Forest carbon stock in Guyana :
Projected emissions and REDD reference scenarios

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Executive Summary

Currency figures in US $

This report reviews various estimates for deforestation rates and baselines that have recently been made, and discusses some of the uncertainties regarding methodology for REDD baselines and reference scenarios. The McKinsey study estimating an opportunity cost for REDD of $580 million per annum is discussed, together with the Conservation International report on the Georgetown-Lethem Transport Corridor and its implications.

Various drivers of deforestation are discussed. They are grouped as land use change, directly driven by human activity, including agriculture, mining, infrastructure and settlements; and endogenous drivers arising from forest processes such as fertility loss, pathogens and fire which are themselves coupled to human activities that exacerbate these factors. Both are driven by economic growth, and a multiplier of 2.65 is calculated relating *business as usual* GDP growth % to forest loss %, using historical GDP and deforestation data.

Several scenarios are then reviewed, of which two can be regarded as potentially acceptable as conservative REDD reference baselines, depending on the outcomes of the Copenhagen December 2009 negotiations and beyond. The historical reference scenario is of 0.4% forest loss, objectively measured by aerial photography from FAO inventories in 1960-63 compared with present SAR mapping. Given a net carbon loss of 641 t CO_2 ha^{-1} when forest degrades or is converted to scrub, savannah or agriculture, this deforestation rate equates to annual emissions of 40 million t CO_2 yr^{-1}. With carbon emissions priced in September 2009 close to $20 t^{-1} CO_2, this represents a carbon market value of $802 million annually.

The second alternative is to consider future non-REDD deforestation as a reference scenario. With 5% GDP growth, as may be conservatively estimated for Guyana over coming decades, and a deforestation multiplier of 2.65, this equates to forest loss of 1.9% annually, or 191 million t CO_2 yr^{-1}. On the same valuation basis, this is a market value of $3.8 billion per annum. Sensitivity analysis is shown for 3% and 8% GDP growth.

Both these reference scenarios (historical deforestation or non-REDD development) are relative to zero deforestation under REDD. The feasibility of this is noted, instanced by many countries with net increases in forest areas. However, it requires major capacity development in land use planning and control, all aspects of forest management, reforestation and land rehabilitation, and applied forest and ecosystem research. Financing this will in turn bye contingent upon the assurance of REDD financing, although the Government of Guyana, through its Low Carbon Development Strategy, has already started to move towards this goal.

Contents

List of Abbreviations

CEC .... Cation Exchange Capacity
CI .... Conservation International
CO_2 .... Carbon dioxide
EVN................................ Economic Value to the Nation
EVW .... Economic value to the World
FAO................................ Food and Agriculture Organization of the UN
FCPF............................... Forest Carbon Partnership Facility
FRA .... FAO Global Forest Resource Assessment 2005
GDP................................ Gross Domestic Product
GFC .... Guyana Forestry Commission
GLTC.............................. Georgetown-Lethem Transport Corridor
IPCC............................... International Panel for Climate Change
LCDS.............................. Low Carbon Development Strategy
OPG................................ Office of the President of Guyana
REDD .... Reducing Emissions from Deforestation and Degradation
R-PLAN .... Readiness Plan for REDD
R-PP .... REDD Preparation Proposals
UNFCCC .... UN Framework Convention on Climate Change
USDA .... United States Department of Agriculture
USGS.............................. United States Geological Survey
VCS .... Voluntary Carbon Sector
WWF .... World Wide Fund for Nature

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Introduction

Consultant's Terms of reference

This report is an output from the *Forest Carbon Stock Assessment Project for Guyana*, undertaken by the Guyana Forestry Commission with support from WWF and Conservation International (CI). It relates to item 3 of the consultant's terms of reference, which is stated as:

> 3. *Develop future projections of emissions as baselines based on status quo and reductions under various scenarios of improved forest management and incentives to reduce deforestation and degradation.*

The complete terms of reference are detailed in Annex A.

Project background

This project was formulated at an early stage of the REDD (Reducing Emissions from Deforestation and Degradation) process in Guyana, and has, during its 9 months operational period from February to October 2009, paralleled a number of significant developments that impact on the relevance of the ToRs provided to the consultant.

From February through to September, several drafts of the Guyana R-PLAN (now termed R-PP for *REDD Preparation Proposal*) were submitted to the World Bank FCPF for review and approval. This has been an iterative process, involving feedback from various international stakeholders as well as a great deal of dialogue and consultation with national stakeholders and communities. The R-PP provides funding for a number of measures all of which overlap the ToRs of this project. The R-PP for example includes development of a reference scenario as a major component (Component 7). This includes both baseline assessment (current biomass stocks and historical deforestation[1]) as has been under taken under this project (see Alder & van Kuijk, 2009b). It also includes proposals for a monitoring system (Component 8) that is based on the outputs from the first report of the present project (see Alder & van Kuijk, 2009a).

In December 2008, as study paper was also issued from the Guyana's Office of the President (OPG, 2008) which included estimates on projected deforestation rates under a 'business as usual' scenario. This paper was based on a substantial economic analysis by the consultants McKinsey & Co.

In parallel with the present project, Conservation International have undertaken a study for the Inter-American Development Bank on various aspects of REDD (CI, 2009a, b). This has included baseline estimates and projections with particular reference to the Georgetown-Lethem Transport Corridor (GLTC).

Both the McKinsey, and to a lesser extent, the CI reports (OPG, 2008, CI, 2009a, b) were based on older estimates of baseline biomass for the forest growing stock. McKinsey relied on the

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[1] To avoid unduly cumbersome language in this report, <u>deforestation</u> should be read as implying <u>deforestation and degradation</u>, unless the immediate context clearly indicates to the contrary, *ie* where they are being distinguished. Both imply the loss of tree biomass, but for degradation, the land unit may still be classified as forest, according to whatever criteria are applicable. We also use the term <u>forest loss</u> as a synonym for the combined effects of <u>deforestation and degradation.</u>

FAO published global Forest Resource Assessment (FRA) data from 2008, whilst CI extrapolated ter Steege's (2001) biomass estimates. The present consultants, in their second report for this project (Alder & van Kuijk, 2009b) updated ter Steege's (2001) estimates using the latest allometric models, and drew attention to the substantial underestimates in the FAO FRA data. It is understood (Holmgren, 2009, *pers. comm.*) that the FRA figures are now updated to agree with these most recent estimates.

The complex situation with regard to project development under REDD continues at the time of writing (September, 2009). Many aspects of REDD have yet to be defined, especially whether it will be market-based, involving in some part tradable carbon units, or solely fund-based. Related to this, the baseline or reference scenario mechanisms or standards that will be required for REDD are presently unknown, though three general techniques are possible, based on historical emissions, current stocks, or a projected reference scenario (CI, 2009a). In relation to Guyana, there are now a number of interested parties as donors or service providers, all offering somewhat overlapping proposals relative to monitoring and forest inventory. Forward progress depends on decisions by the various multinational institutions, most notably the World Bank FCPF, and possible bilateral donors to support specific proposals or to provide programme funding to the Government of Guyana. Much will be resolved in the next few months, hopefully, especially at or after the 16th Conference of Parties to the UNFCCC at Copenhagen in December 2009.

Projections have validity only relative to their assumptions, and without specific standards relative to REDD, there are a wide range of possibilities. The McKinsey report (OPG, 2008) and the CI (2009 a, b) reports represent two examples.

It is therefore proposed in this report to determine and evaluate reference scenarios based on historical deforestation rates and projected *business as usual* (non-REDD) economic development, and to discuss these in relation to the underlying drivers of deforestation and the feasibility of a zero-deforestation REDD scenario.

Previous estimates of deforestation and degradation

The McKinsey forecast

The McKinsey report (OP, 2008) provides a model for projected deforestation derived from the assumption that REDD compensation to Guyana must equal or exceed the Economic Value to the Nation (EVN) to be derived from intensive logging and land-use conversion. It estimates EVN to be between $4.3 billion and $23.4 billion[2] with a most likely estimate of $5.8 billion, equivalent to an annuity of $580 million at a 10% discount rate. From this, and an analysis of the resources available, the spatial sequence in which they can be converted, the likely ramp-up time to develop necessary infrastructure, and so on, it concludes:

> *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.* (OPG, 2008, p.14)

We may note that this report also calculated an Economic Value to the World of Carbon (EVW_c) for Guyana's forests of at least $104 billion, using a carbon value of $20 per tCO_2-e and based on estimated FRA forest areas and carbon stock data for Guyana then available (FAO, 2005). As noted in the introduction, FAO has since revised these figures upwards substantially. Although there are uncertainties in the figures, they show that EVWc is at least 20 times EVN. A REDD compensation of the order of $600 million per annum to Guyana would represent a very low cost form of carbon sequestration compared with the alternatives the report lists, such as hybrid/electric cars, biomass power plants, wind power, forest plantations, nuclear etc. (OPG, 2008, p18).

The Georgetown-Lethem Transport Corridor (GLTC) study

This major study by Conservation International (CI, 2009 a,b) looks at several scenarios that may arise as a consequence of the agreement between Guyana and Brazil to upgrade the Georgetown-Lethem road to an all weather, hard surface road allowing freight transport from Boa Vista and Manaus to be exported via Georgetown. This agreement is now a reality, and the Takutu Bridge, joining Brazil and Guyana for formally opened in September 2009.

The report looks at four scenarios (*op cit*, p 24):

- <u>The Nostalgic Past Scenario</u>. This is based on the extrapolation of historical low deforestation-rate trends, but as the report's authors notes has in fact already been overtaken by events and is therefore a remote probability.
- <u>The Business as Usual Scenario</u>. This is accelerating development with rising above the historical baseline.
- <u>Insufficient REDD</u>. This assumes REDD is implemented, but at a valuation that is too low to counteract the drivers from the road corridor.

[2] All $ values are in US $

- Effective REDD. This assumes REDD compensation that is adequate and policies that are as effective as may be possible in countering deforestation.

All scenarios assume a five-year initial period during which deforestation increases to its maximal level. For the *nostalgic past* scenario, 0.05% per year is assumed. For *business as usual* and *insufficient REDD*, a rate of 0.5% is estimated, and for the *effective REDD* scenario, a rate of 0.1% derived (CI, 2009b, p 105).

Historical rates of deforestation

The second report of the present project, Alder & van Kuijk (2009 b, p. 25 ff.) discusses changes in forest areas in Guyana. Forest type mapping and photogrammetry from country-wide aerial photography was reported by Rees (1963) as giving a total closed forest area of 181,430 km^2. This compares with 156,465 km^2 estimated from ter Steege's (2001) mapping of Guyana's forests from satellite imagery, SAR, and ground truthing from inventory plots. The total recorded forest loss over 39 years is 24,965 km^2, or 16% over 39 years. As an average rate, this amounts to 0.4% per annum.

Completely independently and objectively, Earthtrends (2003) have published a study based on satellite imagery using Landsat composites which estimate a loss of 3% from 1990 to 2001, or 0.3% per annum. These figures are in good agreement from those estimated by Alder & van Kuijk (2009b).

However, they do contrast with some quoted lower, or even zero rates based on the FAO FRA database, which has showed zero deforestation for long periods. This simply reflects the absence of provision of local information for Guyana, rather than any actual estimates of forest area. Both the McKinsey report and the CI (2009) study have relied on the FRA estimates as baselines. In the case of the McKinsey report, this does not invalidate their argument, as they do not use the historical baseline deforestation except to note that is negligible. In the case of the CI study, it is likely that their estimated rates are too low, since even the nostalgic past scenario should have a rate of 0.4% per annum forest loss, as the measured average rate of loss since 1963.

Drivers of deforestation and degradation

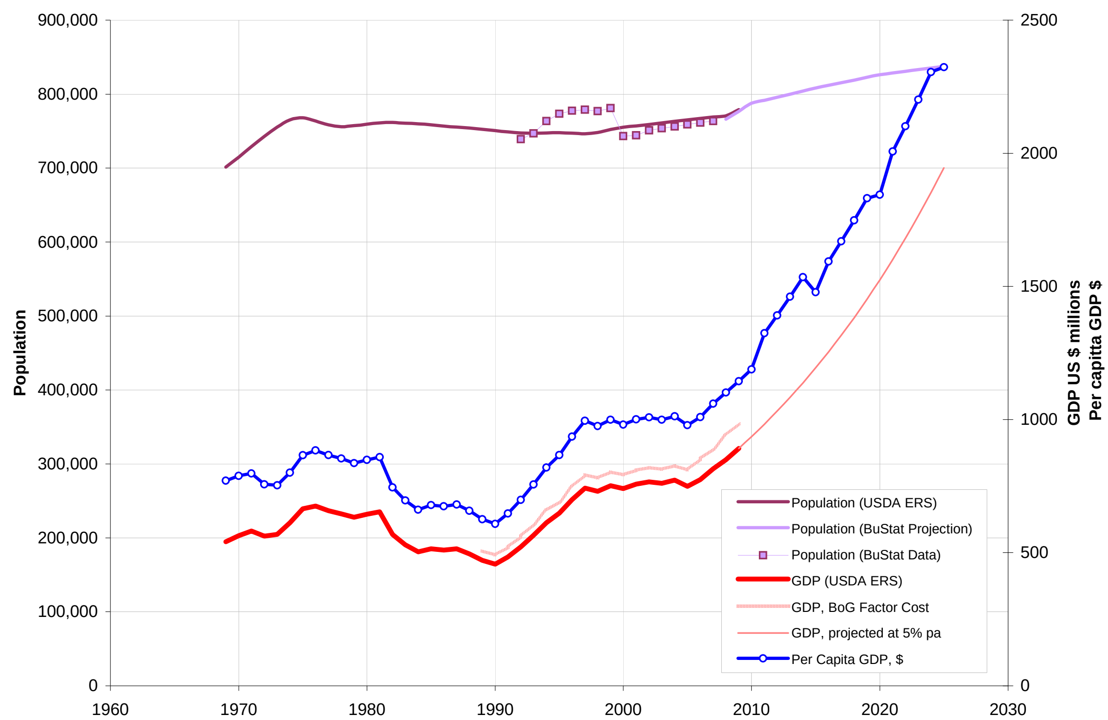
Land use change

Before undertaking projections or future estimates of forest biomass loss, we need to consider what are the basic drivers or causal processes. Why in fact has Guyana lost 16% of its forest cover since 1963, and too what extent are these factor still operative or being amplified under immediately foreseeable economic and environmental conditions?

Activities such as mining, agriculture, aquaculture, roads construction, housing, industrial construction, hydroelectric dams all result in a complete loss of forest cover and its conversion to other land use. In some cases this may not be totally permanent. Mined areas can be rehabilitated to forest once the minerals are exhausted, and agricultural lands can become tree crops grown for timber or allowed to revert to forest. However, in general, such conversion is permanent. Land use change can be planned or unplanned, but in all cases is closely associated with human economic activity.

Figure 1 shows GDP and per capita GDP from 1970 to the present, with projections through to 2025. Guyana's total population is also shown with projected growth[3].

Figure 1 : Guyana population, GDP and per capita GDP 1970-2009 and projections to 2025



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[3] These data are sourced from World Bank Statistics, via the USDA Economic Research Service website (http://www.ers.usda.gov/data/macroeconomics). Some confirmatory data is also included from Bank of Guyana

It can be seen that population has been relative constant at around 770,000 since 1970, with periods of slight decline in the 1980s. Likewise GDP actually declined over the period 1975-1990. During the 1990's it increased by 7-8% annually until 1998, then dropped again to slower growth until 2003, before starting to increase at 3-4% annually. Short-term projected growth is for 5% annually. The GDP figures are in 2005 US$. Data sources for the long-term series are from the USDA Economic Research Service (http://www.ers.usda.gov/data/macroeconimics) and for comparison, shorter terms data series from the Bank of Guyana Statistical Bulletins from 1998, 2002, 2006 (http://www.bankofguyana.org.gy). This latter is factor cost GDP which has been converted to US$ on a 2008 basis, and is therefore slightly higher than the USDA basis figures, though the relative trends are the same. Comparative population data is from the Guyana Bureau of Statistics. Projections for population are the high estimates of Beaie (2006). GDP projections from 2009 are made at a constant 5% per annum.

Guyana's relatively static population is due to net emigration. Again according to Bureau of Statistics figures, from 1996 to 2008, net emigration was 150,880, or 19.4% of the population, which was 777,648 in 1996, and had declined to 766,183 in 2008. The net surplus of births over deaths, or natural population growth, over the same period was 139,415.

We may also note that the main driver for emigration is the large difference in per capita income between Guyana and countries in which there is a well-established Guyanese diaspora. Guyana's per capita GDP in 2008 was $1,101, compared with United States $43,512, Canada $38,596, or the United Kingdom $39,207. Of neighbouring countries, Trinidad has a per capita GDP of $14,189, and Brazil $5,736. Driven by these disparities, net emigration seems likely to continue to be a factor. However, in considering population growth, we have used Baeie's (2006) high projections on Figure 1, which suggest a population in 2025 of 837,511.

How does this affect projections of forest loss? The historical 0.4% per annum (64,000 ha) rate of loss has occurred against this backdrop of an economy and population that have been relatively static. The loss rate was calculated over a horizon to 2001, and over this period the economy has grown by an average of 1.06% pa since 1969. Assuming a direct linkage of deforestation and degradation with economic growth, through mining, agriculture, logging[4], and infrastructure development, this suggests a ratio of 2.65 between the two rates. Applying this to a moderate 5% GDP growth, without REDD policies, we have a 1.9% rate of forest loss. Although GDP growth rates higher than this may be attained for periods (it averaged 8% from 1992-1998), long term rates against a background of global recessions are unlikely to be sustainable at above 5%, but two alternative scenarios are considered: A low average GDP growth of 3%, and a high growth scenario of 8%, both sustained over the long term. These are associated with forest loss rates of 1.1% pa and 3.0 % pa respectively.

Of course, economic growth only drives deforestation if other land uses have greater marginal value than standing forests managed for wood products, tourism, recreation and conservation. In developed economies such as the UK, standing forests have been all but destroyed over the

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Statistical Bulletins (GDP at factor cost, 1989 to present) and the Guyana Bureau of Statistics Statistical Bulletins of 1998, 2002 and 2006. Population projections are from Beaie (2006).

[4] We stress that logging is now controlled by the GFC Code of Practice and other restrictions, and is less destructive than during the historical era being considered. This is discussed further relative to the drivers of forest degradation.

centuries, and those small areas that remain have a high marginal value. There is thus a tendency for forests lands to increase in such countries, as with many of the European countries. In Guyana's development there would come a time where further deforestation would likewise be inhibited by the marginal economic value of the remaining forest. The McKinsey report considers these issues, and suggests that a balance in marginal values would likely occur with about 10% of the forest remaining in strict reserves or well-controlled timber concessions.

Endogenous drivers of forest degradation

Whereas land use change arises directly from human activity, processes such as fire, nutrient loss and disease occur from within the forest ecosystem itself, and lead to forest loss through a series of stages, as illustrated in figure 2 overleaf.

Although these processes are endogenous in the sense that the feedbacks arise from natural ecological processes, the initiating causes have human origin and are associated with human economic activity, in the same way as land use change discussed in the previous section.

Fire, changes in soil hydrology, and nutrient loss are the three inter-related factors. Fire may be caused by agricultural burning of grasslands, sugar cane, shifting cultivation etc, urban activities such as burning rubbish, recreational burning, or indirectly through glass bottles left as rubbish (which may focus sunlight). Fire can very rarely be ignited by dry lightning, but in almost cases there will be a direct or indirect human origin to forest fires.

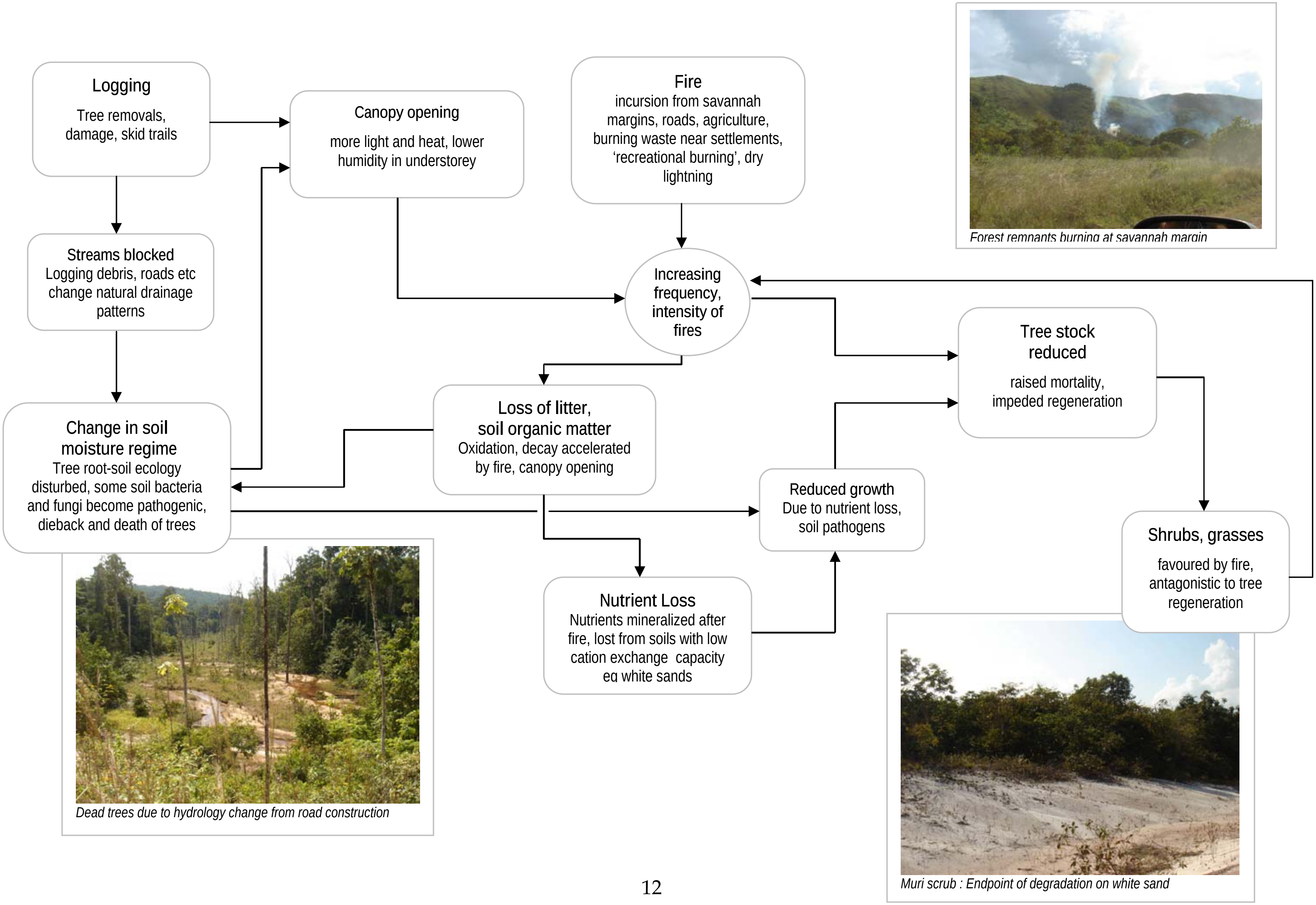
Fire causes changes in the forest, through opening the canopy, directly killing some sensitive trees, and killing regeneration. In addition, burning of litter mineralises nutrients which may then be lost to the ecosystem by leaching, especially on soils of low cation-exchange capacity (CEC) such as white sands. This also reduces soil organic matter, which itself reduces CEC.

If the forest is logged, canopy gaps are created at felling sites, landings and along roads which dry more intensively than closed forest. They also will be associated with felling debris, which increases fuel load. Fires in these areas will burn hotter and be more intense than elsewhere.

Logging and other construction activities, roads, settlements, electricity easements, pipeline developments, mines, hydroelectric schemes and the like will all cause changes in soil hydrology, by blocking, redirecting or changing natural watercourses or directly affecting groundwater. This can lead to tree deaths in several ways, either by drying or wetting roots excessively which are adapted to a different situation, or more subtly but more commonly, by changing the ecology of soil fungi and bacteria so that they no longer co-exist with tree roots in a symbiotic or commensal mode, but become pathogenic, leading to die-back and death. This can be commonly seen along the Linden-Mabura road as a result of blockage of streams by the road (see photo bottom left, Fig 2).

As the forest becomes more open, due to fire, reductions in fertility etc., then the intensity of further fires tends to increase, accelerating the process. The end point will be a scrub vegetation or grassland. In Guyana, Muri scrub seems to be the stable fire climax on white sands, whilst on more fertile soils it will be grassland. Grass is highly adapted to fire, and some species are also antagonistic to tree seedling establishment.

Figure 2 : Drivers of endogenous forest degradation



Forest remnants burning at savannah margin

Dead trees due to hydrology change from road construction

Muri scrub : Endpoint of degradation on white sand

Figure 3 : Approximate areas of greater forest degradation risk

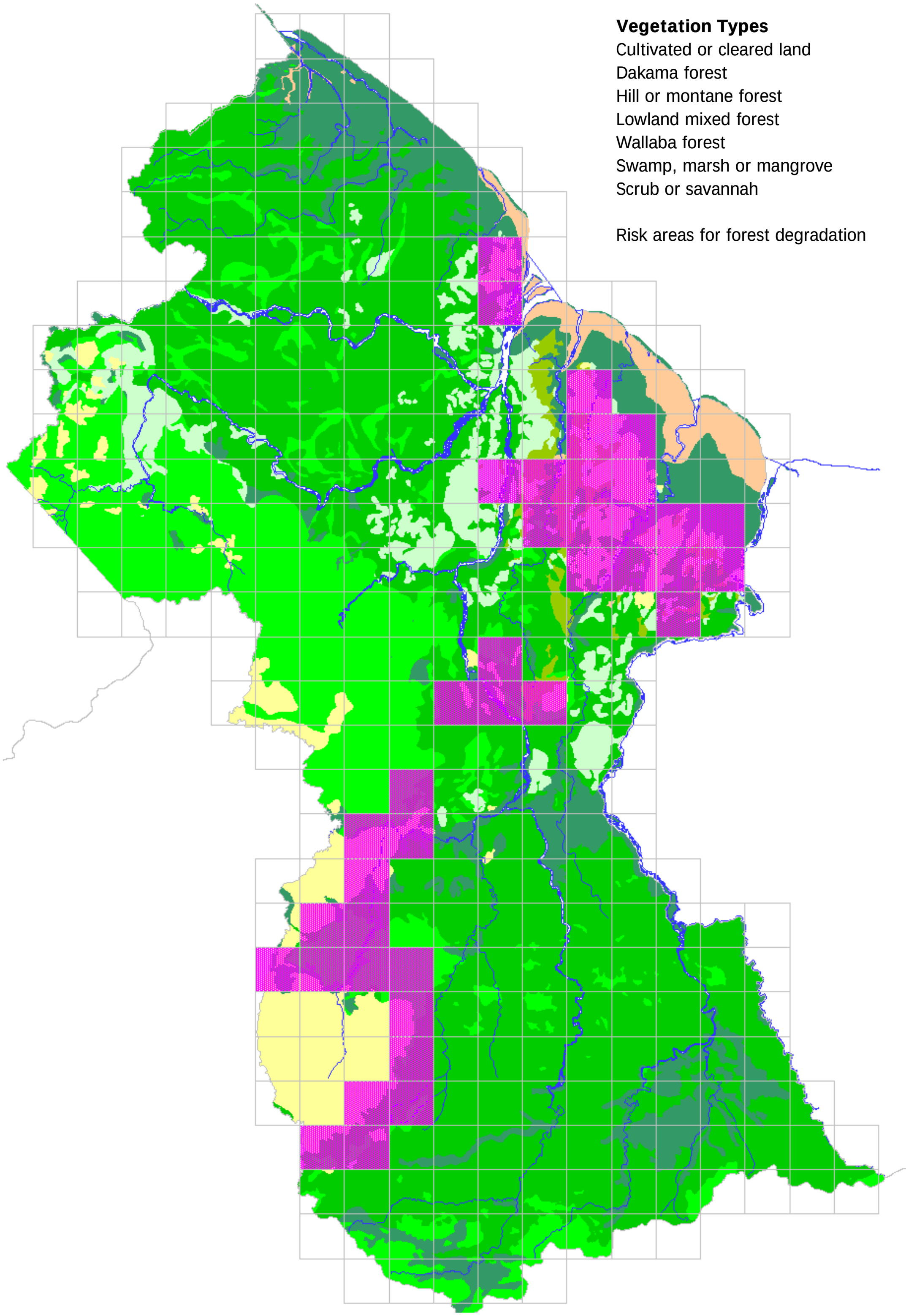


Figure 3 shows the areas considered to show active forest degradation associated with the causal processes described in Figure 2. A 25 x 25 km tiling is used in risk estimation. High risk areas include savannah margins in the drier areas of southern Guyana, where there are frequent fire incursions into adjacent forest. In central and north eastern Guyana, areas which combine patches of savannah or scrub intermingled with forest, low fertility soils are considered at risk.

REDD policies and deforestation drivers

In considering the projected emissions in the next section, the comparative scenario is the REDD one, with zero forest loss. Can this be achieved in practice? Component 3 of Guyana's R-PP document outlines the REDD strategy, but makes the point that "*The activities for the REDD Strategy have not been fully defined and are expected to be as one of the outputs of the REDD Preparation Process*"[5]. However, some points can clearly be made:

- *Zero deforestation is fully achievable*. Many of the wealthier countries, after centuries' of severe deforestation, have now established substantial net growth in their forest areas.
- *Zero deforestation will require substantial financial commitment* to forestry, land use planning, surveys, hydrometerorology, etc. including training of professionals at all levels, increased staff, better equipment, and continuing scientific research to improve understanding and techniques.
- *The Low Carbon Development Strategy recently announced by Guyana Government is an initiation of this process* and a commitment to it.
- *Zero deforestation implies active rehabilitation* of mined areas, the management of currently degrading areas (see Fig 3) to offset endogenous processes through fire management, soil improvement, replanting with suitable pioneer species and so forth.
- *Zero deforestation implies a strict land-use and forest planning regime* at all levels, in which any unauthorised structure, land use or forest activity must be reversed, and in which perpetrators may be subject to severe penalties. To be politically feasible, this requires (a) Considerable public consultation and education, and (b) Alternative pathways and employments.
- *Since Guyana is a democracy, the public must see the delivery of real substantial benefits* from REDD in terms of employment and economic growth.

We necessarily assume for the purpose of the scenario analysis that these points are fully recognised.

[5] FCPF R-PP Guyana September 7 2009 revision, page 34.

Projected emission scenarios

Baseline carbon estimates

In an earlier project report (Alder & van Kuijk, 2009b), baseline carbon values for the major forest types were calculated, and are shown in detail in Tables 13 and 14 of that report. Key figures are summarised in Table 1 opposite. The change from high forest to a scrub or savannah formation, as may be the end-point of forest degradation, involves a net loss of 525 t CO_2-e ha^{-1} in above ground biomass, or 733 t CO_2-e ha^{-1} considering also roots, necromass and soil carbon.

Table 1 Carbon stock values for projections

Measurement basis	Carbon stock $t\ CO_2\text{-}e\ ha^{-1}$ High forest	Scrub savannah	Net loss
Above-ground biomass	664	139	- 525
Biomass including roots	810	169	- 641
Total including soil carbon and necromass	997	264	- 733

For the purposes of the projections, conversion to agriculture, mining or urban land use are considered equivalent to degradation to scrub or savannah formations in terms of carbon loss. The loss of tree biomass, including roots, is used as the reference figure, being both a realistic basis and a median value. Figures are always given in terms of CO_2-equivalents for consistency of valuation with carbon market units.

Carbon valuation

Certified Emission Reductions (CERs) were valued at €13.06 per tCO_2 spot price 25th September 2009, on the European Climate Exchange (see http://www.ecx.eu/EUA-CER-Daily-Futures-Spot). Using an exchange rate of 0.6808 $/€ (see http://fx.sauder.ubc.ca/supplement.html), this gives a price per tonne CO_2-e of $19.18. The McKinsey report used an assumed price of $20 per tonne, which is very close to this current figure.

However, the carbon price may fluctuate, and can certainly be expected to increase as low-carbon policies become more widespread and forceful in coming decades. The carbon price under REDD may also not ultimately be directly linked to the CER market, and may therefore have a lower or higher value.

REDD and non-REDD scenario inception periods

The REDD scenario is one of zero deforestation and degradation, as discussed on page 14. This will take a number of years to achieve, involving many legislative and operational changes, economic incentives, and cultural adaptations. It is a process which has already begun with the Low Carbon Development Strategy (LCDS) which has been adopted in Guyana as Government policy. For the purposes of the scenario analysis, it is assumed that full implementation of REDD requires ten years, and there is a linear improvement from the current deforestation rate to a zero rate.

The alternative scenarios associated with non-LCDS growth strategies involve nothing more than a relaxation of Government controls and restrictions on land use and forest exploitation.

They can therefore begin to become effective immediately if they are deemed appropriate policies.

Comparison of scenarios

Table 2 shows the calculated rates of emission due to forest loss under five scenarios, together with the equivalent monetary value at today's carbon price of $20 per tCO_2-e. The most conservative assumption in a *laissez-faire*, non-REDD situation, is that of a continuation of the historic rate of forest loss of 0.4% pa, as has been happening since at least 1963.

Table 2 : Emissions scenarios with different deforestation rates

Based on average net carbon loss of 641 t CO_2 ha^{-1} with change from forest to savannah, scrub or agriculture

Scenarios	Deforestation rate % / yr	Deforestation rate ha / yr	Annual Emissions t CO_2	Carbon Market Value $ / yr
Continue at historic rate of loss	0.40	62,586	40,117,626	802,352,520
3% GDP growth, no REDD	1.10	172,112	110,323,472	2,206,469,430
5% GDP growth, no REDD	1.90	297,284	190,558,724	3,811,174,470
8% GDP growth, no REDD	3.00	469,395	300,882,195	6,017,643,900
REDD, zero loss	0.00	-	-	-

This amounts to annual emissions from deforestation and degradation of 40 million t CO_2-e, with a market value of $802 million at current prices.

This conservative scenario is quite unlikely, and relates to average GDP growth over the Past 40 years of about 1% (see page 9). A much more likely scenario is that of average 5% GDP growth. With no REDD policies, this would involve an expansion of infrastructure, settlements, mining areas and agriculture, with accelerated logging to maximize forest industry revenues, and would involve an estimated forest loss of 1.9% per annum, based on the gearing of forest loss with GDP over the past 40-50 years. This implies annual emissions from Guyana's forests of 191 million t CO_2-e, with a current market value, annually, of $3.8 billion.

GDP growth and deforestation rates may well be higher than this for periods of a decade or more. Growth of around 7% was sustained during the 1990's for several years, though this was largely a recovery from very poor economic policies that had impoverished the country during the 1975-1990 period. The recent Brazil-Guyana accord on development of the Georgetown-Lethem road, with the likely establishment of a major container port and export outlet, coupled with the current high price of gold, are setting the scene for major expansion of agriculture, logging along the GLTC and mining throughout Guyana. Inundation of forest areas for hydropower is likely to be another factor contributing to forest loss. This higher growth pathway is associated with average annual forest losses of 3%, or 301 million t CO_2-e, with a current market value, annually, of $6.0 billion.

Conclusions

This report builds on an earlier baseline assessment of forest carbon in Guyana (Alder & van Kuijk, 2009b). That amended earlier estimates of forest carbon by ter Steege (2001) to give the average carbon values summarised in Table1 (page 15). It also estimated the historical rate of forest area loss, through two independent sources (aerial photo interpretation, Rees, 1963) and satellite imagery (EarthTrends, 2003) as 0.4% per annum.

The drivers for forest loss are examined. Land use change can be related to economic growth, as forest land is converted for settlements, infrastructure, agriculture and mining. Forest degradation, resulting ultimately in scrub or savannah formations with little tree cover, is explored on pages 11-14. It involves endogenous processes of canopy opening, microclimate change and nutrient loss linked to externally driven factors such as logging and fire. Fire itself is associated with agricultural, residue disposal or recreational burning and therefore linked to human economic activity. Forest loss from all causes can therefore be seen as geared to GDP growth. The average 0.4% forest loss since 1960 has been linked to an average 1.09% GDP growth, giving a ratio of 2.65 between GDP growth % and forest loss %.

The reference scenario that will be adopted for REDD remains a matter for inter-governmental negotiation. It may be either the historical trend of deforestation (0.4% in Guyana), or based on expected future forest land clearances linked to economic development. For the latter case, three scenarios are considered: 3%, 5% or 8% average GDP growth, with the median path the most likely long-term trend. For a historical deforestation reference scenario, annual losses are estimated at 40 million t CO_2 yr^{-1} . This is based on a per ha loss of 641 t CO_2 ha^{-1} as land use changes from high forest to scrub, savannah or agriculture. With current carbon values of $20 per t CO_2, this amounts to a financial valuation for fully effective REDD (zero forest loss) of $802 million per annum.

This is the most conservative reference scenario. A more realistic baseline will be one that is based on non-REDD economic growth at a median 5% per annum. This would result in a rate of forest loss of 1.9% per annum, and emissions from deforestation and degradation of 191 million t CO_2 yr^{-1} , with a current market value of $3.8 billion per year.

These figures may be compared with the McKinsey report (OPG, 2008) estimate that by following an accelerated, non-REDD development pathway over a 25-year period, forest products and other benefits would yield the equivalent of an annuity of $580 million, and that this therefore represented the opportunity cost of REDD to Guyana. Whilst the figure of $580 million is somewhat less than our estimate of $802 million as a most conservative REDD reference scenario, they are clearly of similar magnitude, although the figures are arrived at from different methods of analysis and different basic assumptions.

The feasibility and modalities of a zero-deforestation REDD economic policy are considered on page 14. It is noted that zero-deforestation is by no means idealistic, but is fully achievable, with many developed economies now having substantial net gains in forest area as a result of policies enacted over the last two to three decades. Furthermore, the Guyana Government's Low Carbon Development Strategy is a practical and strong first step in this direction. However, it does require major financial and legislative commitment to strong land use planning and enforcement, effective and scientific forest management backed by strong research capability into silviculture and ecosystem management, and financial inducements to the private sector to enable forest rehabilitation, protection and active afforestation in sensitive or degraded areas. At all levels there is a requirement for capacity development, leading to increased numbers of professional and field staff. This in turn requires substantial financial resources which will themselves depend on the realisation of the international REDD mechanism.

References

Alder, D; van Kuijk, M (2009 a) Proposals for a national forest biomass monitoring system in Guyana. Guyana Forestry Commission, consultancy report, 27 pp.

Alder, D; van Kuijk, M (2009 b) A baseline assessment of forest carbon in Guyana. Guyana Forestry Commission, consultancy report, 34 pp.

Beaie, ST (2006) Population projections, Guyana, 2005-2025. Bureau of Statistics, Guyana. 11 pp.

CI (2009a) South American Regional Infrastructure Development, Forests and REDD: Implications for Guyana. Consultancy Report for the Inter-American Development Bank and Government of Guyana under Technical cooperation Agreements ATN/NP-10749-GY and ATN/NP-10750-GY. 58 pp.

CI (2009b) Biodiversity mainstreaming through avoided deforestation : Guyana case study - Compilation of technical reports. IDB (Bmad-Gcs) Project (Gy-T1058) Technical Document. 334 pp.

EarthTrends (2003) Forests, Grasslands, and Drylands—Guyana. EarthTrends Country Profiles. World Resources Institute. See http://earthtrends.wri.org

FAO (2006) Global Forest Resources Assessment 2005. *FAO Forestry Paper* 147, 350 pp + Annex 3 Tables, 305 pp. Online at: ftp://ftp.fao.org/docrep/fao/008/a0400e/a0400e00.pdf.

GFC (2009) Guyana R-PLAN. Online at http://wbcarbonfinance.org/docs/R-PLAN_Guyana_submission_Final.doc

IPCC (2006) Guidelines for National Greenhouse Gas Inventories : Volume 4 - Agriculture, Forestry and Other Land Use. http://www.ipcc-nggip.iges.or.jp/public/2006gl/vol4.html

OPG (2009) Saving the world's forests today: Creating incentives to avoid deforestation. Office of the President, Republic of Guyana, December 2008, 35 pp.

Rees, TI (1963) Report to the Government of British Guiana on Forest Inventory. FAO, Rome. Extended Program of Technical Assistance Report no. 1762, 67 pp.

ter Steege, H (2001) Biomass estimates for forests in Guyana and their use in carbon offsets. Iwokrama Research Report 2001-01, 43 pp.

VCS (2007) Guidance for Agriculture, Forestry and Other Land Use Projects. Voluntary Carbon Standard. http://www.v-c-s.org.

Annex A - Terms of Reference

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1. For Guyana's main forest types and other land uses compile models for carbon sequestered in woody biomass using methodologies that are IPCC compliant and documented with coefficients and expansion factors according to IPCC Tier 1-3 sources.
2. From existing GFC historical inventory datasets, vegetation and land use maps, remote sensing coverage and other relevant information, compile a baseline assessment of historical carbon emissions from deforestation and degradation in Guyana from 1950 to the present, using the models from 1.
3. Develop future projections of emissions as baselines based on status quo and reductions under various scenarios of improved forest management and incentives to reduce deforestation and degradation.
4. Develop systems for updating biomass field estimates across all land uses including estimates from deforestation and degradation.
5. Establish carbon, biodiversity and social criteria and spatially-explicit data to target incentives to the highest outcome potential.
6. Provide a detailed methodology, technical support and training for a national biomass monitoring system based on permanent plots and remote sensing including project level activities, and establish a capacity-building and monitoring plan, and protocol for the full implementation of this system.
7. Develop an integrated framework for monitoring data at the national level, to maintain and track statistical and spatial information on both deforestation and degradation, and positive protective and recuperative measures.
8. To ensure that all outputs from activities 1-5 are compliant with REDD reporting requirements and technical standards, to maintain open and transparent information on all methodologies, databases and technical coefficients, to produce technical reports as required on these matters.
9. Advise on the identification and implementation of specific areas of engagement through networking and communication, in conducting workshops with other countries and key entities/bodies such as the UNFCCC SBSTA and other key entities/bodies, to build support of Guyana's baseline and methodology.
10. Establish structure for implementation of pilot activities including the development of clear criteria for evaluation of suitable pilot projects, supporting capacity building exercises, and implement site level monitoring of plan and methodology.
11. Evaluate alternatives that address drivers of deforestation and degradation in demonstration sites.
12. Advise on the integration of REDD and land use planning into rural and community development planning.