SAVING THE WORLD'S FORESTS TODAY

Creating Incentives to Avoid Deforestation

December 2008

Office of the President,
Republic of Guyana

Creating incentives to avoid deforestation

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Foreword

The world urgently needs to intensify its efforts to stabilise global temperatures at levels which will avoid catastrophic climate change. Greenhouse gas emissions need to peak within the next seven years and to be cut by 80 percent by 2050. It is difficult to envision how this can happen without effective action to dramatically reduce the approximately 20 percent of global emissions caused by deforestation.

This is part of the challenging background to forging a global deal to combat climate change. Yet, solutions to deforestation are possible. They can be delivered quickly and cost effectively, and have the potential to transform the economic prospects of some of the poorest countries in the world.

This paper seeks to assist those working within the UNFCCC process to deliver these solutions. It is built on the premise that much deforestation happens because individuals, communities and countries pursue legitimate economic activities – such as selling timber or earning money and creating jobs in agriculture. The world economy values these activities. It does not value most of the services that forests provide when trees are kept alive, including the avoidance of greenhouse gas emissions. Correcting this market failure is the only long-term solution to deforestation.

I hope that those who read this paper will see it for what it is – a sincere attempt to reconcile the interests of countries such as mine and those of the wider world. It is not in any way a threat, or a suggestion that we will deliberately destroy our forest if the world does not pay us. Guyana has one of the lowest deforestation rates in the world and we want this to continue.

But in common with other rainforest countries, we face immense development challenges. We need better schools and hospitals, teachers and doctors, economic opportunities and jobs for our citizens. Developing our economy to provide resources to fund these and many other social and economic needs has to be a responsible Government's top priority. If we are to reconcile this with the world's need for forests to be kept intact, we must find a way to make national development and avoiding deforestation complementary, not competing, objectives.

This paper is focussed on how the UNFCCC process can create the incentives to make this possible, but that is only part of a solution. To be sustainable in the long term, any measures to address deforestation must have the support of those who live in, and depend on, the forest. Throughout the first half of 2009, all our people will have the opportunity to participate in a nation-wide conversation on how Guyana can play its part.

As negotiators within the UNFCCC process know all too well, the achievement of climate change goals can often fall victim to seemingly intractable issues. I hope that this paper will help to lift our sights above these issues, create clarity on the solution space for avoiding deforestation and move the world one step closer towards a global deal that is timely, effective and fair.

Bharrat Jagdeo

President of the Republic of Guyana

Executive summary

Without a significant slowing of deforestation in tropical countries, stabilizing greenhouse gas concentrations and reducing the risk of catastrophic climate change will be virtually impossible. Recently, important progress has been made to consider including Reducing Emissions from Deforestation and Degradation (REDD) under the UN Framework Convention for Climate Change, and in doing so, to provide incentives to slow emissions from destruction of tropical forests.

Several important unresolved issues complicate agreement on a REDD mechanism. In order to compensate countries fairly for reducing emissions from deforestation, it is essential to develop a realistic baseline from which to measure reductions in deforestation. Some proposed REDD methodologies rely on historical or stock-based deforestation baselines, which are flawed because they may not reflect current or future pressures on the forest. Moreover, historical baselines create perverse incentives by “rewarding” countries that have allowed faster rates of deforestation in the past. Even more fundamentally, relatively little understanding and agreement seems to exist on how much financial support will be required to slow and someday stop deforestation. Unless these issues are addressed, there is a real risk that REDD will fail to deliver support sufficient to enable countries to reduce deforestation.

The Office of the President in Guyana, based on an independent fact based assessment by McKinsey & Company, has carried out an analysis of what will be needed to align the economic interests of tropical forest countries with those of the broader world community. This analysis starts with the premise that mechanisms can be designed to make participation economically rational for rainforest countries. It offers four contributions to a deeper understanding of how to make REDD effective and fair:

1. The 'economically rational’ deforestation baseline

Current REDD proposals include use of historical baselines, stock/average emissions baselines, and projected baselines. Our work suggests that baseline assumptions should be driven by analysis that assumes rational behavior by countries seeking to maximize economic opportunities for their citizens (an ‘economically rational’ rate of deforestation). Such baselines can be developed using economic models of expected profits from activities that motivate deforestation (vs. in-country benefits of maintaining the standing forest), and timing and costs required to harvest and convert lands to alternative uses.

Since this baseline methodology is tied to actual economic pressure on the forest, it should make REDD more acceptable to forested nations, including highly-forested, low deforestation countries (HFLDs). A forward-looking baseline rate of economically rational deforestation better reflects true pressures on forests than do assessments of historical or stock-based baselines, which likely understate pressures on forests in cases where government policies have limited deforestation in the past.

2. ‘Economic Value to the Nation[1]’

At minimum, any REDD mechanism must support creation of economic alternatives that exceed the economic value to a nation (EVN) generated by pursuing deforestation and profitable after-harvest activities (farming, ranching, mining). This memorandum proposes a methodology for estimating EVN and presents initial results from applying the method to the Republic of Guyana. By placing a real value on tropical forest countries’ best alternative to a negotiated agreement (BATNA), EVN brings new insight to the scale of resources required to reduce deforestation.

3. Boundary conditions for a long-term deal

EVN is the ‘floor’ in a range of values that would align rainforest country incentives with the broader world community. The ceiling is set in principle by forests’ economic value to the world (EVW) – in the form of eco-system services such as carbon storage, bio-diversity and climate regulation. In practice, the ceiling is set by the world’s willingness to pay for carbon abatement (EVW_C) Since a ton of carbon from avoiding deforestation performs the same ecosystem service as a ton of abatement from any other source, the world should be willing to pay the marginal abatement cost for greenhouse gases to reduce emissions from deforestation, subject to any discounts required to account for permanence risk and other concerns such as additionality. Incentives whose value lies between EVN and EVW_C will align national and global interests; values below EVN or above EVW_C will not. If support falls below EVN, deforestation is likely to continue as forested nations act in their rational economic interest. If the cost of forest protection exceeds EVW_C, the world will forgo conservation and seek abatement options elsewhere.

4. Future outlook

The fact that the world has an interest in ensuring that remuneration for forests continues to exceed EVN has two implications. First, given the sensitivity of EVN to commodity prices, any financing mechanism will need flexibility in order to adjust for future shifts in economic pressures to deforest. Second, while markets do not exist for most ecosystem services, their values should not be forgotten. EVW_C is a useful short-term proxy for EVW, but if carbon prices in the distant future were to fall to a point where EVW_C no longer delivered effective incentives, payment structures based on other ecosystem services could be used to ensure that forests continue to receive remuneration in excess of EVN.

* * *

These concepts clarify what will be required to create long-term alignment between the economic interests of forested countries and those of the broader world community. They suggest that countries will continue to face economically rational incentives to deforest regardless of past performance, and help to answer the question of *how much* will be required

[1] For technical assumptions on EVN see Appendix I.

to stimulate substantial reductions in deforestation. The related question of how to finance these requirements in a REDD mechanism is not addressed in this paper.

However, it is clear that in the years before REDD is fully implemented, bridging solutions are required in order to prevent rapid deforestation. The Bali Action Plan called on governments and civil society to engage in demonstration activities to accelerate implementation of REDD, and a number of innovative projects and programs have been launched in the last year. However, very few of these projects involve sovereign governments in national-scale efforts to slow deforestation.

In the absence of a full-scale international framework to deliver incentives for forest conservation, national scale pilots between willing governments, grounded in the basic logic of providing incentives large enough to motivate long-term forest conservation, can generate experience for the future, and start saving the world’s forests today.

Introduction

In this memorandum, the Office of the President in Guyana presents an analysis of what will be required to align the economic interests of tropical forest countries with those of the broader world community. The first section of this memorandum sets out two foundational concepts – Economic Value to the Nation (EVN) and Economic Value to the World (EVW) – that bound the solution space for avoiding deforestation. The second section describes an approach for calculating EVN and uses Guyana as a case study. The final section discusses implications for designing a mechanism to reduce emissions from deforestation.

EVN and EVW: The solution space for avoiding deforestation

There are powerful, rational incentives for forested countries to deforest even though this causes massive negative consequences for the world. Two concepts explain this misalignment of current incentives: deforestation's economic value to the nation (EVN) and forests' economic value to the world (EVW).

Deforestation's economic value to the nation (EVN)

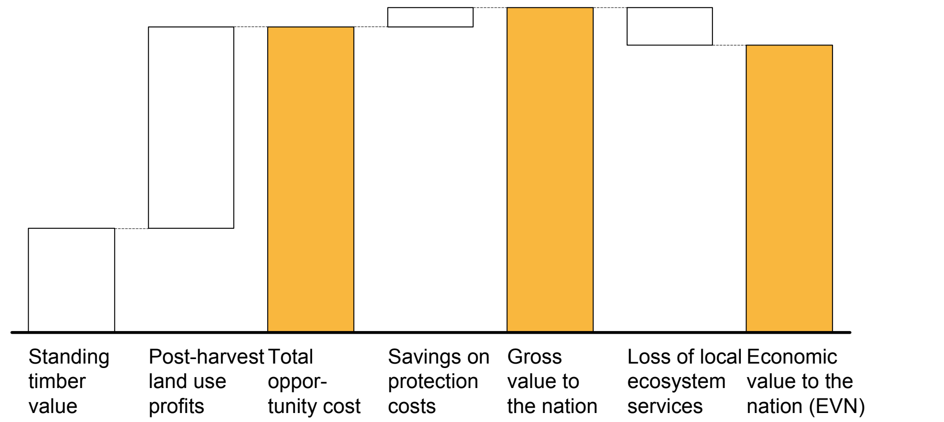
National and local policymakers have a responsibility to their home constituencies to promote social and economic development. Because forested land can generate greater economic value when put to other uses, individuals and companies in developing countries face powerful incentives to exploit these opportunities. In turn, national and local governments will face political pressure to permit or even encourage deforestation. Today's richest countries, such as the United States, actively pursued deforestation and land conversion to agriculture in early phases of development for exactly these reasons.

Land conversion can create significant 'economic value to the nation' (EVN)[2] – which is intuitively obvious judging by the high rates of deforestation typically associated with economic development. The EVN from deforestation has four principal components: standing timber value, post-harvest land use profits, savings on forest protection costs, and loss of local ecosystem services.

[2] For technical assumptions on EVN as applied in Guyana see Appendix I.

Exhibit 1

FOUR COMPONENTS OF EVN



1. Standing timber value. Forests contain valuable wood that can be harvested and sold for multiple uses, such as sawnwood, pulp, and fuelwood. While some of this value can be tapped through sustainable management practices, unsustainable extraction is typically more economically attractive, as it generates higher timber volumes and earlier cash flow. Early cash flow is particularly important in developing countries, which have huge developmental objectives which require funding to lay the foundation for future economic growth.

2. Post-harvest land use value. Post-harvest uses such as commercial agriculture, plantation forestry, ranching, and mining can generate attractive ongoing cash flow after trees are cleared from the land. The value from post-harvest land use is typically even greater than the value of the standing timber and will drive deforestation even where forest resources are not themselves commercially valuable.

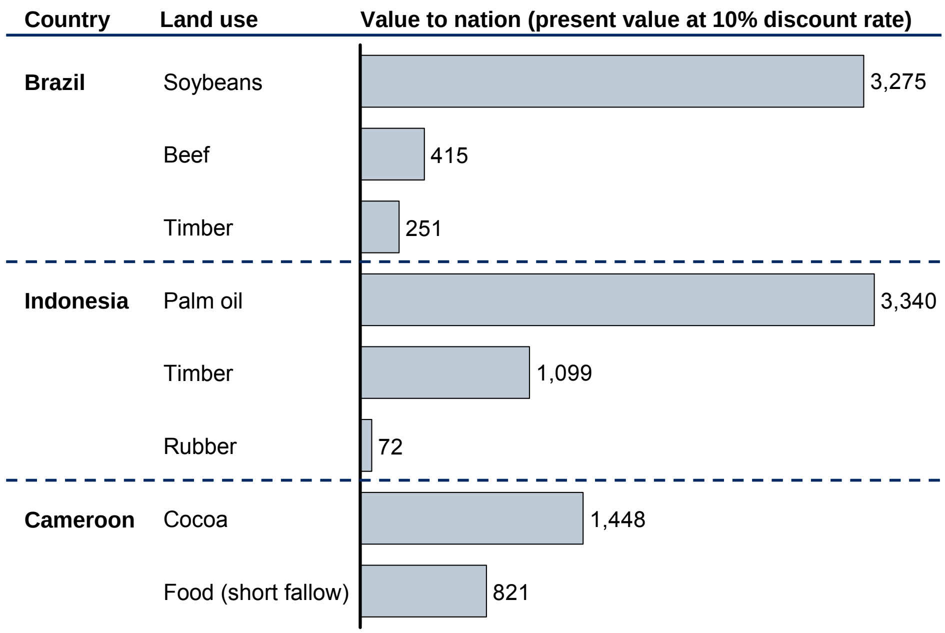
3. Avoided protection costs. Tropical governments spend significant amounts on forestry personnel and equipment to monitor and protect their forests. These costs could be avoided if countries choose to relax levels of forest protection, thereby leading to increased deforestation.

4. Loss of local ecosystem services. Standing forests generate significant local ecosystem services – those services whose economic benefits accrue primarily to local stakeholders – that are lost when forests are cleared. These services include, among others, flood control, the provision of non-timber forest products, and eco-tourism.[3]

3 Local ecosystem services exclude the local element of ‘global’ ecosystem services that will be lost or impaired as a consequence of global climate change, as it is not possible to attribute these impacts to land use emissions relative to other existing and historical sources of greenhouse gas emissions.

Exhibit 2

'ECONOMICALLY RATIONAL' USE OF LAND GENERATES PROFITS... AND DEFORESTATION



Source: Grieg-Gran (2008), Eliasch Review

Defining forests' economic value to the world (EVW)

Standing forests provide tremendous global economic value in the form of ecosystem services, including carbon storage, climate regulation, and biodiversity conservation. However, there are no commodity prices or traded markets for most of these services, making it difficult to estimate their value and impossible for forested countries to generate income from them. Deforestation destroys these services and imposes significant costs on the world; the recent Eliasch Review[4] reports that the world loses \$1.8 trillion to \$4.2 trillion (€1.35-€3.1 trillion) in ecosystem services each year due to deforestation. The size of this number reflects the very significant values that standing forests provide, which some researchers estimate to be as high as \$25,000 per hectare in net present value terms.

The services provided by forests produce 'economic value to the world' (EVW), a concept that captures the true economic value of the ecosystem services that forests provide. However, in practical terms, there is only one market of real importance for an environmental commodity: the carbon market. Since abatement of carbon emissions is the only ecosystem service that the world is currently willing to pay for at meaningful scale, the carbon price is a reasonable proxy for the world's willingness to pay for ecosystem services despite carbon markets'

4 Government of the United Kingdom. Climate Change: Financing Global Forests: The Eliasch Review, page 30. United Kingdom: 2008. (Citing Braat and Ten Brink (2008).)

fragmentation across geographies and incomplete scope (they largely exclude abatement opportunities in the forestry sector today).

The value of avoided carbon emissions from deforestation therefore serves as a proxy for the economic value to the world that forests provide (denoted hereafter as EVW_C). Since a ton of carbon emissions avoided from reducing deforestation provides essentially the same ecosystem services as a ton of carbon emissions abated by other means, its economic value to the world is the same, and the world's theoretical willingness to pay should be the same. Just as Certified Emissions Reductions (CERs) receive the same prices regardless of their source, tons of carbon abatement from avoided deforestation should be roughly equivalent in value to tons from other abatement levers, potentially discounted as appropriate to account for permanence risk and other methodological challenges.

Valued at today's CER price of approximately \$20/ton and assuming crediting for carbon stored only in above-ground biomass, EVW_C from avoided deforestation would range from \$6,500 to \$7,000 per hectare in Guyana.[5] Valued at projected global marginal abatement costs of \$60 to \$80 per ton in 2030, EVW_C could eventually exceed \$20,000 per hectare of forest protected from deforestation.[6] These values vastly exceed most alternative land uses and suggest that the world has a very strong interest in preventing deforestation. Other ecosystem services are valuable, but currently irrelevant to decision-makers given the absence of institutional mechanisms for compensation.

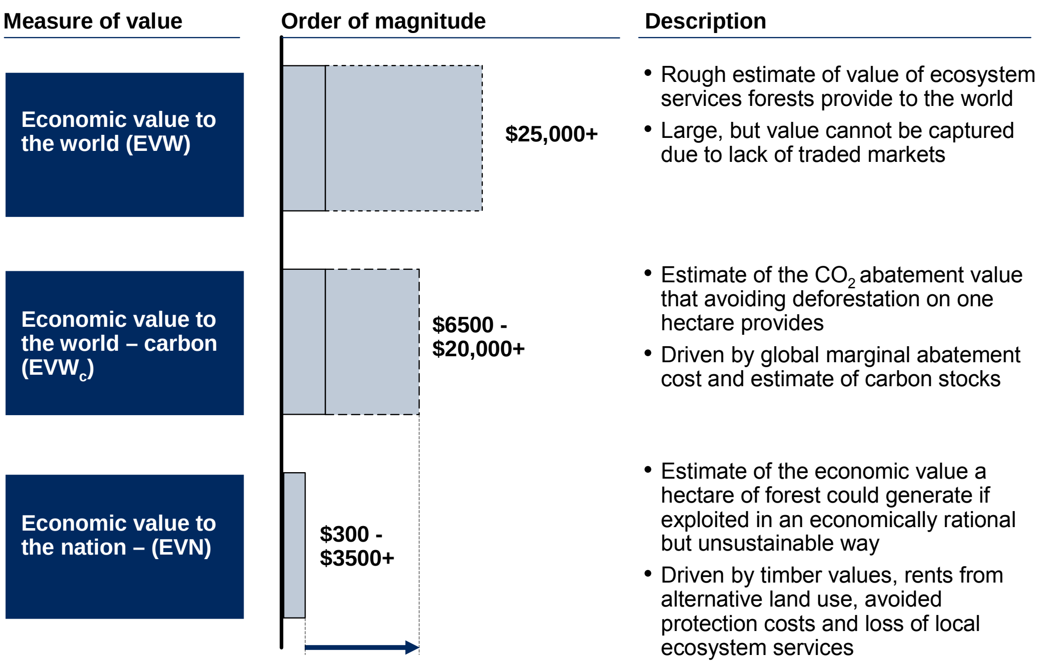
5 Assumption is loss of above-ground biomass only, at 342.78 tCO_2e per hectare, from FAO Forest Resources Assessment 2005

6 Based on 2030 marginal abatement cost from McKinsey & Company. "A Cost Curve for Greenhouse Gas Reduction," *McKinsey Quarterly*, 2007 Number 1

Exhibit 3

EVW, EVW_C, AND EVN PROVIDE BOUNDARY CONDITIONS FOR A DEAL

$US, present value per hectare of forest



Boundary conditions for aligning incentives

Halting deforestation requires aligning the interests of forest countries and the broader community of nations. In turn, alignment would require remuneration for forest ecosystem services that lies between EVN and EVW_C, with EVN the ‘floor’ and EVW_C the ceiling in this range of values. Incentives that lie between EVN and EVW_C will align national and global interests; values below EVN or above EVW_C will not. If support falls below EVN, deforestation will continue as stakeholders in forested nations act in their own rational economic interest, making forest protection progressively more difficult. If the cost of forest protection exceeds EVW_C, the world will forgo conservation from avoided deforestation and seek carbon abatement elsewhere.

In this range of values, forested countries will find economic value from forest conservation that exceeds the economic value to the nation from deforestation, and the world will continue to receive valuable ecosystem services at a cost less than or equal to their full value to the world. All parties will be better off as the world enables forested countries to diversify their economies away from activities that drive deforestation while continuing to grow.

The following section outlines a methodology for estimating EVN and applies it to the Republic of Guyana in an illustrative case study.

How to measure EVN: The case of Guyana

Measuring EVN involves three steps: assessing the value of each component of EVN for each unit of land in a country; charting an economically rational deforestation path; and developing reasonable probabilistic estimates of the EVN. This section explains this approach in greater detail by application to the Republic of Guyana, a developing country with a large tropical rainforest.

Estimating EVN in Guyana

Guyana faces many of the challenges and opportunities that must be addressed in all forested countries to reduce deforestation. The country has a strong track record in sustainable forestry practices, with FAO statistics demonstrating no net loss of forest cover between 1990 and 2005.[7] However, economic pressures to increase value from forest resources in Guyana are growing. The great majority of Guyana's forests are suitable for timber extraction, there are large sub-surface mineral deposits within the forest, and rising agricultural commodity prices increase the potential returns to alternative forms of land use, all increasing the opportunity cost of leaving the forest alone. These challenges will intensify as infrastructure links between Northern Brazil and Guyana advance, increasing development opportunities in the interior of Guyana.

Guyana also faces potentially massive climate change adaptation costs given the need to protect low-lying areas from the risk of flooding (~90 percent of Guyana's population and all of its economic base lives on a narrow strip of coastal land that lies below sea level, rendering it vulnerable to sea-level rise and inland flooding). Moreover, its citizens expect continuously better social and economic services as the country develops. If long-term economic incentives to protect the forest are weak, future Governments may well find it necessary to meet these needs using revenues from unsustainable resource extraction. These pressures bring into sharp focus the need to create meaningful incentives for forest conservation, and make Guyana an important case study in the economics of deforestation.

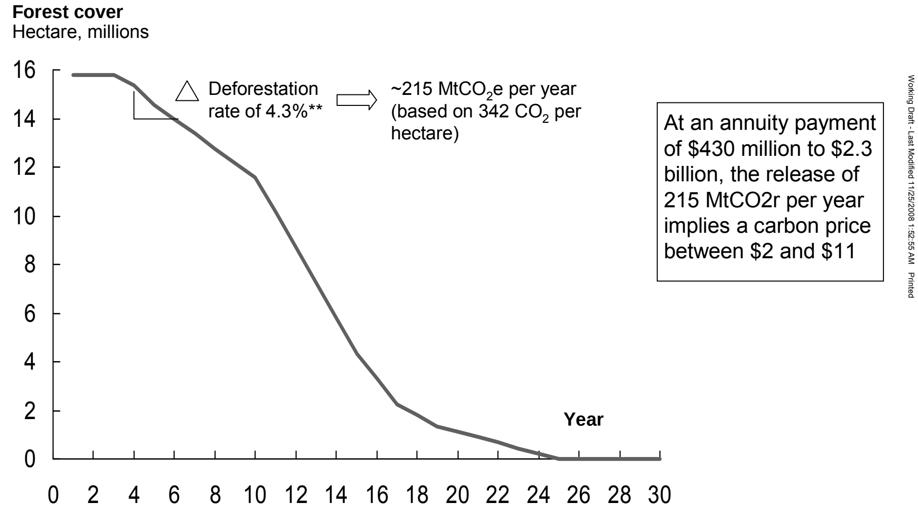
The Office of the President has estimated EVN in Guyana using a baseline scenario in which Guyana aggressively pursues economically rational land use opportunities. A high-level probabilistic analysis indicates a value that is likely to lie between $4.3 billion and $23.4 billion[8] depending on movement of commodity prices, with a most likely estimate of $5.8 billion. These estimates are equivalent to an annuity of between $430 million and $2.3 billion at a 10 percent discount rate[9], suggesting that Guyana forgoes an amount roughly equal to its current GDP of $1,100 per capita in preventing extraction from its forests. Conservative carbon stock estimates and the 'economically rational' baseline deforestation rate suggest a marginal abatement cost of $2 to $11 /t$CO_2$e.

7 Food and Agriculture Organization of the United Nations. Forest Resources Assessment 2005. Rome: 2005

8 80 percent confidence interval

9 10 percent discount rate is standard in forest valuation literature. See Appendix II for reference to other forest valuation studies using a 10 percent discount rate.

Calculation of marginal carbon abatement cost for avoided deforestation in Guyana



Source: FAO 2005 Forestry Assessment; team analysis 0

The Office of the President assessed EVN through a bottom-up analysis of its land use opportunities and the 'economically rational' rate of deforestation. In the following section, the steps used to generate this estimate are described in greater detail, both in general terms and with specific reference to the case of Guyana.

EVN Step 1: Assessing value of each component of EVN. This step involved gathering data for forested lands to estimate each of the four elements of EVN.

1. Standing timber value. Valuation of timber stands is routine for timber investors and involves assessing likely yields of marketable species, extraction costs, and projected prices. While prices have historically been volatile, mean price growth and variance assumptions can be extrapolated from past data and future market trends. However, many tropical countries lack robust timber inventories and their forests contain large numbers of lesser-known species for which the timber market lacks reliable price data.

To date, very strict sustainable forestry rules in Guyana have limited extraction to less than 20 m^3 of timber per hectare over cycles as long as 60 years (implying an allowable cut of 0.33 m_3 per hectare per year), but current forest inventories suggest that substantially greater quantities (60-70 m^3 of valuable hardwood species such as greenheart, locust and mora could profitably be extracted.[10]) This analysis assumes that loggers could extract 40m^3 of commercially marketable species from each hectare of forest under a more permissive regulatory regime, and that the resulting timber could be exported at prices roughly comparable to those facing Guyana today.[11] By applying existing structures for government

10 Guyana Forestry Commission; company data

11 This is a partial equilibrium assumption that excludes from consideration the price impacts of other countries' decisions. Timber prices from International Tropical Timber Organization (ITTO)

revenue, including export levies, acreage fees and taxes on an unconstrained harvest, Guyana could generate substantially greater value from its timber resources than it does today, albeit at a major cost to the world in terms of lost carbon storage, habitat destruction and biodiversity loss. To make the standing timber value truly incremental, the projected value of continuing extraction under a sustainable harvesting regime is subtracted from this estimate.

2. Post-harvest land use value. Data on soil quality, topography, and sub-soil mineral resources were used to identify plausible alternative land uses for forested land. Based on an informed assessment of alternative land uses and assumptions about future yields and prices, returns from alternative land uses were estimated for each region or geographical sub-unit in the country.

The soil beneath tropical forests tends to be thin and poor, and Guyana is no exception. However, Guyana's forests cover a variety of soil types, including some areas with rich soils and mineral deposits that could be exploited within 2 years of forest extraction. Agronomists suggest that by targeting the limited range of areas with 'Class 1' and 'Class 2' soils for agriculture, Guyana can prepare 2.9 million hectares of land for rice, fruit production, and other agricultural efforts as soon as two years after deforestation.[12] On other land areas, palm oil, softwood pulp or hardwood tree plantations – which are ecologically poorer and store less carbon than natural forests – could be planted to generate post-harvest economic value. Similarly, through investments in gold mining equipment, local experts suggest that Guyana could extract at least 9.2 million ounces of identified gold deposits within 30 years.[13] These alternative land uses are, by construction, hypothetical, but they are plausible. Such alternative uses are common in comparable countries, and the Government of Guyana has received – and declined – numerous approaches from investors seeking to develop agricultural, ranching and mining projects in forested areas.

3. Avoided protection costs. By allowing unconstrained forest extraction, Guyana would avoid a cost of US$2/ha for forest monitoring and protection.[14] This is lower than cross-national estimates of US$4 to 9/ha from the Stern and Eliasch reviews but represent the best available cost estimates for forest protection in Guyana.

4. Loss of local ecosystem services. This is the most uncertain of the four elements of EVN for two reasons: the absence of a traded market for most ecosystem services, and limitations in scientific understanding of these services. A range of approaches were used to estimate potential locally realized losses from deforestation. Deforestation would eliminate a range of ecosystem services from forests, including natural watershed protection and revenue from non-timber forest products.[15] This analysis considers three of the most economically

12 Guyana Lands and Surveys Commission

13 Metals Economics Group database

14 Estimate based on the cost of forest protection in Iwokrama, an international program area in Guyana focusing on sustainable rainforest use and conservation

15 Ecotourism is not included in lost ecosystem services because all of Guyana's current planned ecotourism activity takes place in the ~1.5 million hectares of forest it has or plans to place under protection as national parks or wildlife preserves.

important ecosystem services forests provide in Guyana: flood management, non-timber forest products, and eco-tourism.

a. **Flood management.** Management of floods is one of the most important services forests provide in Guyana because the country's low-lying coastal regions are highly vulnerable to inland flooding. A simple estimate of the impact of deforestation on flood risk involves multiplying an estimate of the incremental flood risk associated with deforestation and the economic impact of flooding in Guyana. Recent research estimates that a 1 percent loss in forest cover will result in a 0.4 percent to 2.8 percent increase in frequency of a catastrophic flood.[16] An external assessment by the United Nations ECLAC of a catastrophic flood in 2005 (that cost Guyana 59 percent of its 2005 GDP) estimates ~US$450 million in GDP loss from such a flood. These estimates generate a ranged stream of expected incremental losses from flooding as forest cover declines.

b. **Non-timber forest products.** Many Guyanese citizens obtain value from non-timber forest products (NTFPs), such as wattles and manicoles (hearts of palm). Guyana currently exports US$0.23/ha. of non-timber forest products harvested from standing natural forests.[17] Deforestation will deprive the country of the value of these products.

c. **Eco-tourism.** Eco-tourism is not a major driver of value today. Though this could change in the future, we assume that protecting 10 percent of the country's most attractive forest assets (e.g., Kaieteur Falls) to comply with protected area obligations under the Convention on Biological Diversity will sustain an ongoing opportunity to develop Guyana's eco-tourism sector.

These categories are not exhaustive; deforestation obviously impairs other valuable services that standing forests provide, such as prevention of soil erosion and maintenance of water quality. In some specific areas (and regions of the world), the loss of local ecosystem services will be greater than estimated here. However, mitigating measures can be taken (e.g., prohibitions on deforestation near streambeds) to reduce these risks, and many alternative land uses involving plantation of new trees (e.g., palm oil or tree plantations) will partially mitigate loss of these services even where their negative impact on global ecosystem benefits such as biodiversity conservation or carbon storage is immense.

Using price and yield data from international sources and local topographic and geological information from Guyana's Lands and Surveys Commission, estimates were developed for each component of EVN for each hectare by region. See Appendix I for data sources. The next step is to chart an economically rational deforestation path over time to project cash flows to the nation.

EVN Step 2: Charting an 'economically rational' deforestation path. The present value of each component of EVN depends on the speed and sequence of deforestation, so estimating

16 Bradshaw, Corey et.al. 2007. "Global evidence that deforestation amplifies flood risk and severity in the developing world." Global Change Biology. Estimates probability of catastrophic flood in Guyana is twice in 10 years based on 1990 to 2000 data.

17 Guyana Forestry Commission

EVN requires charting a path that describes the trajectory of deforestation across geography and across time. While deforestation might not in practice follow a predictable path, it is possible to project a profit-maximizing path equivalent to the strategy a central planner might pursue in seeking to optimize returns to the country from deforestation and post-harvest land use. Because it is a value-maximizing strategy, this economically rational path yields the maximum return from forest exploitation, and therefore suggests an 'economically rational' rate of deforestation that can be used to estimate EVN.

Charting the economically rational path involves several steps. Drawing on the assessment of alternative land use developed in Step One above, the planner generates a profit-maximizing harvesting path, where countries begin harvesting trees in regions with existing infrastructure and road access, thus creating a stream of income to be used in developing infrastructure in areas that are less accessible today.

In the economically rational deforestation path, harvest occurs at the maximum rate consistent with the constraints of technical feasibility, market dynamics, and legal commitments. Technical feasibility constrains the rate of harvest because significant infrastructure development, labor movement and land preparation would be needed to execute the strategy. Additionally, anticipated production of commodities must not violate reasonable assumptions of market demand for increased timber, agriculture, and mineral commodities in any given year to avoid the risk of market flooding and price collapses. Lastly, international laws on forest protection (e.g., the Convention on Biological Diversity) and national agreements with indigenous communities are assumed to be honored.

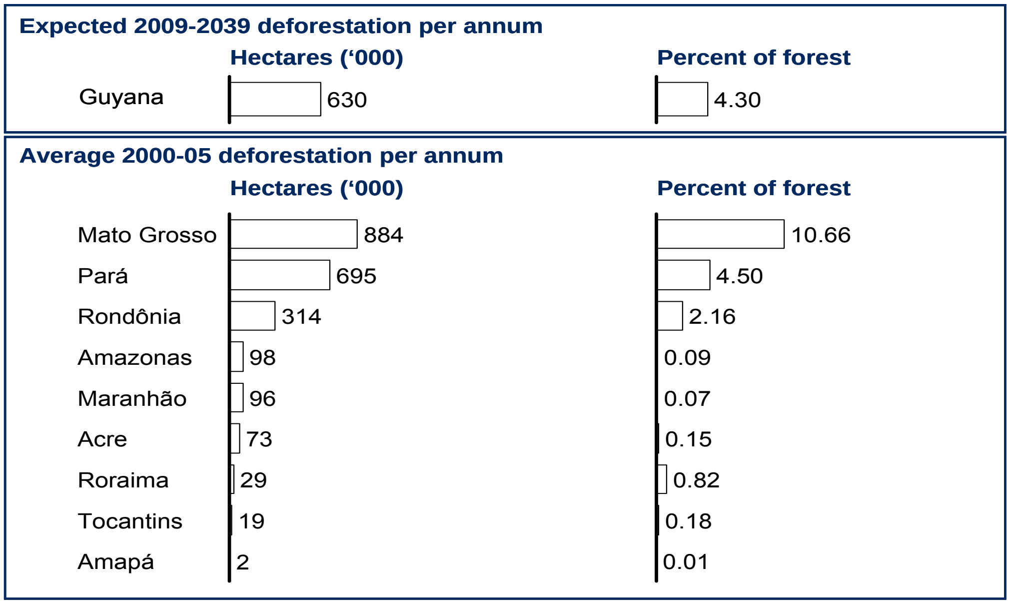
In Guyana, we chart an 'economically rational' deforestation path that involves reducing forest cover by approximately 4.3 percent (~630,000 ha) per annum over the course of 25 years, leaving intact as protected areas the 10 percent of Guyana's forests with the highest conservation value. This rate of deforestation is comparable to deforestation in the nearby Brazilian states of Pará and Mato Grosso, which experienced even faster declines in forest cover between 2000 and 2005.[18] This deforestation trajectory is pursued on lands currently under the jurisdiction of the national government, excluding ~1.7 million hectares of forest under the jurisdiction of Amerindian communities.[19] The timing and sequence of deforestation across regions is influenced by distance to required infrastructure and major population centers.

18 Brazil National Institute for Space Research (INPE) Project PRODES

19 This analysis excludes land, which is under the jurisdiction of Amerindian communities, plus land, which is planned to be placed under Amerindian jurisdiction. However, it is likely that Amerindian communities would elect to participate in REDD mechanisms - in these circumstances overall EVN, EVW and EVWc from within Guyana would increase.

Exhibit 4

GUYANA'S PROJECTED DEFORESTATION VS. BRAZILIAN STATES



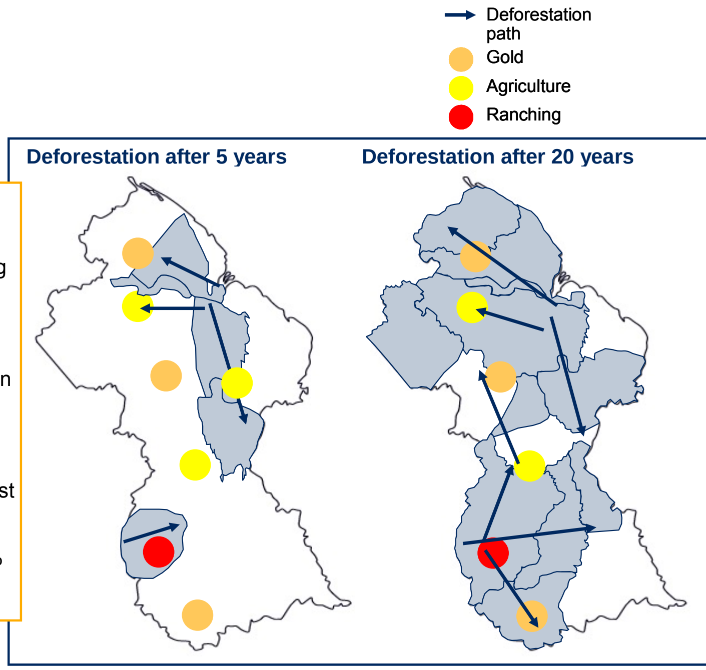
Technical, economic and legal factors place an upper limit on how quickly and extensively a deforestation strategy can be pursued. However, the path described is technically feasible, creates economic value, and is consistent with Guyana's international and national legal obligations. See Appendix III for further detail on the technical parameters for the deforestation path.

Exhibit 5

ECONOMICALLY RATIONAL DEFORESTATION PATH

CONCEPTUAL

- Managed deforestation uses existing road and port structures to begin systematically deforesting areas near major cities
- In each area, deforestation only occurs if the NPV of deforestation is positive
- Areas rich in good agricultural soils and minerals are approach first
- Countries continue to commit to protecting 10% of forest cover under international guidelines



EVN Step 3: Developing probabilistic estimates of the EVN. Since future prices and yields driving cash flows are uncertain, Guyana's EVN is better represented as a probability distribution than as a point estimate. Statistical analysis suggests that Guyana's EVN is highly likely to fall between \$4.3 billion and \$23.4 billion (with a most likely estimate of \$5.8 billion, equivalent to a \$580 million annuity payment at a 10 percent real discount rate).[20] In other words, by protecting its forests, Guyana forgoes economically rational opportunities that could net it the equivalent of \$430 million to \$2.3 billion in additional value per year.

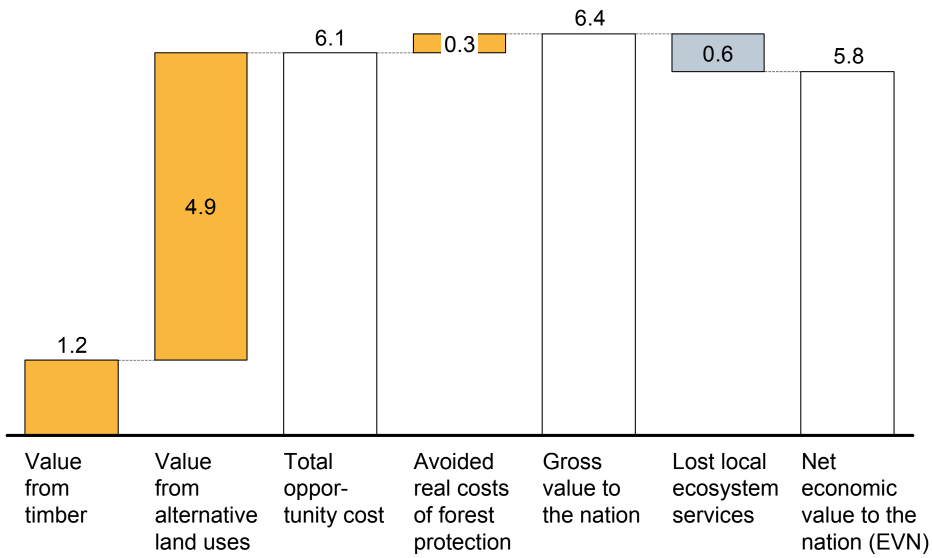
Most of this value comes from forgone opportunities to use land in more intensive ways, though a significant amount comes from the value of Guyana's standing timber. To give a sense of magnitudes, the most likely estimate of EVN (\$5.8 billion in present value terms) is driven primarily by value from timber extraction (\$1.2 billion) and from post-harvest land use (\$4.9 billion), with a contribution from avoided costs of protection (\$0.3 billion) and a downward adjustment for the loss of local ecosystem services (\$0.6 billion).[21]

20 Median 80 percent of simulated values

21 These values assume that Guyana's conversion of land to alternative uses does not impact global commodity prices, as Guyana will remain a "price-taker" in these markets (See appendix III on timber values). Whilst an argument exists that if all forested nations pursued a deforestation strategy, prices would fall (reducing EVN), the current economic pressures on the forest combined with the likely growing demand driven by population increases, may act to offset these.

Exhibit 6

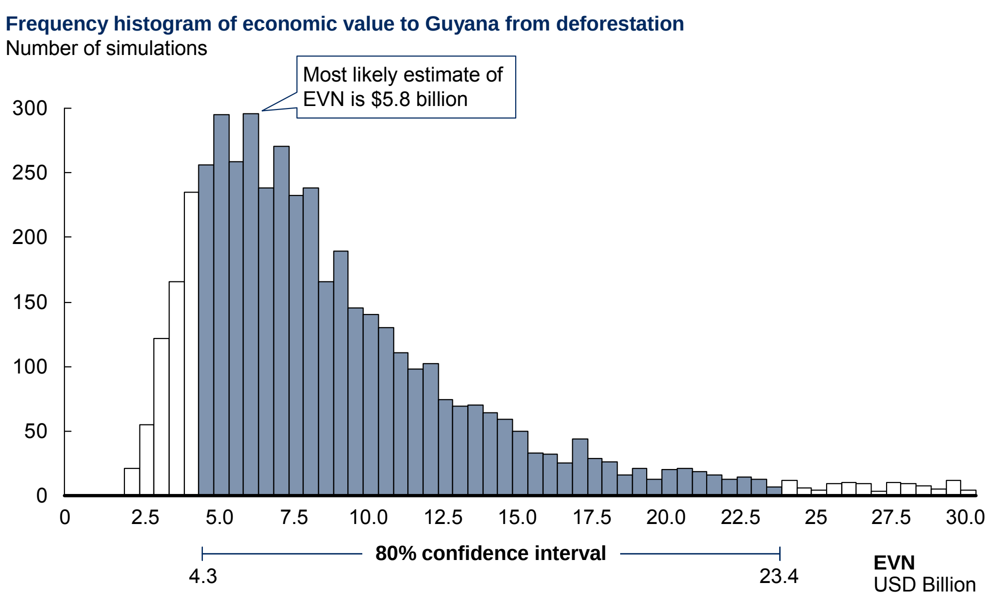
GUYANA'S EVN IS DRIVEN LARGELY BY POST-HARVEST LAND USE



EVN's range of between $4.3 billion to $20.4 billion reflects variability driven by fluctuating prices for commodities such as logs, palm oil, and rice. Under favorable circumstances (such as a commodity price boom) the EVN could be even higher in the future, increasing pressure to deforest.

Exhibit 7

EVN IS LIKELY TO FALL BETWEEN $4.3 AND $23.4 BILLION



Implications for decision-makers

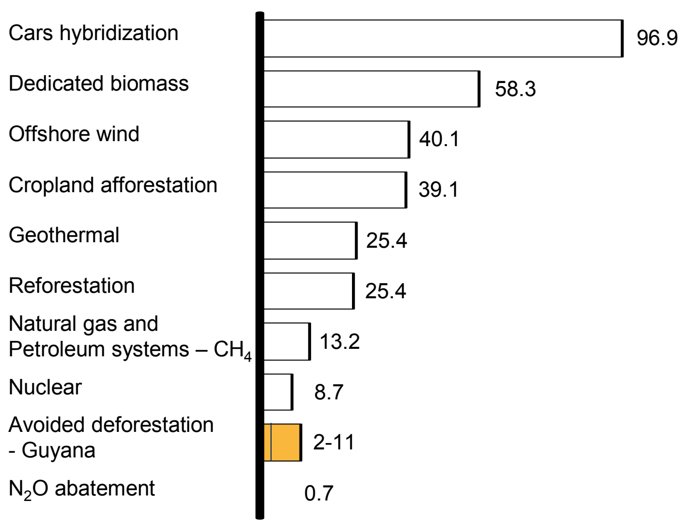
Rainforest countries face a range of large-scale, land-intensive development opportunities implying an 'economically rational' rate of deforestation to maximize economic value to the nation (EVN). In Guyana's case, forgoing these opportunities incurs opportunity costs on the order of $4.3 billion to $20.4 billion in present value terms, notionally equivalent to an ongoing opportunity cost of $430 million to $2.0 billion for forest protection. Using a conservative estimate of avoided emissions (~343 tCO_2 per hectare), this sum translates into an abatement cost of roughly $2 to $11/$tCO_2$e, which compares favorably with most other abatement options available to the world. Yet today, the world provides virtually no support to protect rainforests despite enjoying significant value from the ecosystem services they provide to the world.

Exhibit 8

AVOIDING DEFORESTATION IS AN ECONOMICALLY ATTRACTIVE ABATEMENT OPTION

Cost of carbon abatement

USD per tonne of CO_2



Source: Vattenfall; McKinsey

With financial resources approximating EVN, Guyana could embark on an alternative development path providing economic opportunities and important services for its people while protecting the forests over the longer term. Resources could be used to build capacity for participation in a longer-term REDD mechanism, finance Guyana's significant climate change adaptation needs, improve infrastructure required to attract investment into non-forested parts of the country, and invest in human resources, governance and management capacity required to accelerate long-term economic growth. Without these resources, Guyana's range of choices is much narrower. The Government of Guyana will facilitate a broad-based national consultation throughout the first half of 2009. The aim will be to ensure the involvement of Guyanese stakeholders in determining the allocation of resources secured under any future REDD mechanism or interim arrangement. In parallel, the Government is analyzing fiduciary oversight and other financial governance mechanisms to guard against REDD inflows leading to inflationary pressures and other governance issues.

More generally, the analysis presented in this memorandum has four core implications for decision-makers faced with designing an effective REDD mechanism.

1. The 'economically rational' deforestation baseline will likely differ significantly from historical performance

Current REDD proposals include the use of historical baselines, stock/average emissions baselines, and projected baselines. This analysis suggests that baseline assumptions should be driven by assumptions of rational behavior by countries seeking to maximize economic opportunities for their citizens (an 'economically rational' rate of deforestation. Such baselines can be developed using economic models of expected profits from activities that motivate deforestation (vs. in-country benefits of maintaining the standing forest), and the timing and costs required to harvest and convert lands to alternative uses.

Since this baseline methodology is tied to actual economic pressure on the forest, it should create more balanced incentives for forested nations, including highly forested, low deforestation countries (HFLDs). A forward-looking baseline rate of economically rational deforestation better reflects true pressures on forests than do assessments of historical or stock-based baselines, which likely understate pressures on forests in cases where government policies have actively limited deforestation. Forward-looking baselines are therefore more likely to mitigate the risk of international leakage, which could otherwise intensify pressure on countries where relatively stable baselines would provide little incentive to constrain deforestation.

Methodological challenges will nevertheless confront decision-makers in calculating a forward-looking rate of deforestation, just as baseline and additionality questions plague project design in the Clean Development Mechanism. Permanence questions can be addressed through a variety of means, including the creation of legally protected zones and the use of 'permanence buffers' in crediting reductions. Additionality can be debated until the trees disappear, but there is an emerging consensus (reflected within the Eliasch Review, for example) that without dramatic action, the world's natural forests are likely to disappear in the medium term. Just as the CDM establishes criteria for developing reference emissions baselines, Parties could agree an approach for translating the 'economically rational' deforestation path into forward-looking baselines for REDD.

2. 'Economic Value to the Nation' represents a floor value for durable incentives for forest protection

At minimum, any REDD mechanism must support the creation of economic alternatives that exceed the economic value to a nation (EVN) generated by pursuing rational economic activities involving deforestation. This memorandum proposes a methodology for estimating EVN. By placing a real value on tropical forest countries' best alternative to a negotiated agreement (BATNA), EVN brings new insight to the scale of resources required to reduce deforestation. Parties should consider estimating EVN to provide greater transparency into the effectiveness of incentives provided by different proposals and baseline methodologies.

3. Support between EVN and EVWC would align the interests of forested countries and the broader world community

Incentives whose value lies between EVN and EVW will align national and global interests in the long term; values below EVN or above EVW_C will not. If support falls below EVN, deforestation will continue as forested nations act in their own rational economic interest. If the cost of forest protection exceeds EVW_C, the world will forgo conservation. In principle, if we use as a proxy for EVW_C only the carbon abatement value of avoiding deforestation (and exclude other forest-based ecosystem services for which markets have not yet developed), the world should be willing to pay a carbon price for REDD comparable to that paid for other abatement levers, subject to any discounts required to account for permanence risk and other methodological concerns.

4. Future outlook

The fact that the world has an interest in ensuring that remuneration for forests continues to exceed EVN has two implications. First, given the sensitivity of EVN to commodity prices, any financing mechanism will need flexibility in order to adjust for future shifts in economic pressures to deforest. Second, while markets do not exist for most ecosystem services, their values should not be forgotten. EVW_C is a useful short-term proxy for EVW, but if carbon prices in the distant future were to fall to a point where EVW_C no longer delivered effective incentives, payment structures based on other ecosystem services such as global rainfall regulation or biodiversity conservation could be used to ensure that forests continue to receive remuneration in excess of EVN.

* * *

These concepts clarify what will be required to create long-term alignment between the economic interests of forested countries and those of the broader world community. They suggest that countries will continue to face economically rational incentives to deforest regardless of past performance, and help to answer the question of *how much* will be required to stimulate substantial reductions in deforestation. The related question of how to finance these requirements in a REDD mechanism is best left to policymakers.

However, it is clear that in the years before REDD is agreed and implemented, bridging solutions are required in order to prevent rapid deforestation.[22] The Bali Action Plan called on

22 Whilst beyond the scope of this paper it should also be acknowledged that discussions may be required about the sequencing and evolution of payments over time. For example, in the case of Guyana, due to the investments required, we have modelled a 9-year ramp-up period to "steady-state" deforestation under the EVN scenario, with no incremental logging in years 1 to 3 (due to infrastructure build-out) and a ramp-up to "steady-state" over years 4 to 9. As such, a 5 plus year ramp-up period in payments would be reasonable to reflect the underlying economic alternative, demonstrate positive usage of funds, and generate trust between the parties.

governments and civil society to engage in demonstration activities to accelerate implementation of REDD, and a number of innovative projects and programs have been launched in the last year. However, very few of these projects involve sovereign governments in national-scale efforts to slow deforestation.

In the absence of a perfect international framework to deliver incentives for forest conservation, national scale pilots between willing governments, grounded in the basic logic of providing incentives large enough to motivate forest conservation, can generate experience for the future, and start saving the world’s forests today.

Appendix I: Economic Value to the Nation (EVN) Methodology

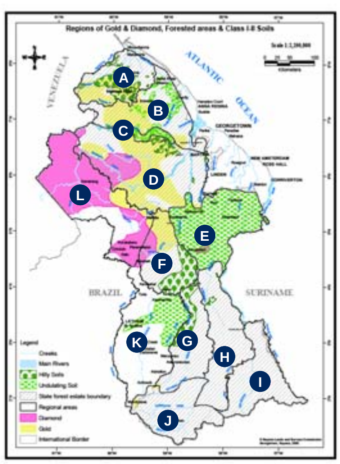
This appendix outlines the calculations and key assumptions for the Economic Value to the Nation (EVN) calculation, including macro assumptions, standing timber value, post-harvest land-use profits, savings on protection costs, and loss of local ecosystem services.

Macro assumptions

- Inflation will continue at the historical average of 4.58 percent per annum from 2000-2007 despite high levels of fluctuations in some years.

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008
Inflation	6.15	2.63	5.34	5.98	4.67	6.24	5.86	3.85	4.22

- The assumed real discount rate is 10.0 percent based on a review of existing forest valuation literature (see Appendix II).
- We assume Guyana's forest contain 342.78 tCO2e per hectare based on the total carbon sequestration estimate from the 2005 FAO Forestry Assessment.
- Guyana's forest was divided into 12 regions (A-L) based on wood types, access, value of post-harvesting after-uses (e.g., based on soil quality and mineral deposits), and ownership.



Standing timber value

To determine the standing value of timber we make the assumptions based data secured from both within and outside of Guyana for forest regions, wood types, production costs, and government fees.

Forest regions

- 20 percent of Guyana's forest is non-productive, according to current estimates by the Guyana Forestry Commission, due to inaccessible mountain areas, streams, and other natural obstructions.
- Guyana can extract 40 m3 per hectare from productive forest areas based on inventories from leading concessionaires indicating marketable species may be as high as 69-79 m3 per hectare.
- Deforestation will not begin until year 4 where regions D and E would be deforested first and subsequent regions added based on infrastructure accessibility and value. Regions are deforested at a rate of 150,000 to 200,000 hectares per annum.

Region	Start year	End year
A	2020	2025
B	2014	2022
C	2014	2014
D	2013	2027
E	2013	2023
F	2020	2023
G	2020	2025
H	2026	2033
I	2024	2024
J	2020	2025
K	Amerindian	Amerindian
L	Amerindian	Amerindian

Wood types

- Guyana's current ratio of wood types will remain constant throughout its managed deforestation plan.

Wood type	Share of timber input
Logs	67%
Sawnwood	15
Roundwood	4
Splitwood	1
Fuelwood	5
Plywood	8

- Recovery rates for each wood type would remain the same as current rates.

Wood type	Recovery rate
Logs	100%
Sawnwood	40
Roundwood	100
Splitwood	33
Fuelwood	100
Plywood	50

- Domestic consumption of each product would remain at current absolute levels (~270,000 m3), growing with population at 0.24 percent per annum, resulting in negligible domestic consumption compared to exports.
- Current average domestic and export prices as of June 2008 from the ITTO Guyana submissions are assumed as base prices.
- Export and domestic prices grow at the same rate based on the maximum likelihood estimate of the best fit statistical model for real price growth from 1961 to 2005, adjusting using the United States CPI.

Wood type	Real price growth	Statistical fit model
Logs	0.79%	Log Logistic (λ=-0.37, α=0.36,β=5.46)
Sawnwood	0.88	Wald (μ=0.44, λ=11.91) Shift=-0.44
Roundwood	-0.22	Log Logistic (λ=-0.37, α=0.36,β=5.46)
Splitwood	0.88	Log Normal (μ=0.49, σ=0.11) Shift=-0.50
Fuelwood	1.62	Gumbel (location=-0.047, scale=0.11)
Plywood	-1.74	Gamma (α=47.73,β=0.013) Shift=-0.64

- Guyana would lose sustainable forestry value for each type of wood if it were to continue its current practices into perpetuity, growing at the above real prices.

Wood type	2007 sustainable forestry
Logs	$20,847,246
Sawnwood	$21,862,299
Roundwood	$2,899,341
Splitwood	$1,725,224
Fuelwood	~$0
Plywood	$8,877,001

Production costs

- Capital investments are incurred 1 year in advance of timber harvesting to begin construction.
- Costs are broken down by function based on current operators in Guyana:

Cost description	Cost (USD/m^3)	Cost type
Fixed management cost (overhead)	$21.41	In-year
Road construction – primary	$0.83	CapEx
Road construction – secondary	$1.65	CapEx
Road maintenance – primary	$0.10	In-year
Road maintenance - secondary	$0.21	In-year
Harvesting cost to roadside	$34.46	In-year
Log transport to mill	$15.26	In-year
Sawmilling cost (inc. loader)	$32.07	In-year
Sawmill licensing Fee	$0.00	In-year
Sawmill Operating Fee	$0.00	In-year
Kiln drying cost (inc. fork-lift)	$25.70	In-year
Planer/moulder	$14.60	In-year
Depreciation on mill equip.	$1.14	CapEx
Transport to Georgetown	$40.12	In-year
Storage and handling - Georgetown	$5.80	In-year
Finance costs on capital	$35.58	CapEx

- Road and transport costs are multiplied by a factor to account for more expensive infrastructure requirements deeper in the forest:

Region	Transport cost factor
A	3x
B	2x
C	2x
D	3x
E	2x
F	2x
G	3x
H	4x
I	4x
J	4x
K	2x
L	4x

Government fees

- Government of Guyana will continue to receive royalties on timber production and export commissions on timber sales at 2009 schedules:

Wood type	Royalties (USD/m^3)	Export commission
Logs	1.65	10%
Sawnwood	7.29	2
Roundwood	0.33	2
Splitwood	0	2
Fuelwood	0.15	2
Plywood	0	2

- Government revenue on foreign companies will continue to come from acreage fees (US$0.37/ha.), licensing fees (US$0.04/ha.), and corporate tax (35 percent).
- 70 percent of companies are expected to be foreign-owned, maintaining the current ratio of foreign to domestic companies.
- Government of Guyana will need to continue to spend US$4,490 per employee for monitoring and collecting fees at a rate of 0.13 employees per 10,000 hectares.

Post-harvest land-use profits

Assumptions are made for agriculture, ranching, and mining based on the factors of available land or deposits, costs and productivity, and forecasted prices.

Agriculture

- Available land
  - Existing soil assessment maps indicate significant amounts of ‘rich’ arable soils in most regions of Guyana’s forest.

Region	**Class 1 undulating soil** (ha.)	**Class 1/2 hilly soil** (ha.)
A	-	191,574
B	183,224	-
C	92,023	-
D	-	104,809
E	1,911,516	-
F	-	198,042
G	-	251,287
H	-	14,795
I	-	-
J	-	-
K	Amerindian	Amerindian
L	Amerindian	Amerindian

- Rice is the most productive and likely product to be grown on class 1 undulating soils given Guyana's history of rice production and growing demand for rice products in the world.
- Class 1/2 hilly soils are equally divided between palm oil plantations and small-scale farming for high-end vegetables as the most likely positive NPV crops for Guyana to grow on these soils. Coffee and cocoa were tested but resulted in a negative NPV.

- Costs and productivity
  - Yields for all products are based on historical averages reported by the FAO. For palm oil, average yields in other palm oil producing countries is used given there has been no palm oil production in Guyana to date.
  - Capital expenditure and land preparation costs are based on historical estimates for rice in Guyana according to current rice producers and the Guyana Rice Development Board. For all other products, 2007 capital expenditure costs in Brazil are used from the Agrianual survey.
  - Capital investments would need to take place on average 2 years prior to crop cultivation.
  - Operating profit margins are similarly based on historical margins for current rice producers and Brazilian producers for all other products according to the Agrianual survey.

Product	**Yield** (Mt/ha.)	**Capex** (USD)	**Operating profit margin**
Sugar	76.92	$2,000	N/A
Rice	4.14	$600	19.64%
Palm oil	4.00	$498	18.75
Cocoa	0.26	$3,978	39.59
Coffee	0.43	$7,561	21.22
Vegetables	6.19	$330	37.00

- Forecasted prices
  - Prices for 2009 to 2018 are based on FAPRI 10-year market price projections by product.
  - Real price growth after 2018 is based on average real price growth from 1960 to 2007 according FAO market prices, adjusted for inflation with the United States CPI.

Product	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
Sugar	$262	$276	$269	$270	$273	$277	$280	$281	$283	$285
Rice	$463	$479	$486	$499	$510	$515	$517	$520	$521	$531
Palm oil	$1,004	$1,026	$1,057	$1,081	$1,110	$1,146	$1,185	$1,229	$1,275	$1,319
Cocoa	$1,551	$1,632	$1,716	$1,805	$1,899	$1,998	$2,102	$2,211	$2,326	$2,447
Coffee	$2,032	$2,018	$2,004	$1,991	$1,977	$1,964	$1,950	$1,937	$1,924	$1,911
Vegetables	$163	$166	$168	$171	$174	$177	$179	$182	$185	$188

Product	Real price growth	Statistical fit model
Sugar	2.66%	Logistic (α=0.027,β=0.11)
Rice	0.22	Log Logistic (λ=-0.47, α=0.45,β=5.44)
Palm oil	2.29	Gumbel (location=-0.098, scale=0.21)
Cocoa	5.19	Beta (α1=2.40, α2=10.08, min=-0.36, max=1.80)
Coffee	-0.68	Beta (α1=0.33, α2=0.34, min=-0.32, max=0.32)
Vegetables	1.61	Gumbel (location=-0.078

Ranching

- Available land
  - There are no lands available on state forest for ranching.

Region	Ranching flatlands
A	-
B	-
C	-
D	-
E	-
F	-
G	-
H	-
I	-
J	-
K	Amerindian
L	Amerindian

- Cost and productivity
  - Yields for bovine bovine beef are based on historical averages reported by the FAO.
  - Capital expenditure and land preparation costs are unavailable.
  - Capital investments would need to take place on average 2 years prior to cattle ranching.
  - Operating profit margins are based on historical margins for Brazilian ranchers.

Product	**Yield** (Mt/ha.)	**Capex** (USD)	Operating profit margin
Cattle beef	0.001423	N/A	30.0%

- Forecasted prices

- Prices for 2009 to 2018 are based on FAPRI 10-year market price projections for beef.
- Real price growth after 2018 is based on average real price growth of beef from 1960 to 2007 according FAO market prices, adjusted for inflation with the United States CPI.

Product	2009	2010	2011	2012	2013
Beef	$2,075	$2,027	$2,000	$1,979	$1,971
	2014	**2015**	**2016**	**2017**	**2018**
	$1,987	$2,017	$2,053	$2,096	$2,138

Product	Real price growth	Statistical fit model
Beef	0.18%	Normal (μ=0.0018, σ=0.095)

Mining

- Available minerals
  - Mineral Economics Group (MEG) data indicates that 9.2 million ounces of gold have been identified for extraction in the forested lands.

Region	Land with gold (Ha.)	Identified gold (Ounces)
A	463,480	513,000
B	526,229	470,000
C	-	
D	1,338,909	4,500,000
E	34,948	592,000
F	303,378	1,297,000
G	5,747	1,748,000
H	-	
I	-	
J	30,903	48,000
K		
L		

  - Deposits of other minerals are not known with any certainty and are thus excluded.
- Costs and productivity
  - Capital expenditure costs are assumed at $74.77 per ounce based on investments made for other small scale mining operations in Guyana.
  - The MEG database indicates that operating costs in Guyana are $260.00 per ounce.

- We assume 2 years are required to put capital investments in place prior to mining.

- Forecasted prices
  - Gold prices have fluctuated significantly throughout history with a dramatic rise recently. We take 2009, 2010, and long-term consensus on gold price for 14 analysts. We assume the long-term price will be achieved by 2015 and will remain constant in real terms thereafter.

Product	**2009**	**2010**	**2011**	**2012**	**2013**
Gold	$750	$883	$838	$796	$756
	2014	**2015**	**2016**	**2017**	**2018**
	$717	$681	$681	$681	$681

Product	**Long-term price**	**Statistical fit model**
Gold	$681	Normal (μ=681, σ=55.80)

Savings from protection costs

- Interviews with Iwokrama, an international rainforest conservancy, indicate that in optimal circumstances, they would require US$2 per hectare for protection of their wildlife preserve. Iwokrama is an international recognized conservation research concession offered to the world by Guyana as an area to study sustainable forest management and ecosystem services.
- The US$2 is conservative compared to the cost of administration of payment for ecosystem services schemes in other countries, ranging from US$4 to US$9 according to Grieg-Gran (2008) for the Eliasch Review.

Loss of local ecosystem services

- Flood risk is estimated based on analysis conducted by Bradshaw, et. al. (2007) based on a review of catastrophic floods around the world. They find that a 10 percent decrease in forest cover results in a 3.5 to 28 percent increase in flood frequency when controlling for steepness and precipitation.
- For Guyana, Bradshaw (2007) indicates that 2 major floods occurred between 1990 and 2000, implying a 20 percent baseline probability of flooding in any given year.
- We assume an average relationship of 15.8 percent increase in flood frequency for every 10 percent decline in forest cover.
- A study by the United Nations Economic Commission for Latin America and the Caribbean indicated in 2005 that a catastrophic flood destroyed much of the coastal

area near Georgetown, resulting in a loss of US$452 million, or 60 percent of Guyana's GDP.

- We assume this economic damage keeps pace with inflation as the potential damage from a catastrophic flood.

Data sources used in modeling assumptions

Soil quality and crop feasibility:

- Soil quality data and crop feasibility assumptions from Guyana Lands and Surveys Commission using FAO classifications.

Timber value:

- Historical export prices for raw logs, sawnwood, roundwood piles, and plywood from FAOSTAT World Export Prices
- Domestic prices for raw logs, sawnwood, roundwood piles, and plywood from Guyana Forestry Commission submission to ITTO

Post-harvest alternative land use:

- Historical export prices for rice, coffee, fruits and vegetables, cocoa, palm oil from FAOSTAT World Export Prices
- Historical yield levels for Guyanese products from FAOSTAT Production database and non-Guyanese products from Agrianual 2007.

Appendix II: Forest valuation studies using 10 percent discount rate

Bann, C. 1997. An Economic Analysis of Tropical Forest Land Use Options: Ratanakiri Province, Cambodia. Singapore: Economy and Environment Program for Southeast Asia

Grieg-Green. 2008. The Cost of Avoiding Deforestation. London: International Institute for Environment and Development *(work basis of 10 percent discount rate cited in Stern Report and Eliasch Review)*

Godoy, R. and Lubowski, R. 1992.Guidelines for the economic valuation of non-timber tropical-forest products, Current Anthropology, 33(4), August-October, 423-433.

Howard, A and Valerio, J. 1996. Financial returns from sustainable forest management and selected agricultural land-use options in Costa Rica, Forest Ecology and Management, 81, 35-49

Kremen, C., Niles, J., Dalton, M., Gaily, G., Ehrlich, P., Fay, J., Grewal, D and Guillery, R. 2000. Economic incentives for rain forest conservation across scales, Science, 288, 1828-1832

Pearce,D.W. 1994. Assessing the social rate of return from investment in temperate zone forestry, in R.Layard and S.Glaister (eds), Cost-Benefit Analysis, Second edition, Cambridge: Cambridge University Press, 464-490

Simpson, D., Sedjo, R. and Reid, J. (1996) Valuing biodiversity for use in pharmaceutical research. Journal of Political Economy 104 (1), pp. 163-185

Wunder, S. 2000. The Economics of Deforestation: the Examples of Ecuador, London:Macmillan

Yaron, G. 2001. Forest, plantation crops or small-scale agriculture? An economic analysis of alternative land use options in the Mount Cameroun area, Journal of Environmental Planning and Management, 44 (1), 85-108

Appendix III: Feasibility assumptions related to the growth path

1. Roads, port facilities, and processing infrastructure required to pursue this managed deforestation path can be developed in four years.

Timber extraction remains a positive NPV activity in all regions even when road costs from existing forestry concessions are increased by 2-4 times for regions deeper in the forest due to their limited accessibility. By delaying deforestation until year 4, Guyana has time to construct required support infrastructure, such as a port that can handle 450,000 TEUs, more than double the capacity required for the maximum annual timber export under this growth path. Processing capacity would also need to grow significantly, but the use of portable sawmills would enable rapid and modular expansion.

2. Significant increases in tropical timber exports from Guyana would not exceed anticipated unmet global demand.

Global demand for timber is likely to grow as population increases and incomes rise. Meanwhile, production has been falling as tropical forest resources dwindle. Under the assumption of at least some fungibility between tropical timber species, projections of demand growth and supply trends suggest a growing demand gap large enough to absorb the average of annual 14 million cubic meters of tropical wood that a ‘managed deforestation’ program would generate. Depending on the long-term evolution of supply and demand for tropical timber, this expansion may or may not result in meaningful downward pressure on prices relative to current levels. This is a partial equilibrium analysis, and does not account for the potential impact of other countries’ land use decisions; further work will be needed to understand the implications of a general equilibrium analysis for EVN.

3. Guyana could pursue this policy while continuing to meet its international and domestic commitments.

Pursuing economic development opportunities in this way would still enable Guyana to meet its protected area commitments under the Convention on Biological Diversity. It would also be consistent with Guyana’s existing policies ensuring that indigenous Amerindian communities maintain control of ~1.7 million hectares of forest, though indigenous communities would continue to have the right to pursue economic development opportunities involving deforestation if they so chose.