES schemes in the US and Australia (Ferraro 2008).

Transaction costs reported here refer to the

⁶ A PES contract procurement auction is a process through which a buyer of environmental services invites bids (tenders) from suppliers of environmental services for a specified contract and then buys the contracts with the lowest bids (Ferraro 2008).

costs associated with the setting up and running of the scheme, not with the transaction costs borne by service providers (as they are covered in the payments). Generally, and as reflected in our case studies, PES programmes face relatively high startup costs and fairly low recurrent costs (Wunder et al. 2008). In government-financed schemes, such as PSA-H in Mexico, the level of recurrent costs is often confined by law to a percent-share of the annual budget. Comparing the transaction costs of the Bolivian NK-CAP project and the Bolsa Floresta scheme reveals that the fixed costs of establishing PES can be very high – and at times prohibitive for local schemes – while larger-scale schemes can benefit from economies of scale effects.

3.6 Equity considerations

Initial experience with PES schemes has occasionally revealed the risk of not reaching out sufficiently to the poorest land users. Because of certain requirements for participating in PES schemes (e.g., land titles, up front investments to finance licensing of land-use plans or necessary managerial skills), poorer land users can be disadvantaged – as was initially the case in Costa Rica for example (Zbinden and Lee 2005). However, efforts are often dedicated to rendering PES pro-poor, helping to ensure that the poor can participate and that they will benefit. For example, poverty considerations constituted one key element in the design of the PSA-H scheme in Mexico and an important innovation consisted in allowing contracts with collective service providers (Muñoz-Piña et al. 2008). Livelihood considerations also play an important role in the Bolsa Floresta scheme, reflected in

the provision of technical assistance and access to health and education services.

Generally, additional co-objectives are more frequent in government-financed schemes than in user-financed schemes (Wunder et al. 2008), and this is also reflected in the selected case studies (see Table 9). In the Latin American PES experiences, typical side-objectives are: poverty alleviation (Mexican PSA-H) and sustainable regional development (Bolsa Floresta), while biodiversity conservation is sometimes pursued as an implicit co-benefit (Mexico, Bolivia). PES schemes can try to limit the trade-off among objectives and render schemes pro-poor or pro-biodiversity, but overloading one scheme with too many side-objectives can ultimately become counter-productive as it basically then reverts to being an ‘integrated conservation and development project’ (ICDP), and these have been widely criticised for their limited effectiveness.⁷

However, PES can also have indirect effects on the poor. In the Bolivian case of NK-CAP, for example, the logging ban made many local people lose the jobs they had with logging companies (Asquith et al. 2002). In particular, such welfare effects can occur in activity-reducing PES schemes (i.e., payments are made to stop conducting ‘destructive’ forest uses), where payments are made for pure forest protection without sufficiently attractive economic alternatives. As was the case for NK-CAP, PES development will need to account and control such indirect effects, and ensure that in these specific contexts, forest conservation does not make the poorest worse off.

⁷ See for example Wunder (2007) for a comparison of PES and ICDP.

Table 9: Side-objectives and welfare effects of PES case studies (adapted from Wunder et al. 2008)

PES scheme	Side-objectives	Welfare effects on poor sellers
User-financed		
NK-CAP, Bolivia.	Biodiversity conservation.	Net gains for community members 1999–2002: per capita gains are estimated to be in the range of US\$100–250 (Robertson and Wunder 2005).
Pimampiro, Ecuador.	None.	Likely higher income and spending.
Government-financed		
Bolsa Floresta, Brazil.	Sustainable livelihoods.	Income generation, access to services.
PSA-H, Mexico.	Poverty alleviation (explicit). Biodiversity conservation (implicit).	Income generation (PES can yield up to 10% of their total income).

4. Concluding remarks

Land-use change and deforestation in Latin America are driven primarily by economic profitability (agricultural expansion and logging), whether for smallholders or corporate interests, and governance weaknesses (notably, lenient law enforcement) – and only to a much lesser extent because of deterministic poverty cycles. Although they are less frequently prime Amazon deforesters, poor forest dwellers (indigenous communities, smallholders, rubber tappers) can be important stakeholders in stabilising Amazonian land use. Changing incentives for the big deforestation actors will likely have indirect effects on these poor people, whether they gain or lose from deforesting and degrading activities (see the aforementioned case study from Bolivia). Large-scale strategies to reduce emissions from deforestation and degradation will therefore require social impact assessments that account for leakage and perverse incentive scenarios.

Latin America has been a pioneer in testing and implementing PES schemes in developing countries, and these experiences are of high value to regional REDD policy design. Experiences from both user-financed schemes and government-financed schemes exist, and can inform the design of national/sub-national REDD schemes, actor constellations and transactions. However, resistance against PES/REDD in Amazonia also exists due to the fear that such schemes represent the first step toward permanent expropriation of resources (fear of sovereignty loss). In these situations, intermediaries whom both service buyers and sellers trust can play an important role in mediating and catalysing initiatives (Southgate and Wunder 2007). In addition, a significant share of deforestation in the Amazon (and in other tropical forest frontiers) happens through private illegal – but often tolerated – occupation and clearing of government-owned forestlands. Note that this type of deforestation cannot be stopped through landowner payments of the PES type: there are no legitimate landowners available to compensate for their conservation efforts (Wunder 2007).

Based on these insights, REDD-related investments could focus on the following two domains: first, on actual performance-based incentive arrangements with a particular focus on effective implementation of the conditionality criterion, and second on improving forest governance by instating effective law enforcement and associated necessary reforms.

4.1 Performance-based incentive schemes based on ‘conditionality’

Among the variety of elements for enhanced and widespread PES arrangements that merit further attention, the conditionality criterion is of particular relevance. Although it is the key feature of performance-based arrangements, PES schemes across Latin America (and elsewhere) have been reluctant to apply ‘hard’ conditionality in practice (Southgate and Wunder 2007). Among the reasons why conditionality receives low popularity are ethical and image reasons. But because it will matter greatly in REDD schemes – especially when REDD credits are to be sold on official carbon markets – further experiments with enforced conditionality criteria in different local circumstances will aid assessment of their implications, and provide information on appropriate design (e.g., insurance for cases of accidental non-compliance etc.).

4.2 Governance investments for effective law enforcement

REDD schemes will have to rely strongly on functioning government institutions and effective law enforcement. So far, however, forest governance in Amazonia, where most Latin American deforestation occurs, remains weak. Land-use change and deforestation are, to a considerable degree, associated with insufficient enforcement of laws and policies: about 80 per cent of deforestation in the Brazilian Amazon is estimated to be illegal (World Watch Institute 2008). Part of this situation is due to past lenient law enforcement since traditionally the use of natural resources and land was, to all intents and purposes, carried out for free (Southgate and Wunder 2007). This tradition obviously clashes with new policies that seek to put an end to the ‘open frontiers’ by starting to enforce existing land-use policies or by establishing a price for the use of traditionally abundant natural resources via environmental taxation or PES. Although a change in land-use mentality is underway, inevitably REDD will have to deal with plenty of resistance – not only because of the idea of REDD per se (aforementioned fears of sovereignty loss, etc.), but because effective law enforcement with respect to land use will become a central requirement.

A key element for REDD-related investments in governance consists of effective law enforcement. To this end, crucial measures include strengthened institutional capacity for effective control and policing (manpower, vehicles, helicopters, other equipment) and

enforcement (including functioning judiciary systems), but also institutional accountability (institutions must be held accountable across sectors for wrongdoings). One innovation for improved environmental law enforcement in very remote areas (such as introduced in Mato Grosso in 1996⁸) is mobile courts, where a judge and police force fly by helicopter to areas where there is a dispute to resolve the matter on the spot. Another Brazilian governance innovation is the establishment of

sectorally independent institutions (e.g., the Brazilian Public Ministry) that monitor public performance and have the power to prosecute the wrongdoings of public servants and government institutions. Although further assessment of the effectiveness of these innovations is needed, they present important steps into the direction of improved forest governance in Amazonia.

⁸ See: www.socioambiental.org/website/parabolicas/edicoes/edicao35/reportag/pg6.html (accessed 30 September 2008).

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