

**PES and REDD+:
The Case of Costa Rica**

by

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I. INTRODUCTION

Global deforestation and land degradation are responsible for nearly one-fifth of global greenhouse gas emissions, and the forestry sector is one of the few viable options for sequestering carbon (IPCC). Deforestation and land degradation result from a complex interaction of incentives. While forests supply a variety of valuable goods and services to local communities and society in general, the drivers of deforestation come from economic agents – the lucrative competing claims of alternative land uses, predominately agriculture. Landowners prefer alternate land uses because they are profitable; the landowner derives no gain from the benefits that accrue to the global community. However, achieving significant reductions in deforestation and land degradation would greatly contribute to global efforts to mitigate the impact of global climate change.

Reduced Emissions from Deforestation and Land Degradation (REDD+)¹ has evolved out of the international climate change negotiations as an attempt to monetize the value of the carbon sequestration services that forests provide in an effort to compete with the financial incentives driving deforestation. The global community intends to pay for forests to remain standing. The designers of REDD+ hope to deliver additional sustainable development benefits beyond simple carbon sequestration, creating a triple ‘win’ for climate change mitigation, biodiversity conservation, and poverty alleviation. Significant aspects of the final design remain unresolved in the international negotiations under the United Nations Framework Convention

¹ REDD+ is shorthand for the full title: “reducing emissions from deforestation and land degradation and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks” (Cerbu, Swallow, and Thompson).

on Climate Change (UNFCCC), such as the exact institutional structure necessary to link multiple levels of government, sources of funding (private or public), safeguards to protect the poor and biodiversity, the choice of benchmark/baseline against which to measure forested land, and the stringency and form of monitoring, reporting, and verifying carbon sequestration. Despite these unresolved details, both the World Bank and the UN have launched programs designed to build institutional capacity and test REDD+ pilot projects in preparation for a fully-fledged REDD+ mechanism.

As REDD+ takes shape, it appears virtually certain that it will include a payments for environmental services (PES) component. A PES program attempts to place a monetary value on ecosystem services such as those provided by forests like clean water, biodiversity preservation, and carbon sequestration. PES programs either pay directly for these services or, more frequently, for a land use that acts as a proxy for these services, such as forested land. While they can be solely government funded, PES programs frequently attempt to create markets for their services. Economist Sven Wunder developed the classic working prescriptive definition of PES: “(1) a voluntary transaction in which (2) a well-defined environmental service (or a land use likely to secure that service) (3) is “bought” by a (minimum of one) buyer from (4) from a (minimum of one) provider (5) if and only if the provider continuously secures the provision of the service (conditionality)” (Wunder). The key features of this definition are the voluntary nature of the transaction and conditionality – the severance of payments if the provider (generally a landowner) fails to ensure the continued provision of ecosystem services.

Costa Rica broke new ground in the developing world by instituting a PES program in 1996, *Pago por Servicios Ambientales (PSA)*, to provide financial compensation to landowners for the ecosystem services provided by their forested lands. The program has received credit for helping reverse the country's deforestation rate, and has helped re-frame forests as something to be appreciated for the utility value of the ecosystem services that they provide, as well as enhancing Costa Rica's image as a 'green' nation on the international scene. The program has made a sizable mark on national land use, as of 2005 enrolling at least 10% of the country's forested area (Pagiola). PSA had a collective enrollment, as of 2008, of 668,369 ha, compared with 541,500 ha in the national park system (Daniels, et al.). Even though a considerable portion of the cumulative enrollment figure includes renewed PSA contracts, the impact on private landholdings still runs in the hundreds of thousands of hectares.

The program pays for a range of ecosystem services, among them carbon sequestration. Following the modern trend towards linking environmental and development projects to climate change issues, Costa Rica has had high hopes of securing funding for PSA by linking it to the international carbon markets, thus far with minimal success. When originally designed, the PSA program was heavily influenced by the concurrent Kyoto Protocol negotiations. Unfortunately for the country, the regulations eventually established for Kyoto's Clean Development Mechanism (CDM)² focused solely on paying for reforestation and afforestation,

² The CDM allows developed countries to exceed their binding commitments under the Kyoto Protocol to reduce domestic greenhouse gas emissions, provided they offset these emissions by purchasing sufficient Certified Emission Reductions (CERs) by investing in projects in developing nations. These projects must reduce greenhouse gas emissions in countries not legally bound to do so, while contributing to sustainable development objectives such as poverty alleviation. It allows developed nations to offset emissions at the cheapest cost anywhere in the globe. Numerous limitations exist, such as the exclusion of nuclear projects and a cap on the amount of offsets that may be purchased. The CDM is run under guidance from the UNFCCC Conference of Parties.

making Costa Rica ineligible for funding. The emergence of REDD+ offers some hope of resuscitating Costa Rica's involvement in carbon markets. In the midst of uncertainty surrounding the final design of REDD+, Costa Rica has recently received a grant from the World Bank's Forest Carbon Partnership Facility's (FCPF) REDD Readiness Fund in anticipation of the program going global, and will certainly lobby internationally, and prepare domestically, to tailor the PSA program to access the sizeable and highly lucrative REDD+ carbon funds.

Costa Rica's innovative PSA program illuminates many of the strengths and weaknesses of PES programs, especially relevant considering the increasing emphasis in international policy discussions on utilizing market-based mechanisms to mitigate carbon emissions. Even though PSA was originally designed with carbon sequestration as only one component of the program, the PSA program can shed light on the likely effectiveness of REDD+ in delivering real carbon sequestration, as well as the potential to achieve other environmental and social goals. Given that PES features will play a large role in REDD+'s design, what does PSA's experience say about the likely effectiveness of REDD+ in delivering climate benefits in combination with poverty alleviation / biodiversity 'co-benefits'? Which possible designs for REDD+ are more effective, and for which goals? This research explores these questions.

A. Methodology

The research draws on a meta-analysis of available literature, supplemented by interviews with key informants. After an extensive literature review, I conducted a series of interviews and personal correspondence with key informants in Costa Rica over the course of 2011. These included representatives of the agency responsible for administering PSA, as well

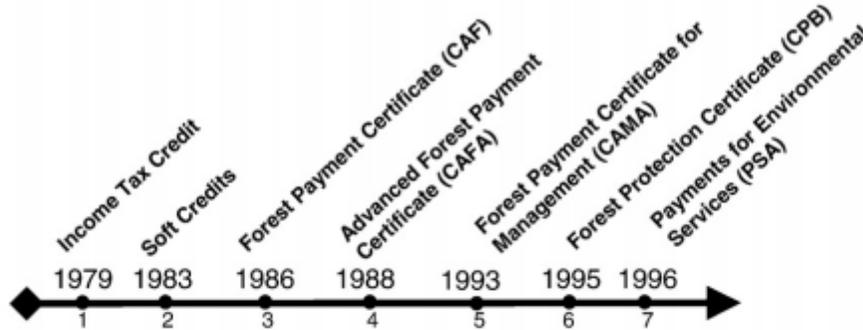
as non-governmental organizations (NGOs) responsible for helping to develop and implement it in the 1990's. This was supplemented with field visits to land enrolled under PSA and talks with landowners in May and September of 2011. As the REDD+ negotiations progressed, I continued to consult with these informants, synthesizing available information into the final analysis. Available non-academic 'grey' literature was also consulted. This analysis serves as a primer for laypersons on issues related to PES and REDD+ and simultaneously offers insights to academics, policy makers, and program designers associated with REDD+. The main limitation of this meta-analysis lies in the fact that it uses only one case to speculate on a global PES program still under design. As a pioneer in the developing world, Costa Rica's program has received substantial attention from academics, making it ideal from the perspective of in-depth analysis. However, the idiosyncrasies of Costa Rica mean that any results must be interpreted with caution, and call for further research into other PES programs around the globe. A further limitation lies in the uncertain state of negotiations over REDD+; any shifts in the debate could quickly make the issues discussed here irrelevant.

The rest of the paper introduces PSA and REDD+, then pulls lessons out of the PSA program for REDD+. The next chapter will explore PSA, establishing the Costa Rican context and historical development before delving into the actual mechanism and evaluating the program's effectiveness against various criteria. The third chapter introduces the current state of REDD+, especially focusing on the setting of a baseline against which to measure deforestation emissions, the governance and institutional context necessary, sources of funding, and the potential impact of REDD+ on poverty and biodiversity. A discussion in the fourth chapter brings together PSA and REDD+. The fifth chapter concludes.

II. COSTA RICA'S PAGO POR SERVICIOS AMBIENTALES

A. Historical Development

Pago por Servicios Ambientales (PSA) built upon groundwork laid by a gradual shift in Costa Rica's government policy, away from facilitating rampant deforestation towards protecting and reforesting land. The cumulative impact of this twenty year change in policy amounted to a major shift in land use for a nation that used to have one of the highest deforestation rates in the world. Following the introduction of the chainsaw after World War II through the 1980's, Costa Rica went through a long phase of clearing forested land for agricultural and other purposes, fulfilling the narrative of taming Nature for dominance by man. Not only were there historic economic incentives to clear land to profit from cattle ranching and agriculture, but deforesting the land used to be a prerequisite to claim property rights. Unmanaged forests could be deemed "useless lands" and appropriated from landowners for 'development' by the government's *Instituto de Desarrollo Agrario* (IDA) and given away for farming or subdivision (Arriagada, et al.). Following the surge of interest in conservation that led to the establishment of Costa Rica's national park system in the 1970's, the government began creating incentives to reduce deforestation pressure, beginning with an income tax credit for landowners reforesting their land, thereby reimbursing some of the startup investment for forest plantations. Low-interest loans, tax vouchers, and up-front subsidies for plantations followed, easing the financial burden of reforestation on landowners. Tax vouchers were extended to the scientifically-managed logging of natural forests, and eventually to the protection of natural forests (Daniels, et al.).

Figure 1: Timeline of Costa Rican Forestry Policy

¹ Income tax credit given to land owners involved in reforestation activities to offset the cost of plantations. The concept was to promote plantations as a way of alleviating deforestation pressure on natural forests. This tax credit targeted large landholders since small holders generally did not pay income tax. Decree No. 10521-AH, Sept. 1979.

² International funding helped to finance low-interest reforestation loans with long grace periods and extended repayment windows. This initiative was the first of several soft credit incentives, some of which still continue in the present (e.g. FONAFIFO-brokered loans for reforestation). COREMA-AID project.

³ Creates the Certificado de Abono Forestal (CAF). Reforestation investments in plantations are made up front by land owner and compensation is given later through a tradable tax voucher. Article 82 of the Second Forestry Law (No. 7032, La Gaceta 13; Circulo 84 – May 6, 1986).

⁴ Like CAF but compensation is given prior to reforestation investment so that land owners with less capital could participate. Decree No. 18691-MIRENEM-H, Dec. 1988.

⁵ Established that scientifically-managed timber extraction from natural forests would be eligible for tax vouchers. Decree No. 22452-MIRENEM-H, 1993 (La Gaceta 170, Alcance 6).

⁶ Established that tax vouchers could be paid for natural forest protection (equal to the CAF vouchers paid for reforestation). Decree No. 23101-MIRENEM-H, April 1994 (La Gaceta 74).

⁷ Article 22 affirms continuation of tax vouchers for protecting natural forest, along with other tax benefits. Article 24 provides that land owners voluntarily allowing forest regeneration are eligible for the same benefits. Article 29 details tax benefits for plantation owners. Fourth Forestry Law (No. 7575, Gaceta 72, Alcance 21 – April 16, 1996).

(Source: Daniels, et al.)

This historical foundation (Figure 1) for PSA gave Costa Rica a huge advantage in launching the program in 1997. When a World Bank loan mandated an end to forestry subsidies, consistent with the global rise of neoliberal ‘structural adjustment’ economic policies, Costa Rica converted the well-established institutions and system of payments for forested lands into the PSA program. The new program made two major revisions to the old timber subsidies, one financial and the other conceptual. Instead of receiving financing from the general budget, the program obtained funding from an earmarked tax on fuel, with a water tariff added in the latter half of the 2000’s, as well as from voluntary payments by beneficiaries.

Conceptually, the PSA program marked a revolutionary shift in the rationale underlying payments. Instead of funding the timber industry, PSA explicitly acknowledges the benefits that forested lands provide, and then gives those ecological benefits an economic value by financially compensating landowners for them. This fell in line with the global ideological shift towards neoliberalism, attempting to internalize a market externality by assigning a price to environmental services. The small portion funded by service users (beneficiaries of environmental services) via voluntary payments also matched the dominant market logic. The fuel tax that financed the majority of payments, however, ran against pure neoliberal ideology as governmental interference in the economy.³

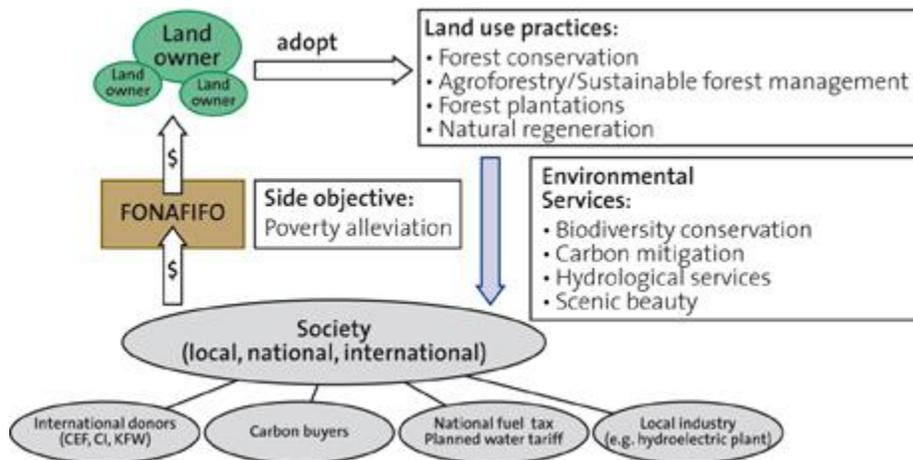
In contrast to the significance of the conceptual shift of PSA to the international community, at the local level most landowners arguably perceived little to no difference when payments shifted from supporting the timber industry to PSA (Daniels, et al.). A small portion of PSA contracts support the startup costs of monoculture timber plantations, further occluding the conceptual shift for landowners. However, the majority of enrolled landowners were now responsible for ensuring that their forests remained standing, and received money to incentivize them to do so. The Costa Rican government desired a certain type of land use, and found a way to coerce private landowners to adopt it, at a reduced cost and effort on the part of the government. In the long term, this conceptual shift spread the idea that the forest has a value. While this does not represent a momentous shift towards an environmentally-friendly

³ In an ideal neoliberal world, emitters of carbon would choose themselves how best to offset their own emissions, thereby providing the market with more 'information' on what services ecosystem users value most. However, the fuel tax concurs with the principle that the 'polluter pays' in that users of gasoline emit the carbon that protected forests in turn sequester, although the connection is loose; the fuel tax can be directed towards any of the four ecosystem services that PSA explicitly recognizes, not just to carbon sequestration.

cultural conscience, at least Costa Rican society has shifted to the point where forests are not indiscriminately cut down.

B. *Pago por Servicios Ambientales*

Figure 2: *Pago por Servicios Ambientales*



(Source: Engel, Wünscher, and Wunder)

The PSA program, conceptually depicted in Figure 2, represents a rather successful decentralization of responsibility for forestry management. At the program's inception, the government set up a semi-autonomous agency to manage the program: *Fondo Nacional de Financiamiento Forestal* (FONAFIFO). The agency is governed by representatives from the public and private sector and has a high degree of freedom in hiring personnel and in administering funds. The government retains some control; the Ministry of Finance has final approval over the budget and the executive branch gets to set payment levels and priorities (Pagiola). FONAFIFO in turn works with private landowners as well as numerous NGOs to disburse funds. NGOs have the expertise to streamline the application process, and possess well-established relationships with foresters for the creation of management plans and the monitoring of

compliance with the agreed upon land use. NGOs also provide technical expertise for timber plantation startup and maintenance.

The PSA scheme holds each individual landowner responsible for the successful management of his/her own forest, utilizing NGOs from civil society to aid in the effectiveness of the program, and allowing the government to coerce a high degree of desirable private land use with minimal effort and resources. In order to get a PSA contract, each landowner is responsible for hiring a forester to draw up a management plan and monitor its implementation over time. Contracts are routinely audited to verify that foresters and landowners provide accurate monitoring reports. Non-compliant landowners forfeit future PSA payments, and foresters can lose their license for incorrectly certifying compliance (Pagiola). Such a system of monitoring, reporting, and verifying (MRV) is essential to build up the trust necessary to give the PSA scheme legitimacy not only domestically, but also internationally, as the developing REDD+ climate change mitigation talks focus increasingly on MRV. Costa Rica's well-established regulatory and infrastructure systems for forestry MRV grant it a strong competitive advantage in accessing REDD+ funds, compared to many developing nations that possess inferior, or even entirely lack, institutional capacity.

The PSA program specifically recognizes four different environmental services deserving financial compensation: hydrologic (e.g. potable water, irrigation, erosion control, water retention for the dry season, hydropower), aesthetic/landscape beauty, biodiversity conservation, and carbon sequestration for the mitigation of greenhouse gases. In theory, all beneficiaries would pay their fair share to all landowners for these services. The program offers

several different types of contracts to landowners (Figure 3). The most commonly issued contract, over 89% through 2008, obliges landowners to protect and preserve extant forest (Daniels, et al.). Reforestation contracts help landowners finance the startup and maintenance costs of a timber plantation. Natural forest regeneration contracts pay for ‘benign neglect’ by landowners to facilitate forest regrowth. An agro-forestry contract pays for the planting of individual trees to improve active agricultural land use. Each contract offers a nationally-set standard payment established without regard to land use opportunity costs to private landowners, or to which of the legally-recognized aforementioned environmental services are provided by any given hectare of enrolled land. In theory, timber plantations are being paid for biodiversity and aesthetic benefits in addition to hydrologic services and carbon sequestration. Payment disbursements do vary with each type of contract; for example, the forest protection contract is disbursed in equal payments over five years, while the plantation contract has the bulk of the funding front-loaded in the first two years to help cover the initial landowner investment.

Figure 3: PSA contracts

Legal status of PES modalities over the last decade. The legal citations listed in parentheses are referenced in the citation column on the right.

Modality	Status	Criteria	Current payments	Priority zones
Forest protection	Dates from Forest Law 7575 to present	2 to 300 ha enrolled, up to 600 ha within indigenous areas	\$64/ha per year for five year period; renewable	SINAC biological corridors; Existing biological corridors; Protection of AyA hydrologic resources; Unpurchased protected areas; Locations in cantons with MIDEPLAN Social Development indexes lower than 40%
Reforestation	Dates Forest Law 7575 to present	Between 1 and 300 ha enrolled; Maximum 50 ha enrolled; Minimum 50 ha enrolled.	\$816/ha over ten-year period	"High potential" forest plantations; Areas with threatened species; Pastures defined as Kyoto lands; Projects under natural regeneration for at least one year
Natural forest regeneration	Dates from first mention in 2005 to present ^a	Minimum of 2 ha	\$41/ha per year for five year period; renewable	None specified
Agro-forestry systems	Dates from 2003 to present	350 to 3500 trees per participant; Up to 336,000 trees per joint project, cooperative or indigenous reserve; Specific requirements per ha.	\$1.30 per tree, over three year period	Projects with organizations with FONFORIFO agreements; Land as described in Ministry of Agriculture's Land Use Capacity Report (1995); Areas with specific agreements with FONORIFO
Forest management	Dates from Forest Law 7575 until 2002	Criteria determined by conservation area	€123,540 (or about \$343) per ha, over five year period	Priority determined by conservation area (SINAC)

^a In practice, forest regeneration was allowed as a PES land use from the beginning in some regions.

(Source: Daniels, et al.)

C. Funding

Funding comes from a variety of sources, governmental and voluntary. The national fuel tax and water tariff offer the only substantial, continuous source of revenue for the program. Annually, the average budget for the PSA program's first decade amounted to over \$13.3 million USD, or 0.43% of Costa Rica's 2006 budget (Daniels, et al.). The fuel tax arguably constitutes a payment from carbon users, although the tax pays for any of the four environmental services recognized by the government, not just carbon sequestration. The same holds true for the water tariff. Despite its size, these two sources of funding cause some concern for the long-term financial sustainability of the PSA program, as a moment of legislative whim could end or redirect them.

Efforts to diversify funding by securing voluntary payments have met scattered success. Hydrologic services have had the greatest success, as several deals have been brokered between landowners and beneficiaries, predominately large users in a single watershed, such as hydropower producers, a bottler, and the municipality of Heredia near San José (Pagiola), although these payments altogether fund less than 3% of overall land enrolled in PSA (Blackman and Woodward). Payments for landscape aesthetics have yet to materialize, probably due to the lack of a single dominant user. The fractured nature of hotels, tour operators, and the tourist industry in general creates difficulty in collective action and many opportunities for free riding. Payments for biodiversity services have attracted some support from global civil society, in the form of several large grants from big NGOs like Conservation International. The Global Environment Facility (GEF), an independent institution launched by

the World Bank and intimately entwined with various major Development Banks and the UN, has also contributed with several grants (Pagiola). However, the recent decline of international funding for biodiversity conservation measures casts doubt upon the likelihood of securing such grants in the future.

Costa Rica hoped to make big financial gains in the global carbon market, initially developing a Certifiable Tradable Offset (CTO) representing a one-tonne net reduction in carbon emissions. After making a big early deal with the Norwegian government for \$2 million in 1997 (Sanchez-Azofeifa, et al.), efforts to link internationally stalled, when the 2001 Marrakesh Accord negotiations over the Clean Development Mechanism (CDM) made only projects related to reforestation and afforestation eligible for carbon credits for reducing emissions (Lecocq and Ambrosi). With most of Costa Rica's potential carbon offsets available in the form of avoided deforestation, in one stroke the negotiations removed most of the PSA scheme from the international carbon market. Despite this blow to funding prospects, Costa Rica has managed to secure some funding under Kyoto for reforestation, as well as on the voluntary (non-Kyoto obligated) carbon market (Pagiola).

Costa Rica has since returned to the international climate negotiations as one of the original proponents of REDD+, pushing for payments to developing countries for avoiding deforestation. REDD+ could open the funding floodgates of the international carbon market for Costa Rica, possibly making the PSA forest protection contracts eligible for new carbon funding from the global market. In fact, the PSA program recently received a REDD Readiness grant from the World Bank's new Forest Carbon Partnership Facility to help the country prepare for

REDD+. While a hopeful start, this far from ensures that the global carbon market will invest in tiny Costa Rica, which will have to compete for funding with more obvious targets, such as Indonesia and Brazil, which can deliver larger economies of scale in carbon emission mitigation. Besides needing to find a competitive advantage, another large barrier looms in Costa Rica's path to a carbon mitigation financial bonanza: additionality.

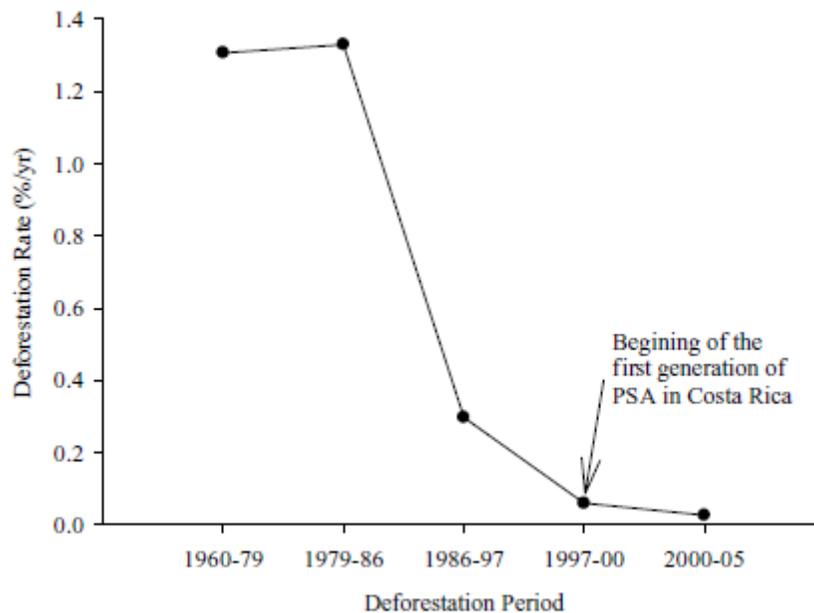
D. Additionality

For successful linkage to international climate change policy, the concept of additionality has become incredibly relevant to the evolution of PSA. Additionality seeks to find out the quantity of service provision PSA has added in addition to what would have happened without PSA. Proving additionality involves the difficult trick of developing a "what if?" counterfactual. For each PSA contract handed out, a hypothetical alternative scenario detailing how land would have been used without PSA must be developed, a process of modeling and before/after observations fraught with assumptions. It is worth pointing out that additionality was not a stated aim of the PSA program at its inception and is not mentioned in the law; if provided with sufficient funds, Costa Rica would pay all landowners regardless of what they would have done with the land. Additionality as a criterion for evaluating the success of PSA has been imposed on Costa Rica by the evolving climate change discussions; carbon offset buyers, desiring the biggest return on their investment, want to know how much additionality a project has.

One overarching trend confounds attempts to determine additionality in Costa Rica: the sheer variety of factors that culminated in an overall change in land use over the 1980's (Figure

4). Despite the fact that the deforestation rate had already dropped considerably, fears over the rapidity with which the nation had cleared its forests led the government to ban change in land use for forested lands in 1996, under the exact same law that instituted the PSA scheme. In a way, PSA was a necessary maneuver to make the ban on clearing forested land palatable to landowners. By keeping forest cover intact, the ban strengthened conservationist goals and reinforced Costa Rica's successful re-framing of itself as a 'green' nation, while boosting the tourist industry which had only recently become the number one foreign currency earning sector in the country. Along with the tourists came a significant number of ex-pat foreigners, enchanted by verdant Costa Rica, buying up parcels of land for their personal homes or the creation of private forest reserves, and generally taking a conservationist mind-set approach to land use.

Figure 4: Deforestation Decline in Costa Rica



(Source: Sanchez-Azofeifa, et al.)

A further major factor, also relating to foreign influence in Costa Rica, was the decline in the economic viability of Guanacaste's long tradition of cattle ranching. For years, large tracts of land in Guanacaste were converted to cattle pasture to raise and sell lean beef on the global markets. However, a decline in the global price of beef caused cattle ranching to dwindle. As tourism took over, landowners abandoned vast hectares of pasture land. Secondary forests quickly regenerated on the neglected land. This shift in land use patterns is mirrored by the correlation between enrollment in PSA and a prevalence of off-farm income for landowners, as well as absentee land ownership; property owners do not live on the ranch, or they find their income elsewhere (Morse, et al.; Arriagada, et al.). Cattle ranching used to be so extensive that PSA payments were set to compete with cattle ranching in profitability per hectare of land use. The PSA payments were meant to tip the balance in land use choices in favor of forests (Daniels, et al.).

This change in land use pattern resulting from the economic shift from cattle ranching to tourism, along with the arrival of foreign conservationists, has made additionality a hard sell for Costa Rica in the global carbon markets. The CDM will only approve of reforestation projects with proven additionality. REDD+ will apparently also make additionality a criterion for approving projects. With so much land already protected by the government, and much private land reforesting itself through neglect, there is very little incentive for the foreign carbon market to pay to protect Costa Rican forests. Nobody wants to pay to preserve trees that, legally, should not be cut down. Costa Rica responds with a merit-based argument, contending that it should receive compensation for its early and proactive efforts to halt deforestation.

The World Bank's REDD-based grant from the FCPF appears to acknowledge this argument, but Costa Rica still has a long battle ahead with the carbon markets.

To make things even more difficult, determining additionality for each contract is insufficient. Two other factors impinge on the effectiveness of any project sequestering carbon: leakage and permanence. Financing reforestation with high additionality in one place will prove ineffective towards the global goal of reducing atmospheric carbon if the reforestation program causes deforestation somewhere else: the carbon emissions leak to another location. For example, Costa Rica may have plenty of forested land right now, but the country is importing Chilean timber. PSA may thus prove to be very effective at protecting local forests, but useless in aiding the global goal of reducing greenhouse gas emissions. Besides this threat of leakage, a forestry project must endure over time. No matter how high the level of additionality, if the forest is cut down as soon as funding ceases, the project lacks permanence. Costa Rica's plantation contracts, while requiring landowners to maintain the plantation for fifteen years, do not mandate a replanting after the timber harvest. Any temporary gains in carbon sequestration may be lost if a more profitable land use comes along. Issues of leakage and permanence are problematic for the international carbon market as a whole, including REDD+, and not issues that the PSA program was initially designed to deal with.

E. Sustainable Development Impacts

Much of the climate change dialogue intertwines with the idea of sustainable development. The CDM, in addition to paying for the mitigation of greenhouse gases by reforesting land, also aims to promote the development of impoverished societies. The CDM

has not been notably successful at inducing sustainable development, as investors tend to pay for large-scale projects like dams for hydropower that provide a better return in mitigating greenhouse gases (Olsen). While REDD+ will also emphasize sustainable development and poverty alleviation goals, it remains to be seen what sort of safeguards will be implemented in order to ensure that these non-carbon sequestration goals will be achieved.

PSA performs similarly although, unlike CDM, the PSA program does not make sustainable development a stated goal. PSA does not prioritize the poor, nor does it incorporate a higher payment level in recognition of poverty-alleviating benefits. Evidence for the program improving the livelihoods of the poor has been mixed. PSA was never supposed to be a tool for livelihood improvement at all, and lacks many of the hallmarks of current development projects; the only nod to the disadvantaged or marginalized comes from a doubling, compared to other landowners, of the area that indigenous groups can enroll in the program. The program's purpose, by providing financial compensation, is to shift a landowner's balance of incentives regarding land use decisions in favor of conservation.

PSA is at best minimally effective as a tool of poverty alleviation. PSA has been found to tend to benefit large absentee landowners who derived income from non-agricultural sources and have lower transaction costs (less paperwork per hectare of land enrolled), as opposed to small landowners (Morse, et al., 2009, Arriagada, et al., 2009). Interestingly, Cole (2010) found PSA participation correlated with higher education levels, suggesting a bias towards the better-off, although the same study showed that the sustainable agro-forestry contract has increased the income of small landowners in southern Costa Rica. For many of the early years of the

program, the *desposesadores*, landowners lacking formal title to their land, were effectively barred from participating. The landless, obviously, cannot benefit at all. These impediments to participation have been somewhat addressed by making the rules more flexible to encourage the participation of smaller, poorer landowners, removing the land title requirement and attempting to find ways to lower transaction costs (Pagiola, 2008). Even with increased accessibility for the poor, the scale of payments is not necessarily enough to make a significant contribution to livelihoods – \$64/ha/year, the annual payment for a forest protection contract, is insufficient to raise a family out of poverty. While a nice bonus, PSA will not put an end to rural poverty, although it seems to have made some incidental improvement in the incomes of impoverished landowners as a side benefit to the stated goal of paying to protect environmental services.

F. Limitations

As an economic tool, and as an effort to induce conservation, PSA proves to be a blunt instrument, lacking efficiency and cost-effectiveness. Many landowners are receiving PSA payments for land that would have been forested anyway. One of the major criticisms of PSA comes from its lack of targeting, both spatially and financially. The program has far less funding than applicants, and it does not easily distinguish between those who simply want PSA and those who truly need it to offset an alternative land use. In an ideal neoliberal world, all beneficiaries would pay their fair share to all landowners for these services via voluntary payments, theoretically negating the problem of targeting payments, but in a world where PSA has had great difficulty soliciting non-governmental payments, FONAFIFO must choose which

land to enroll following priorities set by the executive branch. As all payments are exactly the same per hectare for every contract, there is no way to refine the financial payment via differing monetary amounts according to the environmental value of the land. Desolate strips of land isolated far from human influence (inaccessible by road) receive exactly the same fee as primary forest containing a nearly extinct species' breeding grounds that happens to hold a large quantity of valuable timber. The program has become slightly more targeted over the years, focusing on enrolling priority conservation areas for biological corridors. Still, the program has yet to move towards a system of financial targeting. Without a sliding scale of fees, PSA's set level of payments for the entire country does not take into account differences in land use opportunity costs. This can lead the profit-minded landowner to avoid the desired forested land use (e.g. developing land for tourism or repeatedly selectively logging the forest to the detriment of biodiversity); despite the governmental ban, land use can change substantially while still qualifying as 'forest land', considering the definition of the UN Food and Agricultural Organization (FAO) of forest as at least 10% tree canopy cover (Grainger). Improved targeting, via effective prioritization criteria for enrolling land and a sliding scale of payments for different types of land, can greatly enhance the effectiveness of PSA in using the limited budget that it has.

PSA delivers mixed success as a strategy for ensuring the provision of environmental services, especially on the conservation front. Because mature forests have a fairly stable amount of carbon stored in them, they are not the best choice for an international investor looking to purchase carbon sequestration. Carbon funding will have a natural bias towards reforestation and timber plantations, which will deliver far better results for the investor's

dollar. None of these promise to make a large impact on Costa Rican land use, hampering efforts to access REDD+ funds. Monoculture timber plantations make poor habitat for true biodiversity, though they do create biological corridors, albeit temporary and ecologically impoverished ones that can be clearcut on a cyclical basis.

PSA contracts for preserving the forest only last for 5 years, a further structural flaw that threatens the permanence of conservation gains by potentially reducing biodiversity. While clearcutting is banned, Costa Rican law does allow landowners to selectively log up to 50% of all commercially valuable mature trees outside of steeply graded slopes or narrow riparian zones. This allows a landowner to enroll in a PSA preservation contract and profit from the forest during 'fallow' years, then drop out and log for profit. Unfortunately, the minimum time between cuttings is not long enough to ensure the replacement of the earlier mature trees, so a succession of these cutting cycles will drastically reduce the genetic diversity of the forest by reducing the number of reproductively mature adults, as Lobo et al. (2007) demonstrated with regard to two commercially valuable species in the Osa Peninsula. Beyond the tree species of commercial interest, selective logging has repeatedly been shown to cause immense ecological damage with the system of roads and mechanized yarding techniques. More subtly, light gaps in the forest canopy fundamentally alter the structure of the forest floor, pressuring the earlier, enclosed canopy ecosystem, and changing the 'balance' of biodiversity. Extending the PSA contracts over time, past the length of the 15-year sustainable logging cutting cycle, would help increase the biodiversity conservation gains of the program. Unfortunately, the connection between land cover and environmental service provision is difficult to prove, especially for biodiversity conservation services (Pagiola).

Forest cover serves as a proxy for environmental services. The link between forest cover and the assumed environmental services is not always well established. For example, the link between water quality and forest cover is far more established than the link between forests and quantity of water, or the dry season flow of water (Calder, et al.). For climate change, this means proving the amount of carbon sequestered by a forest. Accurately proving the amount of carbon sequestered for each project can be prohibitively time-consuming and expensive, necessitating an estimate of both above- and below-ground levels of carbon. Above-ground carbon sequestration requires an intimate knowledge of the type of tree, weather conditions, growth rates, water content, and so on for every tree. Below-ground carbon sequestration requires a similarly detailed knowledge of the type of soil present, and entails testing of soil samples. Rough estimates of the biomass above- and below-ground can be used to approximate the amount of carbon sequestered (Morse, et al.). For Costa Rica to participate in the carbon markets, a cheap, effective, and trusted method of estimating the amount of carbon sequestered has to be implemented. Rough estimates suggest that, from 1998-2005, Costa Rica sequestered one million tons of carbon through reforestation plantation contracts, and avoided emitting 11 million tons of carbon with forest protection contracts (Pagiola).

Costa Rica's PSA system has been running for over fifteen years. Despite being a blunt instrument, open to much criticism, it has functioned fairly successfully in inducing conservation amongst private landowners and spreading the social norm that forests are

valuable in and of themselves. It is an archetypal example of a PES scheme for forested land, and has been subjected to a fair amount of rigorous academic analysis from varied perspectives, especially from conservation biologists and environmental economists. The strengths and weaknesses of Costa Rica's program offer illuminating lessons for the PES components of REDD+ currently under development. The following section introduces the current state of negotiations over REDD+, focusing on those issues pertaining to PES.

III. REDD+

A. Historical Development

Despite the fact that land use change and the forestry sector were identified by the Intergovernmental Panel on Climate Change (IPCC) as major contributors to greenhouse gas emissions, the international climate change negotiations largely ignored the sector until 2005, due to concerns regarding the technical obstacles to quantifying carbon emissions. The CDM contained restrained provisions for crediting emissions offsets from reforestation and afforestation projects in developing countries. To date, these projects have contributed to a mere 0.54% portion of the global project portfolio of the CDM (Cerbu, et al.). The historic barriers have hampered the development of a concerted response to the problem of emissions from deforestation and land degradation.

The 11th Conference of the Parties (COP11) to the UNFCCC signaled a movement towards a cohesive global strategy to combat deforestation as a way of mitigating the effects of climate change. The governments of Papua New Guinea and Costa Rica petitioned for the creation of a mechanism as part of the Convention to reward actions taken to reduce emissions from deforestation (RED) in developing countries. COP11 ended with a resolution approving the request and called on developing countries to voluntarily begin taking action to reduce deforestation. It solicited the involvement of various stakeholders, NGOs, and governments to begin transferring technology, building capacity, and establishing demonstration projects, and it asked the Subsidiary Body for Scientific and Technological Advice (SBSTA) to work on creating clear definitions and methodologies for the overarching framework.

The second 'D', standing for land degradation, was added to RED two years later at COP13 in Bali under the urging of the Central African Forest Commission, creating REDD with the inclusion of language calling for developing countries to "*stimulate further action to reduce emissions from deforestation and forest degradation in developing countries*" (Cerbu, et al.). The first substantial support for REDD came from developed nations and multilateral agencies. The Norwegian government made a strong financial commitment to support the startup of a REDD mechanism. This founding grant, combined with additional support from Denmark and Spain, was used by three UN agencies, the FAO, UNDP, and UNEP, to launch the UN-REDD Programme (UN-REDD Programme). The World Bank simultaneously launched its Forest Carbon Partnership Facility (FCPF) and Forest Investment Program (FIP) to support capacity building and the development of REDD.

The scope of REDD widened even further over the ensuing two years, culminating at Copenhagen's COP15 with the inclusion of language seeking "*Methodological guidance for activities relating to reducing emissions from deforestation and forest degradation and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries*" (Cerbu, et al.). REDD became REDD+, allowing the inclusion of a much broader range of activities, provided they led to net growth in carbon sequestration.

Since Copenhagen, the explosion of interest in REDD+ has led to the spread of multilateral and bilateral programs designing and implementing REDD+ demonstration activities and building capacity in developing countries around the world. Beyond the FCPF and UN-REDD, the governments of Norway, Germany, Spain, and the UK have all established funding

programs to support REDD+ (Corbera and Schroeder). Numerous conservation and development non-profits have initiated project-level demonstration activities as well. This multitude of actors experimenting with the shape REDD+ proceeds at high speed even as the global architecture of REDD+ itself stalls, especially in the absence of binding commitments to reduce greenhouse gas emissions.

B. REDD+

As a concept, REDD+ is a fairly straightforward system of transferring funds to cover the cost of conservation. Developed nations and other interested parties (businesses) pay for carbon sequestration in trees in the developing world. While the global community accrues vast climate mitigating benefits from leaving trees uncut, local landowners bear the cost in terms of missed income-generating opportunities. Deforestation and land degradation occur because alternate uses of land (predominately agriculture and pasture land) are more profitable; as with PSA, REDD+ payments given directly to landowners are meant to offset these opportunity costs. If property owners receive enough funding to 'tip the balance' of personal profitability in favor of conservation, they will naturally choose to do so. REDD+ payments incentivize conservation. The devil is in the details. These payments could be given directly to landowners to incentive conservation, as in a typical PES transaction, or they could be directed towards more abstract, difficult-to-quantify actions, such as covering the costs to national governments of changing agricultural policies. The latter type of funding for REDD+ actions will not be covered in this paper. As they are typically given to governments for institutional capacity building, they do not fall under the standard definition of a PES scheme, wherein at

least one party voluntarily pays another (land-controlling) party, conditional upon the continued provision of a desired land use (in this case, carbon sequestration via non-deforestation).

On the global political arena, the contentious nature of the program stems from deep-seated financial and politicized stakes in the international climate change negotiations. Developed nations want to include REDD+ payments as offsets in the event of binding carbon emission reduction commitments. Developing nations fear these offsets will be used by developed nations to avoid meeting domestic greenhouse gas consumption reduction goals. Another fear is that REDD+ payments could result in the developed nations' harvesting all of the 'low-hanging fruits' of carbon reduction, thereby forcing developing nations to make far more expensive emission reductions down the line under the eventuality of UNFCCC carbon reduction commitments expanding to cover the entire globe. Nations quibble over the setting of baselines, in the hopes of reaping big financial gains. A natural Catch-22 tension exists between the stringency of targets and ensuring broad participation: the tighter the program, the more effective the environmental results, but the fewer nations enroll, thereby increasing the risk of leakage and non-permanence, ultimately undermining the environmental results. Debates over ecological justice and climate debt polarize the debate. The nature of the funding mechanism involved (public vs. private) has become embroiled in on-going ideological controversies over the future of the 'free market' and the nature of the global economy. Indigenous and other forest-dependent communities fear the loss of access to already insecure livelihood safety nets in the event of 'elite capture' in the form of massive land grabs if forested

land becomes more valuable, leading to the further impoverishment of those least able to cope.

Technical hurdles to REDD+ also provide major stumbling blocks. Many nations hoping to profit from REDD+ lack the necessary governance institutions to establish and enforce regulations preventing deforestation, or to effectively run a system of REDD+ payments for environmental services. Baselines against which to measure deforestation must be established, along with systems for monitoring and reporting on carbon sequestration. Strong forestry policies must be established, followed by cross-sector linkages, taking into account potentially conflicting policies in sectors such as agricultural policy. Enforcement agencies need to be endowed with proper punitive authority. Property rights must be firmly established, and not just over land; a new form of private property, carbon rights, must be created. Systems for disbursing payments, funneled through a variety of institutions from the global to the local level, will have to be created. Actions eligible for payments need to be defined; emission reductions must be quantified. Many potential REDD+ nations are not known for a firm rule of law, so the issue of corruption must be dealt with.

Although negotiations continue, a considerable degree of uncertainty exists regarding the ultimate form of REDD+. Major ongoing issues relate to the precise sources of funding for the mechanism (multilateral, bilateral, private markets, or mixture), as well as the potential for inclusion as an offset mechanism for Annex I countries in meeting their emissions targets (probable, if Kyoto ever gets off the ground again). Decisions must be made regarding the baselines against which to measure success, and guidance must be developed over how to

setup trustworthy systems for measuring, reporting, and verifying emissions reductions. Due to concerns over national sovereignty, support for language on co-benefits for biodiversity and sustainable development, or at least the inclusion of safeguards to prevent harmful outcomes in these areas, remains a stumbling block.

C. Funding

Acknowledging that many nations currently lack the capacity to participate as full members of a REDD+ system of payments, with performance-based payments conditional upon the delivery of carbon sequestration disbursed from the global to the local level, international negotiations have come to center on what is known as a 'phased approach' to preparing for REDD+. In the first Phase, governments receive funding solely to build capacity, creating or strengthening the institutions, policies, and legal frameworks necessary. Phase 2 consists of initiating pilot/demonstration projects, along with further financing for capacity-building activities. Phase 3 will be the mature state of REDD+, with formal payments transferred in exchange for verified emissions reductions (Angelsen, et al., 2009). Finance for the first two Phases comes from the international community in the form of grants. This REDD-Readiness funding is administered through both the World Bank, with their FCPF and FIP, and the United Nation's UN-REDD Programme (a partnership of UNDP, UNEP, and FAO). Eligible countries are drafting plans for engaging in REDD+ and presenting them to these agencies for approval.

The funding mechanism for the mature phase of REDD+ remains contentious, with debate centering on public or private funding sources. On one side, there is the belief that only a private carbon market can generate the sizable funding necessary to finance REDD+. As the

counter-argument points out, in the absence of a binding compliance market based on mandatory carbon emission-reductions, it is difficult to see how the voluntary market can come remotely close to generating enough funding. It is further argued that the private sector will not take into account co-benefits such as poverty alleviation or biodiversity conservation outcomes, and would thereby limit the potential gains of REDD+.

Estimates widely vary depending upon underlying assumptions, such as the price of carbon, with ranges such as \$2.3-23 billion USD possibly needed per annum (Kaninnen, et al.). The 2011 financial resources of the largest multilateral supporters of REDD+ capacity building and demonstration activities, the UN-REDD Programme and the FCPF, stood at \$118 million USD and \$165.8 million USD respectively (Multi-Partner Trust Fund Office; Forest Carbon Partnership Facility), with a combined total of \$283.8 million USD. Considering the projected volume of funding necessary to finance REDD+ and the domestic political landscape in developed countries in the aftermath of the 2008 financial collapse, there seems little likelihood of the public sector generating enough funding to finance REDD+. The natural compromise is a mixed fund approach, wherein private carbon markets finance a portion of REDD+ while some public grant institutions (like the GEF and UN-REDD) channel funding to support co-benefits, or to those nations so uncompetitive as to be unable to participate in the market. But this simply shifts the debate to an argument over the percentage of public versus private finance.

The exact method of disbursement of funds from the international to the local level remains undecided. Payments could be disbursed on a per-project basis, directly compensating

those engaged in REDD+ actions, thereby by-passing potential problems of corruption at the national level. Such a system runs a risk of leakage that many deem to be unacceptably high, leading to the argument for a system of national accounting, wherein payments are transferred first to national governments and then channeled to individual projects. This approach places individual projects at risk of not being paid, due to the failure of unaffiliated projects within the country. The debate is settling on a 'nested' approach shoehorning these two systems together, with projects at the local level subsumed within an overall national accounting.

Defining REDD+ actions, and then tying those actions to exact payments, is incredibly complicated. Quantifying the carbon stored by a given patch of forest depends upon determining the type of tree and other shrubbery species present, figuring out the carbon content within, and combining it with the carbon content of the soil. A cost-effective method must be designed for carrying out that technically complex procedure of measuring carbon content. Actions to preserve the forest must then be explicitly tied to precise quantities of carbon saved, and proof of additionality must be provided. In the case of direct transfers of payments to landowners to preventing logging, this may be fairly straightforward. However, REDD+ actions could also be defined as removing governmental subsidies for cattle-raising, or reducing subsidies for soy bean production, or lifting tariffs on imported lumber. Such far-reaching policy changes may have sweeping impacts on deforestation rates, but attributing causation and converting it to quantifiable emissions reductions proves to be problematic.

Quantifying payments remains contentious. Payments could be disbursed based upon the available stocks of forested carbon: \$X/ton of carbon. While it makes intuitive sense to tie

payments directly to the amount of carbon sequestered, this runs the risk of frivolously spending more money than necessary. It would be more efficient to set payments based upon the opportunity costs of conservation compared to the forgone most profitable alternative land use. Setting payments with regards to opportunity costs also more directly addresses the needs of landowners. But setting payments based upon opportunity costs ensures that the cheapest forested land will be preserved, not necessarily the most endangered forests, and has less likelihood of benefitting poorer landowners.

The difference between disbursing payments ex post or ex ante has considerable ramifications over the distribution of risks and ability of stakeholders to participate. Disbursing payments prior to the conservation of forested land permits landowners to invest in the actions necessary for conservation, but place the payee at risk of not receiving the promised carbon credits if the landowner fails to deliver. As such, developed country investors will prefer ex post payments, disbursed after delivery of proof of carbon sequestration. This places the burden of risk upon the landowner, who may not have the initial capital needed to invest in conservation, or may not be able to find a buyer after the investment is made. Ex ante payments would enable broader participation, especially amongst poorer stakeholders lacking the resources to invest in the upfront capital investments for conservation.

D. Baselines

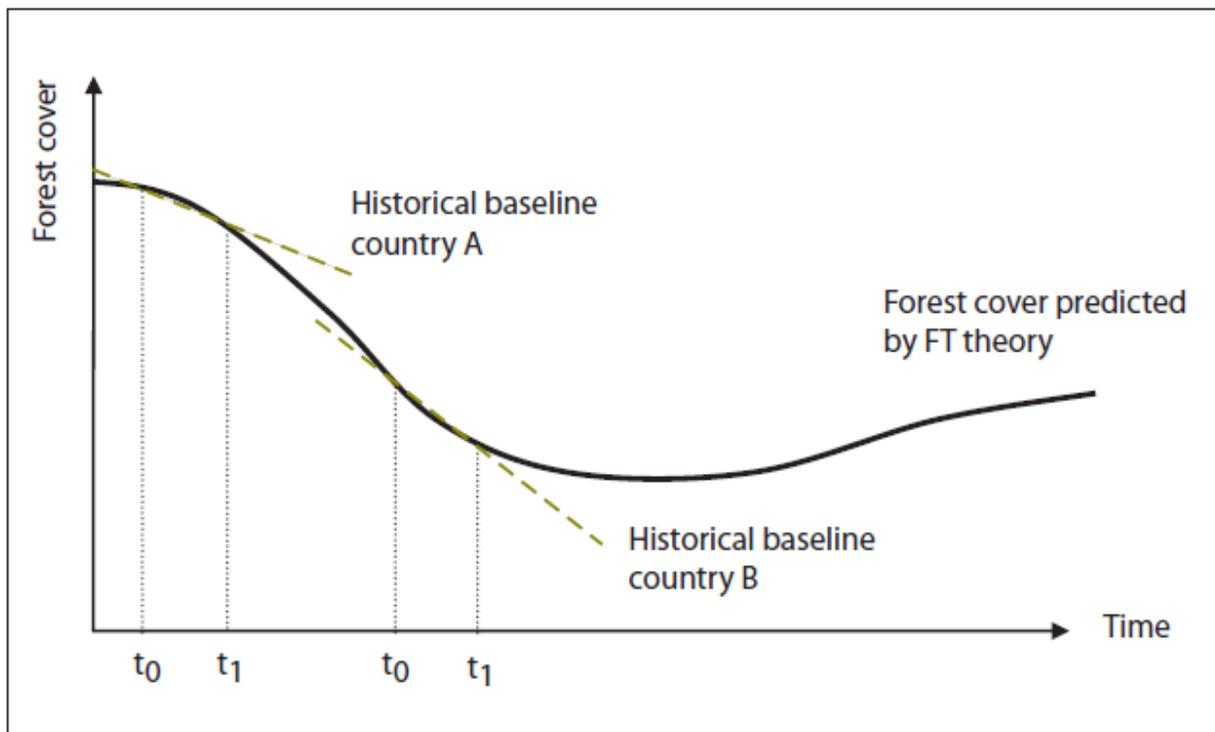
Technical guidance and political dialogue continue to develop regarding the complicated process of establishing deforestation baselines, the critical line against which to measure emission reductions. On the national level, three main options exist for the choice of the

baseline/reference level. The least likely option for baselines would establish it with reference to projected deforestation rates: predicting the future. The second option rather straightforwardly ties the baseline to historic deforestation levels. Despite the commonsense appeal of such an approach, several areas of contention exist. It disenfranchises the so-called 'early action' nations, like Costa Rica and India, which have already slowed or reversed their deforestation rates. It also leads to a problem of perverse incentives; the possibility of increased funds once REDD+ begins would incentivizes nations to continue, and even accelerate, current deforestation rates in order to enhance the lucrativeness of the baseline.

The final option relies upon historical deforestation rates with an adjustment for 'national circumstances'. The rationale for this option is tied to the forest transitions model (Figure 5, next page). In the model, nations start with a period of high forest-cover and a low deforestation rate. As a period of 'modernization' and economic growth begins, nations begin 'liquidating' their natural capital to spur development, resulting in a situation of high forest-cover and high deforestation rates, speeding towards a situation of low forest-cover and high deforestation rates. Eventually the trend bottoms out as economic activity transitions away from agriculture and other land-use change to other activities, resulting in a state of low forest-cover and low or negative deforestation rates. The rationale behind the 'historical-adjusted' baseline is to help nations in the early stages of the forest transition model, nations that have a high forest-cover and have yet to begin deforestation at high rates for economic gain (Figure 5, next page). REDD+ payments, in theory, will help forested developing countries 'bridge the gap', financing the transition directly into 'modern' forms of economic activity and bypassing the period of rapid deforestation. The danger is that 'national circumstances' could become

code for ‘unnaturally inflated baselines’, leading to an economic boom while undermining climate effectiveness.

Figure 5: Forest Transitions Model with Historical Baselines



(Source: Angelsen, ed., 2008)

Baselines must be set in such a manner as to ensure global additionality for climate effectiveness; if they are set too high, the risk is run of generating a bunch of ‘hot air’ credits, depressing the price of carbon credits and reducing overall climate effectiveness. But while tighter baselines ensure the climate effectiveness of REDD+, they also reduce the incentive of nations to participate in REDD+. The less profitable REDD+ will be for a nation, the less interested it will be in participating, again resulting in undermining the climate effectiveness of REDD+, but now by permitting leakage: pockets of non-participating nations into which deforestation can relocate, destroying global additionality. The complicated task of establishing

an overall global baseline, and then undergoing the complex zero-sum game political process of setting national baselines within that overall goal, has yet to be accomplished. If current negotiations are an indication, it never will be, and the final design of REDD+ will establish baselines for each individual nation without regard to a global target, ultimately erring on the side of expanded participation and potential 'hot air' credits. 'Reference levels' will probably become the benchmark against which emissions will be measured; a combination of a business-as-usual baseline based upon historic trends and adjusted to account for 'national circumstances' (Angelsen, et al., 2011).

E. Governance, Institutions, and Monitoring, Reporting, & Verification (MRV)

REDD+ is envisioned to operate in developing nations across the globe, all with varying governance contexts. The aforementioned 'phased approach' to funding REDD-Readiness addresses the large gap between current capacity and the institutions, policies, and legal frameworks necessary to implement REDD+. Government Ministries must be strengthened, and provided with the resources (financial, personnel, and otherwise) to implement REDD+ policies. Not only must the forestry sector be addressed, but cross-sector policy linkages must be created, especially with agricultural ministries and institutions, as the agricultural sector is the primary driver of deforestation. Land-use policies must be streamlined across the national policy spectrum. Enforcement of laws and policies must be strengthened, as corruption is rampant in many potential REDD+ nations. A national mechanism must be devised to channel funds from the international to the local level that bypasses the same potential corruption. Without first building this capacity, REDD+ cannot work.

REDD+ must work at multiple scales of governance, with local communities effectively enforcing forest conservation policies 'on the ground', backed up by municipal and state/provincial government, interacting with central government ministries and the overarching national governance scheme, all operating within the international REDD+ mechanism. The complex ties among all of these different entities means that REDD+ will be implemented in each nation where different power interests and political struggles are already entrenched (e.g., between ministries, local vs. national level), further complicating the implementation of REDD+.

Cost-effective and accurate systems of monitoring, reporting, and verifying (MRV) carbon sequestration must be developed. Legal operational definitions must be drafted for many terms (e.g. forest cover, deforestation, degradation, sustainable forest management, forest enhancement). Remote sensing, via airplanes and satellite technology, are predicted to play a huge role in monitoring and verification, but the technology must first be refined for greater cost-effectiveness and accuracy. While it may be sufficient for detecting clearcutting deforestation, remote sensing does not reliably go to the resolution necessary to detect forest degradation. Monitoring degradation will be extremely difficult, due to the inability to clearly define it and the easily hidden nature of such activity, until the cumulative impacts of degradation eventually lead to complete deforestation.

Remote sensing will be accompanied by ground-based visual verification, requiring expensive man-power and equipment such as handheld GPS devices. Scientific hurdles exist in quantifying the amount of carbon sequestered by a given patch of forest. The composition of

species must be determined. The size of tree trunks must be established, coupled with measurements of branching. These must be compared to predetermined 'yardsticks' of per-species carbon content, based on prior scientific analysis. Bushes and shrubs on the ground should be included in carbon accounting. Below-ground soil samples would need to be analyzed to establish the carbon content. Such a rigorous accounting would be too expensive to do accurately and properly for every patch of REDD+ forest, so some proponents of REDD+ hope to use a form of community-based rapid rural appraisal techniques for verifying carbon sequestration. These would have to be designed in such a manner as to be sufficiently robust to ensure the credibility of their reports, combined with the ability to scale them up for broad usage by many forest-dependent communities. There is a natural tension between the economics of MRV and the accuracy and robustness of monitoring and verification. The more costly the method of MRV is to conduct, presumably increasing accuracy and confidence in climate effectiveness, the ultimate goal of REDD+, the more expensive REDD+ credits become, and the less benefit there is for owners and sellers of carbon credits. Cost-effectiveness is the name of the game.

F. Property Rights

REDD+ hinges upon clear property rights. Land tenure must be explicitly defined. In order to disburse payments for forest protection, ownership over land must be established. That owner must further be capable of excluding access to others to the forest, preventing deforestation and land degradation. Unfortunately, many potential REDD+ nations do not have clear land tenure laws and policies in place, and ownership of land is frequently unclear and

deeply contested. REDD+ may exacerbate preexisting land conflicts among landowners. Meddling in legal land tenure in the developing world to establish formal, legal forms of property rights similar to those found in developed nations also threatens customary community forms of land tenure, such as those exercised by indigenous communities. REDD+ has the potential to disenfranchise those who lack clear land tenure, or those having only usufruct rights to forested land. Land tenure is a crucial piece of the REDD+ puzzle that must be addressed in the institutional capacity-building phases of REDD-Readiness before performance-based REDD+ payments can be disbursed.

A new form of property rights must be codified in the law: carbon rights. Once carbon becomes a marketable commodity, ownership must be clearly defined before it can be traded. The locus of ownership determines liability in the event that deforestation occurs; as we have seen, PES programs rely on conditionality to function. In the event of logging, responsibility is easy to assign, but who is responsible if, ten years after forest carbon credits are sold, an uncontrollable fire burns down the supposedly protected forest? If individual landowners control carbon rights, they have greater control and more profit, increasing incentives for them to participate. On the downside, the risk of non-permanence drastically increases if carbon rights are not located at the national nexus; landowners only risk losing future REDD+ revenue for themselves if deforestation occurs, while governments risk being completely disenfranchised from receiving REDD+ funding. Unfortunately, if liability is held at the national level, successful projects may lose REDD+ funding through no fault of their own, due to the failure of other projects elsewhere in the nation (Palmer).

G. Sustainable Development 'Co-benefits' and Safeguards

REDD+ is often billed as having the potential to deliver multiple 'co-benefits' beyond carbon sequestration, such as the aforementioned governance capacity building, conserving biodiversity, and alleviating poverty. The narrative suggests a 'win-win-win' for climate, the environment, and the poor. While it certainly has the potential to deliver these benefits, it also runs the risk of undermining these additional goals, and even actively hurting them, in pursuit of carbon sequestration. It is increasingly understood that 'safeguards' must be implemented along with REDD+ to ensure that these 'win-win-win' co-benefits are actually delivered, rather than being mere rhetoric. Skepticism of 'win-win' benefits by indigenous and forest-dependent community groups certainly appears warranted; CDM projects, large-scale carbon sequestering climate mitigation schemes touted to also provide positive sustainable development impacts, have had a rather dismal record of actually delivering those co-benefits (Olsen).

Environmentally, REDD+ draws harsh criticism for permitting selective, sustainable logging and forest plantations to be included as recipients of REDD+ funds, the '*sustainable management of forests and enhancement of forest carbon stocks*' part of the REDD+ definition. In theory, sustainable logging of forests could make them more economically valuable to landowners, reducing the necessary size of individual REDD+ payments and increasing the entire program's cost-effectiveness. Such logging can be done with many techniques that minimize the impact on the forest ecosystem, such as directional felling, avoiding the use of heavy machinery, limiting the number of mature trees removed so as to maintain good genetic diversity, and extending the period of time between cutting cycles to allow forest recovery. The

problem is ensuring that the cutting cycle is designed for ecological soundness and ensuring proper enforcement of those regulations, especially difficult when agents with powerful economic motivations lobby to boost maximum allowable lumber harvests and to simultaneously shorten the cutting cycle.

Environmentalist groups frequently denounce the inclusion of timber plantations as threatening biodiversity outcomes. A compelling economic logic underpins the desire to sequester carbon within forest plantations. Plantations can sequester more carbon than 'natural' forests. Natural forests have a fairly steady carbon content; what they have is what they've got, and paying for their conservation amounts to avoided deforestation. Plantations, on the other hand, are typically rapidly-growing species, actively sequestering vast chunks of carbon. While this carbon may eventually be released to the atmosphere through decay, many decades of useful life can be gained from cut lumber. In the meantime, for every cutting cycle at a plantation, another sizeable chunk of carbon can be sequestered. The fact that these plantations typically form as large mono-crops may be unfavorable to habitat for biodiversity, but the economic logic is sound, underscoring the perils of condensing all of the complex values of a forest into a commodity valued for only one function. Maximum carbon sequestration gains come from plantations, not 'virgin' forests, lowering the frequency with which REDD+ payments will deliver biodiversity co-benefits.

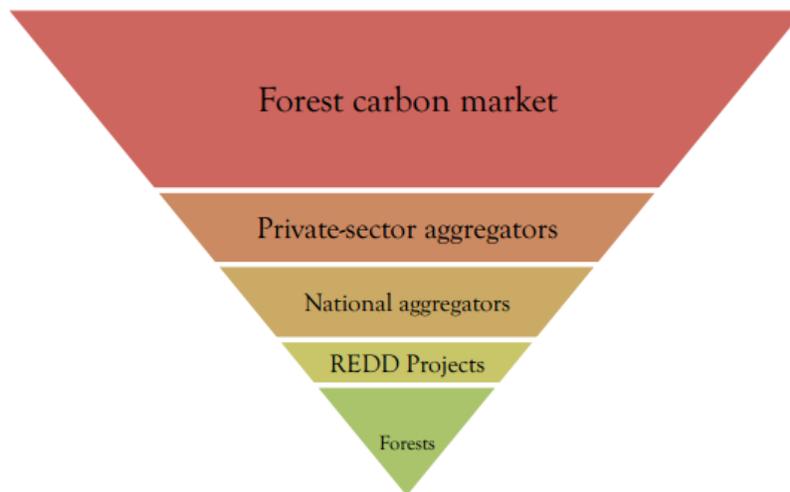
One of the biggest apprehensions regarding REDD+ is the dangerous potential to further marginalize the weakest members of society, which forest-dependent communities tend to be. REDD+ could pose a threat to traditional lifestyles if large national governments choose to

collect REDD+ payments by targeting the politically marginalized, e.g. punishing the slash-n-burn agricultural practices of indigenous groups, instead of targeting large, politically influential agricultural producers or the timber industry. As REDD+ increases the value of forests, the very real possibility exists of elite capture – ‘land grabs’. The poor and landless tend to rely on forests as a ‘safety net’, harvesting fuel wood and non-timber forest products for subsistence use, or to boost incomes during lean times. Those lacking formal land tenure rights are especially endangered. The possibility of land grabs gravely concerns many indigenous groups, who are frequently embroiled in disputes with national governments over land rights.

Poor and marginalized groups face large barriers to engaging in REDD+. They are less likely to have the title to their land, or any other form of explicit proof of land tenure. Their smaller size makes them more difficult to identify. They are less likely to be educated and easier to take advantage of. They are more likely to live in remote areas, and less likely to be reached by REDD+ information awareness campaigns. Already there are rumors of ‘carbon cowboys’ in remote parts of the Amazon and Congo, reportedly tricking unsuspecting forest-dependent communities out of the rights to their forest carbon. Even if all of these barriers are overcome, the poor face higher transaction costs compared to larger landowners, making them less desirable from the perspective of potential carbon credit buyers. Transaction costs are intrinsic to REDD+ projects. Examples include paying a forester to develop a forest management plan, investments for forest protection (like fire-suppressing ditches), application and documentation fees, and the costs of MRV. As in the case of PSA, large landowners have lower per-hectare transaction costs, as many of these transaction costs have an ‘economies of scale’ return. One possible solution lies in organizing poorer landowners into a collective,

bundling their REDD+ activities together to lower transaction costs and make themselves more appealing on the international carbon market, but this requires the aid of NGOs or some other agent for collective organization, yet another bit of capacity building that needs to be done.

Figure 6: A REDD+ Monopsony



(Source: The Munden Project)

The probable market-based structure for funneling REDD+ revenue seems likely to create barriers preventing money from trickling down to the poor. Such a market structure will necessitate large financial clearing houses to channel the funding. Since these clearing houses will need to have significant resources and technical expertise at their disposal in order to manage a global commodity chain, there will likely be very few that develop. There is a strong likelihood of the development of a monopsony⁴ (Figure 6), wherein a few middlemen end up dominating the market, much like a local village subjected to the purchasing whim of two vendors buying all of their crops. The lack of competition makes it very likely that these

⁴ Technically, a monopsony is the market condition that exists when there is only one buyer.

middlemen clearing houses will reap the bulk of the profits, with poor landowners receiving only the fraction that is leftover (The Munden Project).

Considering all of these prospective disasters, international negotiations are attempting to implement safeguard provisions for REDD+ projects to ensure at the minimum that negative impacts are avoided, and enhance the provision of positive co-benefits. National sovereignty concerns complicate this debate over incorporating safeguards into the design of REDD+. Many nations fiercely oppose the inclusion of language recognizing the rights of indigenous or other marginalized persons. Attempts to find a diplomatic solution have failed thus far. The hope is to include vague language about project-affected persons, thereby subsuming all marginalized groups under a generic rubric and avoiding some of these concerns. The possibility remains that safeguards may become so weakened as to make them politically palatable in negotiations, but ultimately decreasing their actual effectiveness in preventing negative outcomes.

IV. DISCUSSION

Costa Rica's PSA program, having operated for over fifteen years, offers an example of one of the longest-running and best-studied PES programs in the developing world. Costa Rica, having risen to the status of a middle-income nation with a stable social, political, and economic environment, offers an example of a better-case, if not best-case, scenario for examining how implementing a PES program for the forestry sector functions in theory and in practice. As we have seen, the design of REDD+ at the international level faces numerous complexities and tradeoffs. Having surveyed the major issues, it is time to reflect on the strengths and weaknesses of Costa Rica's PSA program, and to use those lessons to inform the design of those components of REDD+ pertaining to PES programs.

A. Funding

Often theoretically billed as a neoliberal, incentive-based market mechanism, PSA requires substantial state intervention and therefore operates in practice far closer to a tax-based subsidy for conservation. Despite repeated attempts to secure voluntary funding, as originally envisioned, PSA has met limited success, primarily eliciting transactions from large hydropower producers where one dominant user of a watershed had a clear, vested interest in preserving forested land. Costa Rica never succeeded on the international carbon markets, mostly due to the exclusion of deforestation projects under the CDM. It received a few grants for biodiversity conservation, but they dried up as the novelty of the PSA program to foreign investors wore off. Overall, the vast majority of PSA funding has come from domestic taxes and loans/grants from international financial institutions, development banks, and conservation

organizations; only 3% has come from voluntary sources (Blackman and Woodward). PSA requires state intervention; it does not work as a stand-alone market. PSA is a subsidy for conservation masquerading as a market mechanism.

As the dominant discourse in negotiations pushes for private, market-based funding, it is becoming clear that the designers of REDD+ intend for it to function as a stand-alone, self-sustaining voluntary market for carbon sequestration services with the public sector only providing the startup funding to develop the facilitating governance framework. REDD-Readiness funding is only meant to build sufficient capacity within nations until they can take over this facilitating function. Costa Rica's experience with PSA was meant to do exactly this: use public subsidies to jump-start a voluntary market for forest-based ecosystem services. The market never materialized. PSA still relies on heavy state intervention in the form of tax revenue, redistributed from water and fuel users to landowners. It is even debatable as to whether the funds are actually high enough to pay for the ecosystem services delivered by forests; the payments distributed to landowners are insufficient to cover the opportunity costs of alternate land uses. PSA funding arguably is a way of compensating landowners for the prohibition on clearing their forested land, an infringement upon private property rights enacted in the same law establishing PSA. Further research will be needed, but if it is found that PSA's difficulty in securing voluntary payments turns out to be a systematic feature of similar PES schemes around the globe, proposals for generating sufficient funding for REDD+ will need to be substantially rethought, as it will be unable to rely upon simple market exchanges.

This bodes ill for REDD+. There is a powerful argument that only private markets can come up with the tens of billions of dollars to finance REDD+ on a global scale, as governments and donors will not provide such sizeable funding. However, in the absence of binding international agreements on mandatory emission reduction targets, it seems unlikely that a large private market will develop. Of course, given the lack of governance institutions in many developing nations, taking years to build capacity might be beneficial. However, the stalled political momentum at the UNFCCC risks REDD+ losing credibility among the tropical forested nations. REDD+ might fall apart before it really gets started unless a reliable, sizable, sustainable source of funding can be found. Following the decision at COP 17 in Durban to push off mandatory emission reductions until 2020, for the rest of this decade, at least, REDD+ funding will only come from large multilateral and governmental sources. PSA's experience strongly argues against the viability of a purely market-based funding mechanism for REDD+. If the PSA experience with private funding proves to be typical for PES programs, REDD+ will not develop into a fully self-sufficient market based upon voluntary transactions. This is a key argument in favor of either totally public assistance, or, more likely, some form of hybrid private-public funding mechanism, with market transactions covering a portion of REDD+'s financing needs, supplemented by more traditional public-sector assistance. PSA's failure to generate a reliable and sizeable source of private funding implies that REDD+ will require a far heavier role for public sector finance than is optimistically hoped for by proponents of voluntary and mandatory carbon markets.

The individual landowner will care most about the timing and amount of funds disbursed under REDD+. The structure of these payments carries different risks and benefits to

landowners and carbon credit buyers, and will determine which landowners will receive benefits. Ex post payments would limit the liability of investors by being delivered after the land is protected and would tend to go towards wealthier landowners; ex ante payments would come beforehand and provide the capital necessary to invest in conservation. The actual dollar amount will be set based upon the actual carbon content of the land or upon the difference in value to the landowner of forgone alternate land uses: carbon stocks vs. opportunity costs. Carbon stock payments make the most intuitive sense, but payments based upon opportunity costs use funds more efficiently by directly addressing the needs of landowners to 'tip the balance' of land use in favor of conservation. Opportunity cost payments would bias investors against valuable forests on prime arable land and make middle-income nations like Costa Rica less likely to benefit. Both the carbon stock and opportunity cost approach rely upon complicated estimation techniques, measurements of carbon content or projecting economic differences in the value of land uses.

PSA operates on a simplified method of payment disbursement. Preservation contracts are disbursed in equal yearly amounts. Plantation contracts are front-loaded in the first two years. These payments are closer to ex ante, although landowners must pay the initial transaction cost of paying a forester to draw up a land use management plan before receiving funds. Payments are set exactly the same, depending on the contract, for the entire country. They therefore entirely ignore the difference between opportunity costs and the environmental services provided by forests (the equivalent of carbon stocks under REDD+). PSA contracts, designed to compete with the cattle ranching of the 1990's, do not necessarily cover the opportunity costs of current alternate land uses, such as urbanization and ecotourism

development. Many PSA contracts have not been deployed in locations where it will ‘tip the balance’ of land use in favor of conservation. PSA’s poorly refined system for targeting payments has resulted in the spending of vast amounts of funds to protect forested land that would have been preserved anyway. On the positive side, the poor system of targeting had made it administratively simpler to operate, and disbursing payments ahead of time helps landowners to make the investments necessary for forest conservation and timber plantations. A simplified, workable form of REDD+ may have to accept this tradeoff: simpler, streamlined administrative costs in exchange for more ‘wasted’ funds going to landowners, with standardized payments set without delving too deeply into opportunity costs and carbon stocks. Payments should be disbursed ex post, to enable more landowners to invest in conservation. Further research into the tradeoffs inherent in PES programs between opportunity costs, carbon stocks, and administrative costs would prove illuminating, as would research into the impact of ex post and ex ante payments on stakeholder participation.

B. Baselines

On the highly politicized issue of setting a benchmark against which to measure REDD+ actions, Costa Rica presents a dilemma. Having halted and even gently reversed one of the worst deforestation rates in the world over 20 years ago, the nation now hopes to receive REDD+ funds. As one of the original proponents, Costa Rica makes a moral argument that it deserves to be rewarded for acting early on the issue. India is another ‘early action’ nation, so the issue of operationalizing a baseline and the accompanying political negotiations carry some weight. As one of the original proponents of REDD+ back in 2005, Costa Rica’s pleas certainly

deserve some sympathy, but the fact remains that it will be very difficult to prove additionality meriting REDD+ funding in a nation that for over 15 years has legally banned a change in land use for forests, especially given the PSA program's poor record of efficiently targeting payments to those lands most in danger of deforestation and degradation.

Granting Costa Rica a moral win in this regard would help fund the tiny nation's PSA program, but it runs the risk of undermining the global climate effectiveness of REDD+ by generating 'hot air' credits. It can easily be argued that Costa Rica has already undergone the 'forest transition', economically developing past the point where rampant natural resource extraction fuels the transition to a more mature economy. Agriculture is no longer dominant; tourism and the service economy are the major economic drivers. From a simple perspective of increasing cost-effectiveness of payments for carbon sequestration, Costa Rica should be barred from receiving extensive REDD+ funding as it cannot provide much proof of additionality for avoided deforestation. It still could receive payments for reforestation and afforestation, but these would only make up a tiny fraction of potential REDD+ finance. Even if it was one of the originators, cost-effectiveness concerns dictate that Costa Rica should be one of the international 'losers' in REDD+.

But cost-effectiveness isn't the only concern. The issue of leakage, of deforestation relocating to another part of the globalized world, matters. Operationalizing a 'moral reward for early action' baseline would make participation in REDD+ more attractive to developing nations by increasing the potential financial benefits. While decreasing climate effectiveness per dollar spent, inducing the participation of more nations will simultaneously strengthen

climate goals by reducing opportunities for leakage. Costa Rica's PSA program was designed without concern for additionality; if provided with sufficient funding, FONAFIFO would provide all eligible Costa Rican landowners with PSA funds. While FONAFIFO can only afford to pay one-fifth of applicant landowners, it has spread the social norm that standing forests are valuable in their own right. It is fairly certain that enough funding to cover the entirety of forested land eligible for REDD+ payments will never materialize, but the Costa Rican case suggests that a slightly looser baseline may be warranted, both to encourage broad participation and to spread the notion of the value of forests. Exploring the tradeoffs inherent in the rigidity of baselines versus broad participation would be a fruitful area for future research, and the overall effectiveness of REDD+.

C. Governance, Institutions, and Monitoring, Reporting, & Verification (MRV)

Costa Rica's PSA program had a number of advantages working in its favor when it was founded. Costa Rica has been a bastion of political stability in the otherwise chronically troubled Central America. It has successfully grown economically into a middle-income nation. The government, despite recurrent popular perceptions of being overly bureaucratic, has a fairly well-established set of institutions and policies. Issues of land tenure have been mostly resolved. The PSA program was able to build upon the prior policy and institutional framework of timber subsidies from the '70's and '80's. Providentially, the commodity price of beef bottomed out when cattle-ranching subsidies were cut, just as Costa Rica's reputation as an eco-tourism destination was growing, ending one of the key drivers of deforestation while simultaneously providing a reason to preserve the forest. Costa Rica already had a fairly well-

developed system of governance for the forestry and agricultural sectors, and was able to capitalize on those when PSA arrived on the scene. This, of course, means that REDD+ nations should utilize any existing institutional structures, building on or converting whatever exists in the most expedient manner possible. Unfortunately, many REDD+ nations do not have anywhere near the same number of advantages that Costa Rica had, and the road to REDD+ will be much more difficult for them. Research into the exact institutional settings necessary to facilitate PES programs would be revealing, with great attention paid to the sequence in which these institutions must be established. For example, establishing a PES system without first protecting the land tenure rights of forest-dependent communities will almost certainly lead to their disenfranchisement by enabling elite capture and rent-seeking behavior over now valuable forested land.

The fairly well-developed rule of law in middle-income Costa Rica makes it relatively easy for landowners to control access to, and usage of, their forested land, a vital precondition for a PES program to work. A landowner able to manage their land facilitates accountability for changes in land use, which builds the trust between purchaser and provider of environmental services necessary to disburse payments. Even in Costa Rica, with fairly well-established property rights, accessing PSA funds can be difficult for the poor and marginalized forest-dependent communities. Costa Rica has some problems with the landless and conservation refugees. The title-less *desposesadores* of remote Costa Rica have faced frequent problems with enlisting in the PSA program. They were entirely barred from participating during the first decade; the rules were changed to allow them to enroll without title to their land, although this still does not remove other barriers, like the transaction costs of enrollment in PSA.

This underscores the importance of formalizing tenure rights over forested land before a REDD+ system of PES can commence, a major obstacle in many potential REDD+ nations. This means seeking expedient means of resolving property disputes amongst competing landowners, and finding ways of integrating usufruct rights and communal 'open' property regimes such as those often held by indigenous communities into the overall national framework of property rights. This will probably be an attempt to harmonize those approaches to land tenure with a form of private property rights as has been done in Costa Rica, where the communal land rights of indigenous groups are legally recognized and collectively managed by the community. Beyond a statutory recognition of communal property rights, these rights must be backed by enforced legal provisions that support the ability of landowners to control access to land. The Costa Rican experience suggests that stumbling blocks will appear for certain communities and individuals attempting to enroll in REDD+, even in the presence of a fairly well-established set of private property rights. Land tenure must be actively addressed for REDD+ payments to work, and it must be viewed as having some learning curve in order to include a maximum number of potential applicants. Methods of formalizing uncertain tenure rights without disenfranchising the disadvantaged is an enlightening area for further research, especially in the case of PES programs.

The PSA program easily addresses the issue of carbon rights. As soon as the PSA program disburses funds, the landowner transfers property rights over forest carbon to FONAFIFO, which can sell them for carbon credits. This permits Costa Rica to set up a national-level accounting system for carbon credits. Risks to both global investors and individual landowners are minimized under this system, and the chance of leakage or non-permanence

within the nation would also be lowered, thereby enhancing climate effectiveness. This suggests that some form of property rights over the carbon content of trees should reside with the landowner, who would transfer them to the appropriate national authority, and thence to carbon credit buyers. In exchange, the national authority would have punitive powers over the landowners, e.g. the suspension of REDD+ payments and fining mechanisms, in the event that forested land becomes converted to other purposes. Hopefully this will streamline the process of establishing carbon rights while simultaneously sharing liability for carbon reversal between landowners and national governments.

The happenstance role of pasture land abandonment cannot be overemphasized in Costa Rica's reversal of deforestation rates. Costa Rica was lucky in that its agricultural policy happened to dovetail with forestry conservation at the perfect time. This cannot be expected in most REDD+ nations. It is not enough to target the forestry sector only; agricultural policy must also be addressed in any successful attempt to halt deforestation. Many nations have poor cross-sector linkages, with each ministry acting as its own stovepipe, unaware of the actions of others. A system of PES under REDD+ would not have the role of harmonizing government policies amongst numerous sectors. The PSA experience offers no solutions to this problem; Costa Rica was lucky enough to avoid dealing with this issue altogether. However, the law banning changes in forest land use in Costa Rica also contained the provisions that established the PSA program in order to make the ban domestically politically viable. This suggests that potentially unpopular major cross-sector policy changes can be made concurrently with the institution of a REDD+ PES program, the metaphorical carrot to foster domestic acceptance.

Costa Rica has a well-developed system for monitoring, reporting, and verifying (MRV) land use. As envisaged for REDD+, MRV in Costa Rica consists of remote sensing (satellite and airplane monitoring), combined with spot checks on the ground by trained personnel to verify that results are consistent with aerial photographs. FONAFIFO is perfectly positioned as an ideal national reporting agency for any global REDD+ mechanism. Costa Rica has old aerial maps exist against which to compare new data, both for setting baselines and for monitoring performance over the years. Foresters map the terrain of any land enrolled in PSA, and continually recertify that landowners are complying with the terms of the PSA contract. Even so, Costa Rican foresters only recently managed to acquire handheld GPS devices for use in monitoring. Prior to that, the tree line on some PSA-enrolled land slowly migrated over the years, with landowners slowly removing a several meter stretch of forest over the years, expanding cultivated land. While permitting a slight degree of potential for landowners to 'game the system', PSA did establish a reasonably accurate system of MRV at a low cost, and has improved upon it by adding GPS devices.

This emphasizes the need to develop low-cost MRV for REDD+. A tradeoff exists between accurate, precise measurements and the cost of MRV. Costa Rica's PSA experience suggests that a fairly low-cost system of MRV can be established and will be rigorous enough to prevent rampant deforestation. Land degradation is far more difficult to quantify and monitor; disbursement of REDD+ payments for avoided degradation could be held back until more accurate yet cost-effective forms of MRV are established as technology and innovation proceeds. The blunt approach to MRV under PSA is sufficient to establish a system of reliable reporting rigorous enough for the purposes of REDD+ regarding deforestation, permitting the

disbursement of REDD+ payments to landowners and getting REDD+ off the ground. Further research into the tradeoffs between accuracy and the cost of MRV would be instructive, focusing on a system reliable enough to monitor land without being prohibitively expensive.

D. Sustainable Development Impacts: Biodiversity and Forest-Dependent Communities

PSA proves to be a blunt force for biodiversity protection. A small portion of PSA contracts have paid for timber plantations, which provide carbon sequestration and hydrologic benefits in addition to providing an ecologically poor form of biological corridor. Given the inclusion of forest plantations as eligible for funding, REDD+ may not deliver the biodiversity conservation benefits that some proponents promise. As noted earlier, timber plantations sequester more carbon than 'natural' mature forests. Such plantations will presumably be more attractive to funders. Despite requiring startup capital, plantations should lower the costs for carbon investors, due to their potential to generate revenue for landowners. The most profitable carbon investment does not necessarily carry the most biodiversity benefits, as timber plantations tend towards ecologically impoverished monocultures. This has not been a huge problem for PSA, where the vast majority of contracts go towards the preservation of extant forests; plantations amount to 5% of all issued contracts (Pagiola).

However, PSA was designed to pay for more than carbon sequestration; a REDD+ market may lead to entirely different results. The fears of biodiversity enthusiasts may prove unwarranted, but this depends to a large degree on the proportion of REDD+ investment driven by decisions made by private carbon investors, which in turn depends on cost-benefit analyses of paying for mature forests versus plantations. This is not an argument against permitting

eligibility of plantations for REDD+ funding. Rather, it argues for a more nuanced understanding of the environmental benefits of REDD+. Acknowledging the tradeoffs inherent in REDD+ will go a long way towards understanding the uses and risks of such a scheme. Focusing on the risks could lead to safeguards that prevent the conversion of mature forests to plantations, or could establish a cap on the percentage of REDD+ funds used for timber plantations. The regulations established regarding REDD+ will play an important role here. This clearly is an area for further research.

A further critique on the potential biodiversity benefits of PSA, the program does enable selective logging by landowners when not enrolled in the forest preservation contracts, which only last for five years. Selective logging can harm biodiversity, both via damaging extraction techniques and by successive harvesting of the most mature (and lucrative) trees, limiting genetic diversity. These impacts can be limited by regulating the means and quantity of timber extracted. Costa Rica's regulations, permitting the harvest of up to 50% of all mature trees and requiring a 15-year period between harvests, are arguably not stringent enough to ensure forest biodiversity. Selective logging does, however, make forests more valuable to landowners, which in turn lowers the opportunity cost of forest protection. Careful REDD+ safeguards could be put into place to ensure that forest biodiversity does not suffer from selective logging, coupled with sufficient institutional capacity of nations to enforce such a forestry policy. Cautiously permitting well-regulated selective logging under REDD+ could increase the cost-effectiveness of the program and the benefits derived by landowners, fostering poverty-alleviating co-benefits for REDD+. A considerable degree of further research into the biodiversity and poverty impacts of selective logging would be beneficial.

Considerable inconclusive research has been conducted over the effectiveness of PSA in particular and PES schemes in general at alleviating poverty. PSA was designed to pay landowners for their forest services. Poverty alleviation is not part of the program's intent, although there has been some effort put into targeting PSA contracts at poorer landowners. While there is some evidence that PSA has helped a few landowners through supporting agroforestry (e.g. commercially-valuable fruit trees), PSA's impact upon the poor remains negligible. As mentioned, evidence suggests that PSA is structurally biased against participation by the poor. The landowners that do enroll in the program tend to own larger tracks of land; it is easier for FONAFIFO's limited staff & resources to deal with several large landowners than many small landowners. PSA contract holders tend not to rely upon their land for their livelihoods, deriving most or all of their income from off-farm sources. Furthermore, each PSA contract comes with associated transaction costs (e.g. application fees, forester surveys, fire checks) that are easier for large, typically wealthier landowners to pay at economies of scale.

To some degree these barriers have been circumvented by the aid of NGOs; the classic example is the work of the regional NGO FUNDECOR, which gathers many small landholders together for a collective application to the PSA system. PSA's experience shows that NGOs can play an important role in facilitating participation by the poor and marginalized in PES programs. NGOs will play a key role in spreading the benefits of REDD+ to marginalized communities. More importantly, a key lesson is that proponents of REDD+ should acknowledge that it is primarily a program for carbon sequestration. Development benefits and poverty alleviation will be incidental, as they have been for PSA, although further research would aid in establishing the conditions under which PES programs can help alleviate poverty.

The proposed market structure of REDD+ is a major source of threat to the equitable distribution of REDD+ benefits. As a market mechanism, the funds for REDD+ will need to be channeled through institutions at the global level, where standardized REDD+ credits can be bought and sold. The technical complexity renders it very likely that only a few such institutions will develop. In all likelihood, a monopsony will develop, as has happened in other commodity markets. In the absence of regulation, these clearinghouse middlemen will reap most of the profits from REDD+ credit purchases, which will not trickle down to the poor landowners that the money is supposed to help. Costa Rica has avoided this problem at the national level by establishing FONAFIFO, the quasi-governmental entity that manages all PSA funds, run by a board of public and private sector representatives. An international body with similar powers, responsible for coordinating the global flow of REDD+ funds from the developed to the developing world, would be focused on covering administrative costs, rather than reaping a profit, enabling more funding to go to landowners.

Despite often being billed as a climate-biodiversity-poverty triple win, REDD+ risks pitting elites against the poor, marginalized, indigenous, and otherwise forest-dependent communities. Although it seems counterintuitive, REDD+ endangers marginalized groups by making their forests more valuable. Those without title to their land or some other form of secure tenure are at grave risk of 'land grabs' by the wealthy and powerful. Considering the potential size of financial flows, national forestry departments might not risk leaving forests in local hands, preferring to appropriate control under some form of eminent domain clause, ensuring the provision of carbon sequestration services to meet national REDD+ targets at the expense of the poor. The powerless could find themselves subject to livelihood restrictions to

prevent land degradation, outright banned from the forest or otherwise limiting extant usufruct rights. It is easy to envision government crackdowns against indigenous groups practicing shifting cultivation, an easier target than powerful landowners or timber barons. Many social justice groups strongly oppose REDD+ on these grounds.

The Costa Rican experience legitimizes many of these fears for reasons unrelated to PSA. During the 1970's, numerous individuals and communities were forcibly removed from their land when the national park system was established, sometimes without compensation for lost land. However, there is no evidence that PSA led to 'land grabs' or the denial of usufruct rights by forest dependent communities when it was established 20 years later. PSA has not led to the worst fears of REDD+ critics, presumably due to Costa Rica's fairly stable democracy, well-established private property rights, and at least passive support for the rights of the disadvantaged in the legal system. Many other potential REDD+ nations do not have this advantage. This emphasizes the need for careful sequencing of REDD+ actions in building institutional capacity. The rights of the poor, especially land tenure rights, must be established and enforced for the poor and powerless before REDD+ payments can be disbursed. Despite being stymied by sovereignty interests during international negotiations, attempts to establish REDD+ safeguards to protect the poor are well-warranted. A compromise needs to be found, sufficiently rigorous to protect the poor while still inducing the participation of recalcitrant nations to boost climate effectiveness.

V. CONCLUSION

REDD+ remains in flux. While negotiators debate the final form of the program, it will probably include a PES component. Negotiations push back and forth between market and public funding, with those favoring market sources dominating the discussion. The technical complexity behind establishing a baseline for measuring emission reductions is complicated by politicized interests and the need to find a compromise between environmental effectiveness and encouraging broad participation. Certain governance institutions must be in place before REDD+ payments can be disbursed, and many potential REDD+ nations lack these necessary structures. Although REDD+ proponents hope to combine biodiversity protection and poverty alleviation co-benefits with carbon sequestration, critics assert that the program will inadvertently hurt biodiversity and the poor. The Costa Rican experience with PSA, the first PES program for forested land in the developing world, offers a number of lessons for the eventual establishment of REDD+.

Despite the lack of cost-effectiveness in targeting the financial resources available to it, the PSA program has been successful in facilitating the protection and slow regeneration of forests throughout Costa Rica. The PSA program shows how a government initiative can decentralize responsibility for forest conservation to civil society and individual landowners, engaging multiple levels of governance in addressing an environmental problem. PSA attempted to create a market for environmental goods and services, replacing the 1970's state-administered model of fortress conservation with a model of conservation based on the commodification of nature as an attempt to halt environmental destruction; conservation was

privatized and decentralized, and individuals become responsible for managing natural resources.

Unsurprisingly, as mitigation of greenhouse gas emissions was only one piece of the design, PSA appears to have had little impact as a form of combatting climate change. The program was designed to cover a range of services, with carbon sequestration being only one, apparently originally geared towards attracting foreign funding during the lead-up to the Kyoto Protocol. Those attempts to profit from the international climate change policy initiatives have mostly failed. Costa Rica has been left out of the global carbon markets, due primarily to the regulations of the CDM combined with its small size, middle-income nation land use opportunity costs, and the international emphasis on additionality. The PSA program never has had much success in jump-starting a voluntary market for payments, with a minimal amount coming primarily from large dominant users like hydropower producers. The program also only occasionally delivers the additional sustainable development services that it claims to, such as biodiversity conservation and especially poverty-alleviating social 'co-benefits'.

Despite being portrayed as a market solution to environmental externalities, PSA functions more like a state subsidy for forest conservation that decentralizes governance responsibility to the level of the individual. PSA proves that a small earmarked tax commitment from a middle-income nation can be used to incentivize the preservation of forests by private landowners, as well as spread the social norm that standing forests are valuable in their own right. Based upon PSA's extreme difficulty in securing voluntary funding, it seems probable that REDD+ cannot succeed as a purely neoliberal market mechanism, because it will not develop a

sustainable, sizeable source of funding, especially in the absence of a global agreement with binding greenhouse gas emission reduction commitments. PSA's flat-rate approach to disbursing payments to landowners does suggest that a rough method of setting payment levels to landowners, based upon a simplified compromise between the carbon stock and opportunity cost approaches, could lower administrative costs. Disbursing payments to landowners ahead of time will enable broader participation. The substantial percentage of public funding under PSA allows Costa Rica to redistribute finances where it deems desirable, even with the aforementioned minimal degree of targeting. Without such an international system, the benefits of REDD+ will flow directly to the cheapest carbon credits, which few additional benefits, as has happened with the CDM. REDD+ payments for environmental services are not fundamentally flawed, but a REDD+ PES program will not develop based purely on market transactions. A mixed fund approach will be required combining market funding with a significant degree of public sector funding, regulation, and administration.

From the ideal perspective of maximizing carbon sequestration when setting national baselines, a global cap on deforestation should be established and then divided up amongst nations. Such a zero-sum game is impossible given the politicized nature of REDD+ negotiations. The pragmatic solution lies in finding the Pareto optimum baseline politically palatable enough to encourage broad participation by nation-states, thereby lowering the risk of leakage, while sufficiently rigorous to ensure gains in climate effectiveness, i.e. carbon sequestration. The debate over baselines should explicitly acknowledge this tradeoff. Instead of a myopic focus on additionality and therefore cost-effectiveness for carbon credit buyers, the final design of REDD+ should anticipate some 'wasted' funds as the price for political viability,

broad participation by nations, and overall effectiveness via reduced potential for leakage. Focusing on the tradeoffs inherent in such an approach will force attention to be paid to the tension inherent in encouraging participation without inflating baselines to the point of gross abuse for profit at the expense of climate effectiveness. While this does not alleviate the difficulty of operationalizing a baseline for 'early action' nations, it does serve to redefine the debate as a matter of tradeoffs rather than just carbon sequestration returns per dollar spent. Climate effectiveness is more than a matter of efficiently using funds. Costa Rica's PSA program has effectively spread the notion that forests are valuable in their own right, and spreading such a norm around the globe via a set of REDD+ payments at slightly inflated baselines may lead to more lasting gains than a simple cost-effectiveness approach.

Costa Rica had numerous advantages in setting up a PES system such as that necessary to get REDD+ off the ground, including a stable government, an economy transitioning away from agriculture, a secure system of land tenure, and a strong policy history in the forestry sector. Even with these advantages, PSA has had to evolve in response to lessons learned along the way, improving MRV systems and targeting of lands for enrollment, adding a water tariff as a source of funding, and opening the program to title-less landholders. This serves to underscore the immense complexity of REDD+. Many potential REDD+ nations, such as the Democratic Republic of the Congo, will need a huge upfront investment in governance, especially the forestry sector and agriculture, before any performance-based REDD+ payments can be disbursed. The long period of time over which Costa Rica's advantages came together suggests that such governance investments may be needed over a long-term duration (i.e. 10 or 20 years) as each nation goes through its own learning curve. Despite the program's flaws, the

PSA program proves that a rudimentary yet functionally effective PES system for forested land can be established. The complexities of running such a system can be simplified, and such a rudimentary system can work well enough to foster forest protection. The designers of REDD+ would do well to heed the adage: “Don’t let the perfect be the enemy of the good.”

The rhetoric and reality of REDD+ do not match regarding the purported sustainable development co-benefits, the poverty-biodiversity-climate synergies of a grand win-win-win. REDD+ can easily negatively impact the poor and biodiversity. The ecological benefits like hydrologic services and carbon sequestration may be numerous, but they won’t necessarily lead to the best biodiversity preservation, especially if a large portion of funding goes to support monoculture timber plantations or excessive selective logging. If PSA is any indication, the poor will either negligibly benefit or be harmed by a PES scheme established under REDD+. As evidenced by PSA’s difficulty in securing voluntary payments, private markets respond to the interests of investors. REDD+ will respond to investor’s desires to sequester carbon. Funds will go to where investors get the biggest return on their investment, i.e. wherever carbon credits are cheapest and risk is lowest. Some nations and landowners will win big under a market scheme; others will be completely bypassed. Those most in need will be among the bypassed, both nations with poor governance capacity and the poorest (and often title-less) landholders facing transactions costs beyond their ability to pay. The CDM, a carbon mitigation offset scheme supposed to deliver co-benefits, has done a poor job of alleviating poverty as investors drove it to generate carbon credits at the cheapest cost. REDD+ proponents need to acknowledge this historical pattern, and avoid blindly optimistic narratives of a triple win. This will shift rhetoric away from ‘co-benefits’ to safeguards. Costa Rica’s PSA is not a poverty

alleviation program, and there is little reason to think REDD+ will be. The same holds true, to a lesser extent, for the biodiversity benefits that are not guaranteed under a PES scheme. A rigorous set of REDD+ safeguards, which means a stronger role for the public sector, would mitigate many of the worst fears of critics and foster co-benefits. Further research into similar PES schemes would prove illuminating when designing these safeguards.

The overall lesson of PSA for REDD+ is to reduce expectations. It is disingenuously optimistic to sell REDD+ on the basis of the unlikely 'best case' scenario of self-sustaining private market transactions and sustainable development co-benefits. REDD+ will operate first and foremost as a tool for carbon sequestration; forest protection is integral to the program, but not necessarily pristine, mature forests. Poverty alleviation could become an incidental gain, but it will not be the main outcome. Implementation of the program involves certain tradeoffs, and these tradeoffs must be acknowledged and debated if the designers hope to minimize harm and increase the benefits of REDD+. Overreliance on market sources of funding endangers the additional goals of the program and argues for a substantial degree of public funding. Safeguards must be in place to protect marginalized forest-dependent communities. The program will rely heavily on a successful governance structure, including secure land tenure, respect for local autonomy in controlling forests, protection from powerful outsiders, punitive powers in the event of deforestation, and a cost-effective yet sufficiently robust method of MRV. The hoped-for co-benefits will not materialize without such state influence. PSA proves that a system of payments for environmental services can successfully decentralize environmental governance for forested land, but it relies on an active role for the state to accomplish such goals.

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