INTERNATIONAL CLIMATE INITIATIVE

Regional project
Climate Protection through Forest Conservation
in Pacific Island Countries

On behalf of
Federal Ministry for the Environment, Nature Conserv and Nuclear Safety
of the Federal Republic of Germany

REDD FEASIBILITY STUDY

FOR CENTRAL SUAU, MILNE BAY, PAPUA NEW GUINEA

February 12, 2013

SPC Secretariat of the Pacific Community

Growing the Pacific. Growing our future together. L'Océanie, le terreau de notre avenir.
SPC Land Resources Division

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

Report prepared by Scott Alexander Stanley (scott.alexander.stanley@gmail.com)

On behalf of SPC/GIZ Regional Project
"Climate Protection through Forest Conservation in Pacific Island Countries"

P.O. Box 14041, SUVA, Fiji

e-mail: karl-peter.kirsch-jung@giz.de

ACRONYMS AND ABREVIATIONS

BAU	Business as usual
IFM	Improved Forest Management
LtPF	Logged to protected
OCCD	Office of Climate Change and Development
PDD	Project Design Document
PES	Payment for Environmental Services
PNGFA	Papua New Guinea Forest Authority
REDD	Reduced emissions for deforestation and degradation
RIL	Reduced impact logging
RSPO	Roundtable on Sustainable Palm Oil
tC	Tons carbon
tCO_2e	Tons carbon dioxide equivalent
VCM	Voluntary carbon market
VCS	Voluntary Carbon Standard
VCU	Verified carbon unit

TABLE OF CONTENTS

EXECUTIVE SUMMARY

This feasibility study comprised three phases – 1) the planning and land cover analysis phase, 2) the field phase to ground truth the first iteration land cover map and gather contextual information, and 3) the analysis and write up phase. The land cover analysis indicated that 38,700 ha was in primary forest, with roughly 3,000 ha covered in secondary forest, and another 18,200 ha dedicated to agriculture. The field phase took place from October 2nd – 12th with four communities being visited and two forest areas rapidly surveyed. During the forest survey, 28 basal area sample points (3P method) were taken using a cruising prism that provided a quantitative and rapid method to check the land cover map. Of the 28 sample points, only two points didn't correspond with the first iteration map. Information gained during the field phase allowed for the most appropriate VCS-approved methodology to be chosen, which was VM0011 that considers the business-as-usual scenario (baseline) to be an industrial logging concession and the with-REDD project option to protect the area and not log it. While PNGFA has planned for this area to be a RIL demonstration site that reduces emissions through improved planning, road construction, and felling techniques, no VCS pending or approved methodologies for RIL are available, and as such the emission reduction potential could not accurately be estimated. However, from a range of RIL-related publications, the emission reductions should be from 30% to 50% of that calculated for a logged-to-protected project type.

The analysis phase using data from a PNGFA timber inventory in Central Suau indicated a mean aboveground biomass of 350 t/ha (>20cm DBH), which is consistent with other studies in PNG. During logging, the spreadsheet model designed for this study suggested that at least 50 t/ha of biomass would be extracted in logs, while another 70 t/ha would die from logging-induced mortality or be cleared for roads, skid trails, and logging decks. In total, logging would eliminate 30% of the biomass, which is corresponds with several other PNG studies.

Applying a logged-to-protected scenario in conjunction with regrowth data from PNG studies suggested that baseline emissions would range from 177 to 194 tCO_2e per hectare over the first ten years. Once non-permanence withholdings and leakage were deducted, the net carbon credits (verified carbon units – VCU) were estimated to vary from 124 to 136 VCU/ha over ten years. Gross revenue projections applied three price scenarios for the VCU sales, a low price of $3/VCU that corresponds with actual market prices in 2011 for projects that have been validated and forward selling their credits. A medium price of $6/VCU and a ceiling price of $9/VCU were also input into the

spreadsheet model. $9 per VCU coincides with the 2011 market price for projects that have been VCS verified with issued credits. Under the low price scenario gross revenue would range from $360,000 to $393,000/year, while for the medium price scenario revenues range from $720,000 to 787,000/year. At $9 per VCU, gross revenue ranges from $1.08M to $1.18M.

Using population data published in the Milne Bay Provincial Forest Plan, Central Suau's population in 2008 was estimated to be 6,619 and assuming a 2.7% percent annual growth, in 2012 the population would be 7,400 inhabitants. Assuming five people in per household, roughly 1,500 households would be located in Central Suau. Dividing the gross revenue by the number of projected households provides an estimate of potential annual revenue per household and ranged from a low of $228/year to $750/year. At the mid and high price scenarios, the contribution to annual household income is significant given the limited opportunities in this isolated area. Even at the low price scenario, once other benefits from the project are factored in, such as enhanced tenure status gained through Incorporated Land Groups, the REDD option should be viewed as socially, technically, and environmentally feasible.

The primary recommendation to come out of this study is that a VCS Improved Forest Management (IFM) project that focuses on RIL would not currently be technically feasible, since there are no approved or even pending methodologies. Secondly, even when VCS eventually approves a RIL methodology, the estimated revenue from carbon credits would most likely be insignificant, approximating 30% of the abovementioned totals. From an environmental perspective, correctly implementing RIL would take years to accomplish, and in the meantime, generate serious environmental impacts including high erosion, increased potential of landslides, and a degradation of the water quality. During interviews with Central Suau community leaders, they universally stated that while they desired increased economic options they didn't want to sacrifice the area's pristineness in return. The option of a VCS Logged-to-protected project type could provide significant income, while still maintaining vital ecosystem services. The emission reduction estimates presented in this study are based on an approved Logged-to-protected VCS methodology

1. INTRODUCTION

The German Agency for International Development (GIZ) and the Secretariat of the Pacific Community (SPC) have been supporting Papua New Guinea's efforts to establish REDD+ mechanisms that will reduce emissions while providing alternative revenue options for rural areas. As part of this support, GIZ has committed to developing a Project Design Document (PDD) for Central Suau demonstration site in Milne Bay Province. Suau is one of five national REDD demonstration sites selected through a multi-institutional assessment. Typically, the first step in developing a PDD is to conduct a feasibility study to assess whether there are technical, social, and/or financial constraints that could significantly impede a REDD project. Forest Carbon Consultants was awarded the contract to conduct the feasibility study, of which this draft report forms the principle deliverable.

The tasks of this feasibility study are to:

1. Provide recommendations on whether an existing GHG methodology approved by the VCS is compatible for the project site.
2. Assess aspects related to whether the project would be eligible under VCS criteria with a focus on additionality, leakage, and permanence in the project.
3. Determine the most likely land use scenario and provide a rough estimate of GHG emissions from those baseline activities.
4. Provide a first iteration rough estimate of the 'with project' GHG emissions and assess the financial feasibility of the potential revenue generated carbon credit sales on the voluntary market.
5. Even in the event that the project would not be feasible under the stringent criteria of the VCS, it may still have significant merit for climate change mitigation and conservation reasons and the consultant should consider suitable certifications and broader implications of whether bilateral support is warranted.
6. Using freely available satellite imagery and imagery that the project partners have on hand, provide a fist iteration of the forest stratification that would correspond to statistically significant differences in biomass between strata. Conduct rapid ground-truthing of the stratification.

7. Based on previous biomass surveys done in similar forest, provide a rough estimate of the number of sample plots needed to comply with VCS's criterion of +/-10% sample error with a 90% level of confidence.

Papua New Guinea was an early leader in promoting the concept of REDD within the international climate change negotiations and has been instrumental in its acceptance as a mitigation strategy. However, as a result of political tactics, mismanagement and illegal carbon trade within PNG, efforts for voluntary carbon market projects (VCM) were frozen, while demonstration activities to inform the national readiness process were stalled. It also caused bilateral donor agencies to hold off on providing REDD funding. As a consequence of the abovementioned problems, starting in 2010, the national government adopted a policy of not promoting or actively supporting voluntary carbon market REDD projects. However, the governance structure for planning and implementing REDD+ readiness in PNG is now matured and the Office of Climate Change and Development (OCCD), responsible for developing REDD policy, along with the PNG Forest Authority, responsible for REDD implementation, are realizing that VCM projects can provide valuable lessons while generating revenue sources for impoverished rural communities.

It should be noted that feasibility studies typically allow for about 10 to 14 days in the field to gather data on the forest conditions and types, to ground truth the first iteration benchmark map, and gain contextual information on the socio/political aspects of the project. Due to several delays, only five days were spent in the project site where some limited ground truthing was conducted and five communities were visited to meet and interview village leaders.

This report is divided into the following sections: project site description, brief discussion on the current status of the voluntary carbon market, eligibility analysis under the VCS guidelines and the selected VCS-approved methodology, legal analysis, potential to generate verified carbon units (VCU), cost/benefit analysis, and recommendations.

2. PROJECT SITE DESCRIPTION

2.1. LAND COVER TYPES

Central Suau, located in Alotau District in Milne Bay Province comprises ~ 64,000 ha of land. An initial land cover analysis was conducted, which indicated that 60% of the area is in pristine primary forest, with an extensive mangrove area representing nearly 5% of the total area, found mostly in Mullins Bay (Table 1 and Figures 1 - 2). A traditional system of shifting cultivation is practiced by the majority of the 28 villages, and has had a surprising impact on the area, with 28% of it under cultivation (~18,000 ha). Another 3,000 ha are classed as secondary forest, degraded primary forest or forest gardens. A detailed description of the land cover analysis is found later in this report.

Table 1 Breakdown of land cover types in Central Suau

Land Cover Types	Area (ha)	Percent
Primary Forest	38,706	60.3%
Degraded Primary or Secondary Forest	3,042	4.7%
Mangrove	3,030	4.7%
Agriculture	18,222	28.4%
Grass	13	0.0%
Rock	2	0.0%
Sand	8	0.0%
Unclassified (clouds)	1,217	1.9%
Grand Total	**64,238**	100.0%

Figure 1. 2010 LANDSAT image of Central Suau (yellow line), also showing large palm oil estates by New Britain Palm Oil Co. to the north of Suau (source: Geobook Milne Bay, UPNG Remote Sensing Center, 2010)

Figure 2 Land cover types identified from LANDSAT 2010, 2011, and Google Earth imagery (2012).

2.2. CURRENT AND PLANNED LAND USE DYNAMICS IN PROJECT AREA

As stated earlier, smallholder agriculture provides both subsidence and cash incomes to the majority of the villagers in Central Suau. Almost all of the 28 communities are located right on the coast and typically a narrow flat strip of land is used for housing. In most villages, within 500 meters of the coast, the flat areas give rise to hills and small mountains where much of the agricultural production takes place. As population pressures have swelled in the last 20 years, increasingly steeper areas are being cultivated causing high erosion and more frequent land slides. The principle crops are cassava and other tubers, hill rice, betel nut, and corn.

One recent development that will have wide-ranging impacts is the upgrading and extension of two roads. On Central Suau's eastern side, the dirt road to Leleiafa is being upgraded and extended to Fife Bay. This will not only provide road access to Fife Bay, but also Avololo and SeaSea Avololo, along with close road access for several more communities. These communities have been somewhat isolated and to reach Alotau had to first walk a day to Leleiafa, and then catch an available car ride to Alotau or take a boat. On the western border of Central Suau, a second road is being upgraded in the Modewa ex-timber concession. This will allow the western most communities much easier access to the markets of Alotau, and with improved access to major markets comes the opportunity to generate increased revenue selling agricultural crops in the commodity markets. However, the downside is that increased market access will correlate with the desire to augment cultivated areas and drive higher deforestation rates (Arnold et al. 2011).

To the north of Central Suau as can be seen in the LANDSAT image in Figure 1 are various large oil palm estates totaling 13,500 ha that are owned by New Britain Palm Oil. The company has an extensive out-grower program with 700 farmers participating that includes roughly 2,000 additional hectares. However, given the steep topography in much of Central Suau, oil palm doesn't represent a serious deforestation risk, which was confirmed by the Managing Director for these estates.

While palm oil isn't seen as a deforestation driver for Central Suau, it has been blamed for the sharp reduction in fish and crab catches in Mullins Bay. In Figure 1, mangroves are distinguished by their bright green color as seen surrounding Mullins Bay, and New Britain's estates practically abut this forest type. The estuary flowing into Mullins Bay is almost entirely encircled by oil palm estates and any runoff of fertilizer, herbicides, and pesticides would flow directly into the estuary and out into the Bay. Nearly every villager interviewed in Leileiafa and Dahuni mentioned that the reductions in crab catches were their most serious problem since in those villages the primary income source is through selling crab, followed by fish. Besides the abovementioned villages, there are several more communities with livelihoods dependent on crabbing and fishing from Mullins Bay. While not directly related to REDD, any project working in Central Suau will need to take this issue into account. New Britain Oil Palm is a Roundtable on Sustainable Palm Oil (RSPO) member and the Managing Director was indeed concerned about the impact that their estates may have on the Bay, and will be commissioning studies from a leading Australian university. Teasing out the causes of the crab declines will not be easy, and besides runoff from the palm oil estates, a burgeoning influx of migrant workers drawn to those same estates may have caused a spike in demand that led to overfishing of various species.

The PNG Forest Authority identified Central Suau as an area for sustainable timber management under a 35-year natural forest concession. Clans own the forest of Central Suau like most of PNG, and the PNGFA is obligated to follow a 10-step process of gaining the timber rights from these clans before any concession can be granted. As part of the approval process, the clans must first demonstrate legal ownership of these forests through a process termed Incorporated Land Groups (ILG). PNGFA had begun to facilitate the ILG process and conducted a timber inventory in Central Suau. Both of the aforementioned activities are administratively time consuming and require substantial financial resources; which clearly demonstrate that the State's intention was to move forward with developing an industrial scale timber concession.

In 2010, with renewed commitment toward developing REDD demonstration sites, the plans for Central Suau were changed to a REDD demonstration site. Nevertheless, in interviews with villagers, every single respondent indicated their desire to improve their livelihoods and provide better educational opportunities for their children, and while they didn't want their forest destroyed, these villagers would have allowed a timber concessionaire to operate as long as they gained substantial financial benefits.

3. CURRENT STATUS OF THE VOLUNTARY CARBON MARKET

The conceptual framework for how carbon credits are accrued, monitored, and eventually retired under many national REDD schemes is still evolving, and a compliance market for carbon credits won't come into existence before 2020. However, a voluntary carbon market (VCM) currently exists and could both provide financial benefit to impoverished rural communities along with being an incubator of ideas and testing ground for monitoring and revenue distribution methods. Development of various national REDD components could be accelerated applying the lessons learned from projects, along with helping to inform policy enactment and reform.

In 2011 the voluntary carbon markets recorded the second highest amount of carbon credit transactions, totaling $576 million (Peters-Stanley and Hamilton 2012). It should be remembered that the world's worst recession since the Great Depression has occurred over the last five years, and has had some impact also on the carbon markets. Carbon credit transactions peaked in 2008 with slightly over $600M in sales, and despite the long-term economic downturn demand has risen each year since then with 2012 seeing the price almost reach the 2008 peak. REDD-derived credits continue to be in demand with a higher mean price at credit issuance of $9/ton CO_2 compared to energy-derived credits due mainly to the generation of social and ecological co-benefits and the charismatic nature of some projects (Peters-Stanley and Hamilton 2012).

4. ELIGIBILITY ANALYSIS

4.1. SELECTION OF A THIRD PARTY STANDARD

In 2011, of the total issued carbon credits on the voluntary market, 47% of all transactions used the Verified Carbon Standard (VCS); by far the most commonly used standard in the world. The majority of institutional investors and bilateral development agencies view VCS as the most demanding standard available that ensures scientific rigor is applied to quantifying the carbon pools and estimating future emissions. In PNG, given the Melanesian system of clan ownership of almost all forestlands, a standard that focuses on the social and ecological aspects of REDD projects is also recommended. Compliance to the Climate, Community, and Biodiversity (CCB) Standard ensures that best practices related to the social and ecological aspects are achieved in a REDD project. The PNG government could reduce the risk of any further scandals and ensure that communities gain substantial benefits by requiring that a REDD project achieve both VCS and CCBA validation within a set amount of time. Both standards use third party certification bodies to first validate the calculations and estimates made in the PDD; followed a few years later by verifying that the estimated emission reductions are actually being achieved. For the purposes of this feasibility analysis, VCS guidelines and VCS-approved methodologies will be used. Of note, is that VCS and CCBA recently announced an initiative to streamline dual validation and have released a template designed so that only one Project Design Document needs to be written for both standards[1].

4.2. ELIGIBILITY CRITERIA UNDER IMPROVED FOREST MANAGEMENT

REDD projects are categorized by VCS according to their 'business-as-usual' scenario, or often termed the baseline case. In essence, determining the baseline case requires answering the question – what is the most likely land use activity that will happen in the project site? As mentioned earlier in this report, PNGFA had conducted a timber inventory and initiated discussions with clan leaders to gain their approval for an industrial logging concession. There is little doubt that in the absence of carbon financing, this area would become a timber concession. Therefore, the most likely business as usual scenario would be commercial logging of Central Suau for at least 20 years. Applying VCS guidelines, this type of scenario fits into the Improved Forest Management (IFM) category. Improved

---

[1] (http://v-c-s.org/sites/v-c-s.org/files/VCS%20CCB%20Guidance%20Project%20Development%20Process.pdf)

forest management projects are somewhat unique in that there isn't a change in land use classes driven by deforestation, but rather the baseline and project scenarios assume that forest will stay as forest; thus the focus is on reducing forest degradation commonly caused by logging. Besides degradation and its associated emissions, eligible activities are those that increase sequestration and both activities must be on forestlands managed for wood products under a license granted by government.

To be eligible for an IFM project the following VCS criteria need to be met:

- Forest management in the baseline scenario must be planned timber harvest;
- Planned timber harvest must be estimated using forest inventory methods that determine allowable harvesting intensities (m^3 ha^{-1});
- The boundaries of the forest land must be clearly defined and documented;
- The baseline condition cannot include conversion to managed plantations.

The latest version of VCS's Forestry guidelines lists four major activities that can qualify under the IFM category, which are:

1. **Reduced impact logging (RIL)**: encompasses a comprehensive suite of activities that range from improved planning of roads and skid trails, accurately mapping the location of trees to be felled, improved techniques in directional tree felling, and reducing the size of roads, skid trials, and log decks.

2. **Logged to protected (LtPF):** applies to either logged over or virgin forests and could be partially implemented in a concession in conjunction with FSC certification or the entire HPH could be taken out of production. An example of the latter option is the Noel Kempt project in Bolivia.

3. **Extended rotation or cutting cycle (ERA):** originally designed for even-age plantations this objective is also applicable to natural forest concessions under a selective harvesting regime. The two most common examples applicable to Indonesia are:

    a. Increasing the minimum cut diameter of harvestable trees,

    b. Extending the re-entry period for selective harvesting.

4. **Low productive to high productive (LtHP):** applies to highly degraded forest where there's a paucity of commercial species or where the normal successional forest cycles have been arrested. The aim is to increase stocking of commercial species that leads to enhanced carbon sequestration and typically has been done through enrichment planting. Additionally, this objective could be employed where the normal successional stages have been arrested, examples being where intense wildfires devastate extensive forest

stands and subsequently bamboo and/or vines dominate, thereby suppressing natural regeneration. Even though this objective is primarily for rehabilitating degraded forest, VCS does require that the area meet the country's definition of forest.

Options (1) and (2) above are relevant for the Central Suau project.

4.3. RELEVANT IFM ACTIVITIES FOR CENRAL SUAU

Despite the fact that various bilateral and multilateral agencies have funded projects to promote reduced impact logging (RIL) over the last 15 years, the majority of the world's natural forest concessions have yet to adopt this practice. There are various reasons why RIL isn't more widely practiced, but overall, perhaps the most compelling reason is a lack of incentives for implementing what most concessionaires consider to be more complicated and, at least initially, a more costly set of practices. The correct implementation of RIL typically requires the company to fundamentally redesign their organizational structure, providing more resources, both human and financial, for their planning departments. Furthermore, the concessionaires that have successfully implemented RIL have needed to redress their staff payment system, which was based only on production (i.e. cubic meters of trees cut or logs skidded, etc.) to a system that combines volume and quality criteria. Thus, RIL requires a fundamental paradigm shift by concessionaires, including making a substantial investment in additional staff, training, and possibly newer heavy equipment (e.g. new CAT 527 track skidder). Therefore, it's probable that a financial barrier does exists that greatly discourages wide-scale application of RIL practices, and if this can clearly be shown then additionality criteria would be satisfied and the REDD project would be eligible under a VCS IFM project.

PNG's five REDD demonstration sites are designed to test a range of REDD project types, with Central Suau listed as the only RIL project site. However, several points need to be taken in consideration. First, not a single concession applies a comprehensive set of RIL practices in PNG, as recognized under FSC principles[2]. As mentioned in the above paragraph, making this transition to RIL requires a serious financial commitment including a complete paradigm shift by senior management. Cloudy Bay Timber Company, which is scheduled for a full FSC assessment early next year, has begun RIL implementation, but it will take several years to fully complete the transition from traditional logging in their concession[3]. Detecting the differences between FSC-compliant RIL and traditional logging in a robust statistically valid way is exceptionally difficult, and currently no VCS approved or pending methodology exists. Without a

[2] No PNG commercial concessions have gained FSC certification.

[3] Personal communication with Cloudy Bay Timber general manager.

methodology, there isn't a way to accurately predict future emissions under a baseline scenario.

Even when an approved methodology becomes available, the number of credits that could be generated under a RIL option in Central Suau would be minimum given the small size of annual logging compartments. An effective logging area can be estimated by taking the area in primary and secondary forest (~41,000 ha – the area too steep to log [>40% slope]), and approximates 33,000 ha. 33,000 ha ÷ 35 year cutting cycle = ~940 ha. Assuming that there would be about 20 C ton/ha difference between the baseline and RIL would equate to 18,850 Ct/year. To convert carbon to CO2 a multiplier of 3.67 is used and equals 69,200 tCO^2e per year. Current prices of VCU before validation are $3 - $5 CO2/ton; thus, the total rough estimated gross revenue would range from $200,000 to $346,000/year.

The second project activity that is relevant for Central Suau is a logged to protected option. Under that option, the State decides to protect the site in order to meet their emissions reductions commitments rather than allowing commercial logging to take place. That option is a good fit for Central Suau for several reasons, that include:

1. The forests of Central Suau are pristine, have never been logged on a commercial scale and are thought to harbor high biodiversity.
2. The topography is steep with xx% over 40% slope that would increase both logging costs per hectare and cause high environmental damage from erosion and sedimentation of the area's rivers and streams.
3. No commercial timber company in PNG has gained FSC certification and there's a paucity of trained technicians that are experts in RIL techniques among other best management practices. Even with a fully committed company, it would take years to achieve a level of competence that would minimize environmental damage.
4. There isn't a VCS approved GHG methodology for RIL or even a pending methodology going through the double approval process. Therefore, there isn't an accurate method to estimate baseline emissions, which leaves only a logged to protected option that does have approved methodologies. Eventually, there will be approved RIL methodologies since several International NGOs are developing methodologies.

4.4. SELECTION OF A GHG METHODOLOGY

There are two applicable VCS-approved methodologies under the Logged to Protected (LtPF) option, and listed below:

a) VM0010 Methodology for Improved Forest Management: Conversion from Logged to Protected Forest

b) VM0011 Methodology for Calculating GHG Benefits from Preventing Planned Degradation

Of the two above methodologies, VM0011 allows for emissions from logging damage and road and skid trail construction to be included in the baseline. The baseline scenario for forest management includes selected timber harvest practices. The quantification of GHG avoided emissions (the with project scenario) is determined based on a change in land use practice and an increase in carbon sequestration.

Key criteria of the VM0011 methodology are:

- The IFM project activity may contain more than one discrete area of land.
- The minimum duration of a monitoring period is one year and the maximum duration is 10 years.
- Project proponents are free to decide on the periodicity of verifications, however, under the VCS AFOLU Guidance Document, if verification does not occur within 5 years, 50% of the buffer account credits are cancelled.
- Carbon pools included: aboveground trees, dead wood, harvested wood products.
- Project emission source included: burning of biomass.
- A Historical Baseline Scenario derived from the historical practices of the baseline agent of timber harvest must be used where data is available, otherwise a Common Practice Baseline Scenario determined from a timber harvest plans shall be used.
- A planned timber harvesting schedule has to be submitted by project proponents as part of the VCS PD.
- Project proponents have to submit a detailed description of the vegetation stratification adopted for the project area ex ante.
- Baseline projections are calculated ex-ante and are not adjusted throughout the project lifetime.
- In all cases, where wood is harvested for conversion to wood products, carbon stock in the long-lived wood products pool must be included in the baseline case.
- The potential for illegal extraction of trees from the project area shall be assessed ex ante and ex post through a participatory rural appraisal (PRA) of the communities in and surrounding the project area.

The eligibility criteria above can all be met in the Central Suau project site.

5. ADDITIONALITY ANALYSIS

The analysis of additionality is a test to see whether emissions would occur beyond a reasonable doubt in the absence of carbon financing; in essence that this particular project will generate emissions reductions that wouldn't have happened otherwise. For projects in this VCS category, additionality must be shown using the "Tool for the Demonstration and Assessment of Additionality in IFM Project Activities". A three-step process is carried out to satisfy the above test, which is listed below:

Step 1: Identification of the alternative land use scenario to the IFM project activity.

Step 2: Investment analysis to determine that the proposed project activity is not the most economically or financially attractive of the identified land use scenarios.

Step 3: Barriers analysis.

STEP 1. IDENTIFICATION OF ALTERNATIVE LAND USE SCENARIOS

Given the steepness of the Central Suau site, there are only three likely land use options under the baseline scenario – a) status quo with no activities taking place besides some very small scale illegal logging by villagers and continual expansion of agricultural activities; or b) community-based logging with Lucas walk-about sawmills; or c) a commercial-scale logging concession.

Given PNG's booming economy driven by the oil and gas sector, the Papuan currency has risen by 35% over the last two years against the US Dollar; and the rural poor are increasingly being financially squeezed since PNG imports much of its food stables.

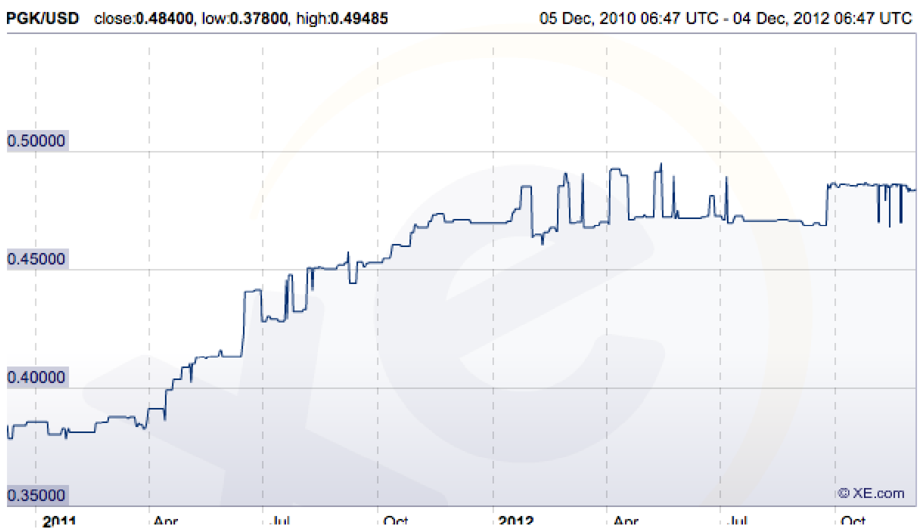

Figure 3 Two-year graph of exchange rates between the USD and PNG currency

In interviews with community leaders in four villages, they almost universally expressed the need to augment their incomes due to inflationary pressures. And, also stated that while they were rich in forest resources, those resources weren't contributing to help meet their needs. These leaders also stated that while they were against the destruction of their forests, they would allow selective harvesting through commercial logging. Given how few options there are for providing revenue to the Central Suau communities, there's a strong likelihood that they would approve commercial-scale logging.

Option (b) was also discussed with village leaders. Over the last several years, one or two villagers per community have participated in chain saw logging, usually within 500 meters of their villages, since the flitch timbers are manually carried by several men. Additionally, there was one Lucas mill operating in the eastern part of Central Suau for several years, but broke down and the village leader that operates it doesn't have the funds to fix it. A financial review of small-scale community-based timber processing in PNG came to the following conclusion[4]:

> Timber processing, even for small-scale portable sawmill operations, is capital-intensive. Few community-based operations in PNG currently achieve the required mill production, recovery and transport arrangements for long-term financial viability of their portable sawmill operations. Aggregating production and producing at a larger-scale can increase viability, but this presents political challenges for communities. High transaction costs are associated with being a part owner of a processing facility and significant continuing effort is required to ensure that the community receives an equitable return from its resource and labor inputs.

Working with community-based forest management initiatives can be successful, but the donor organization and/or NGO should realize that it requires a ten-year minimum commitment in funding and technical assistance. Furthermore, it is doubtful that a CBFM initiative would benefit the majority of 6,600 residents in Central Suau.

During discussions with several senior PNGFA staff, they confirmed that Central Suau was planned to be an industrial-scale logging concession and is listed on Milne Bay's five-year forest plan[5] as the second highest priority for industrial

[4] (Keenan, Grigoriou, and Yosi 2010)
[5] Provincial Forest Plan, Milne Bay Province 2008 – 2013, p.19

timber production. Therefore, the most likely baseline land use scenario is industrial-scale timber production.

STEP 2. INVESTMENT ANALYSIS

Carbon credits generated from REDD projects range in price depending on the stage of project development. The highest prices are generated after the VCUs have been issued and in 2011 the mean price reported was $9.00 per VCU. For REDD projects that have only been validated, the price could range from $3 – 6 per VCU. For carbon credits to financially compete with revenues generated from industrial logging, the VCU price would need to be $25 – 30. Therefore, a timber concession represents the best investment of the options available.

STEP 3. BARRIER ANALYSIS

Barriers could be technological, cultural or legal, while financial barriers are dealt with in Step (2). In the Central Suau case, while there aren't cultural barriers that would limit a REDD project, there are legal and technological barriers. Currently, for IFM projects that would like to gain carbon credits through reduced emissions from RIL, VCS-approved or pending methodologies don't exist; which represents a considerable technological barrier, and would require significant time and funds exceeding $200,000 to develop and gain double approval on a new methodology. With a logged to protect option, methodologies are available with VM0010 being the best fit.

6. LEGAL ANALYSIS

6.1. APPLICABLE LAWS

While no specific laws or regulations related to REDD have been enacted, there are a range of policies including legislation that are pertinent for an IFM project. (Leggett 2012) reviewed REDD-related laws and policies and provided a synthesis of key policies:

- National Forest Policy – this was issued in September 1991 by the National Executive Council and covers areas of forest management, the forest industry, forest research, forest training and education, and forest organization and administration.
- Forestry Act 1991 – This Forest Act was a direct result of a Commission of Inquiry and provided for the establishment of the new and autonomous Forest Authority to replace the old Department of Forests. The Act provides for much tighter controls in the acquisition and allocation of land for forest development.
- Forestry (Amendment) Act, 1993 - this was certified in April 1993 and provided for a clear administrative function of the Board, the National Forest Service through the Managing Director and the Provincial Forest Management Committees.
- The National Forest Development Guidelines – these were issued by the Minister for Forests and endorsed by the National Executive Council during September 1993. The Guidelines established essentially an implementation guide for aspects covered in the new Forest Act, especially in terms of sustainable production, domestic processing, forest revenue, training and localization, review of existing projects, forest resource acquisition and allocation and sustainable development.
- The National Forest Plan – under the Forestry Act 1991 (as amended), the Forest Authority is required to prepare a National Forest Plan to provide a detailed statement of how the national and provincial governments intend to manage and utilise the country's forest resources. The National Forest Development Programme (NFDP) under the Plan is now under implementation.
- The Logging Code of Practice was finalized in February 1996 and tabled in Parliament in July 1996. The PNG Code is inconsistent with the Regional Code proposed at the 1995 Suva Heads of Forestry Meeting but is more specific to PNG operating conditions. Mandatory in July, 1997.
- The 1996 Forestry Regulations, which cover all facets of the industry procedures and control, were approved by the National Executive Council

during 1996, in principle subject to some changes to be finalized soon. These Regulations provide the legal status for the implementation of many of the requirements specified under the Forestry Act 1991 (as amended).

- The Forestry (Amendment no. 2) Act 1996 was passed by Parliament and certified on the 11 October 1996. The major amendment relates to the membership to the Board to still have eight members, including the representatives of a National Resource Owners Association and the Association of Foresters of PNG.
- Since the Forestry Act was first enacted in 1991, it has been amended six times. The first in 1993, followed by others in 1996, 2000, 2005, 2007 and 2010.

Currently, there are no policies that clarify the taxation that could be placed on carbon credits generated through REDD, nor is there any guidance yet on benefit sharing mechanisms. To attract legitimate private sector investment, the issues associated with taxation, including how the State will handle benefit sharing will need to be clarified through policy enactment.

6.2. CARBON RIGHTS

The rights to carbon credits generated in natural forest areas are still ambiguous since no ratified laws or policies yet exist that govern this aspect, but the National Climate Change Policy Framework (NCCPF) does state that carbon remains the property of the customary landowners. However, the NCCPF also asserts "the development and sale of carbon credits will be the responsibility of the State". The preceding statement is quite similar to how timber rights are handled in PNG, however, since Free, Prior, and Informed Consent (FPIC) has been inculcated into REDD, Forestry Authority staff responsible for gaining the approval of the communities will need a thorough knowledge of the FPIC process.

7. POTENTIAL TO GENERATE CARBON CREDITS

7.1. PROJECT BOUNDARIES AND SCOPE

7.1.1. SPATIAL BOUNDARIES

The spatial boundaries of the REDD site should exclude agricultural areas, but since some of the roughly 3,000 ha of secondary forest may actually be in a fallow state from the villagers' shifting cultivation, the precise boundaries at this stage can't be estimated. For the purposes of this feasibility study, the boundaries are assumed to include 38,700 ha of primary forest plus the 3,000 ha of secondary or degraded primary forest that totals 41,700 ha. However, it should be stressed that during the FPIC process some of the secondary forest may be allocated to long-term agricultural production for the participating communities; and thus, the project boundaries and total area may change.

7.1.2. CARBON POOLS

For Logged to Protected project types, the carbon pools to be measured are typically restricted to biomass in the tree components and don't include non-woody above ground vegetation since it's total contribution is normally insignificant. The selected methodology, VM0010, lists the following carbon pools shown in Table 2. Harvested wood products under a baseline scenario are included and the percentage that goes to long-lived wood products needs to be estimated.

Table 2. List of carbon pools and which ones are to be included in the GHG methodology according to VM0011

Carbon pools	Included/Optional/Excluded	Justification / Explanation of choice
ABG trees	Included	The stock change in the ABG tree biomass shall be estimated
ABG non-trees	Excluded	Exclusion is always conservative when forests remain as forests
Belowground	Excluded	Unlikely to change significantly in forests remaining as forests and is difficult to measure – omission is conservative
Dead wood	Included	Required under VCS Tool for AFOLU Methodological issues
Harvested wood products	Included	Will be greater in baseline than project scenario and significant
Litter	Excluded	Insignificant and exclusion is conservative
Soil organic carbon	Excluded	Exclusion is always conservative when forests remains as forests

7.2. MODELING THE BASELINE AND WITH-PROJECT SCENARIOS

In order to model the business as usual or baseline scenario, reliable estimates of the following parameters are needed:

a) Total biomass in unlogged forest,
b) Biomass that would be extracted during logging and the percentage that would go toward long-live wood products,
c) Biomass that would be killed due to road, skid trail construction, and felling damage, and
d) Regrowth rates post logging.

7.2.1 MEAN EXTRACTABLE BIOMASS

VM0011 allows for the baseline scenario to be created in two ways, applying a historical average timber volume harvested or a common practice approach. Since logging in Central Suau hasn't taken place yet the common practice approach is used with the primary data coming directly from a timber inventory conducted by PNGFA. A spreadsheet of the inventory data provided by PNGFA was analyzed for this report, which indicated that 96 plots, each one 0.10 ha were installed. Both timber volume and biomass were estimated from the raw data with the results provided in Tables 3 – 6.

Table 3 Mean timber volume m3/ha for trees of commercial size (>= 50cm DBH) by species group and log form factor. Species groups 1 and 2 and form factor 'A' and 'B' considered merchantable.

Species Groups	Timber Volume By Log Form Factor A	B	C	D	TOTAL
1	5.50	19.23	11.41	3.84	39.99
2	1.36	15.56	10.31	2.03	29.26
3	0.44	8.30	7.47	2.66	18.86
4	1.65	13.43	15.30	5.95	36.33
5	-	0.40	3.42	2.01	5.83
TOTAL	**8.94**	**56.92**	**47.90**	**16.49**	**130.26**

PNGFA regulates the volume that can be exploited through a minimum DBH of 50cm that can be felled and Table 3 above shows only the trees that are equal to or exceed that minimum. Unlike biomass surveys that only record DBH and at times total tree height, a log form factor was assigned to each tree with grades 'A' and 'B' considered merchantable. The tree species were grouped into trade classes with Class 1 representing luxury woods that command higher prices, while the Class 2 group includes lesser-priced species that are commercially acceptable in PNG. Table 4 presents the mean timber volume for only commercially acceptable species with merchantable logs.

Table 4 Mean timber volume m^3/ha for trees of commercial size (>= 50cm DBH) for only commercial species groups and merchantable log form factors.

SPECIES	LOG FORM FACTOR		
GROUPS	A	B	TOTAL
1	5.50	19.23	24.73
2	1.36	15.56	16.92
TOTAL	**6.86**	**34.80**	**41.65**

Table 4 suggests that about 40 m^3/ha on average is commercially available in the Central Suau area. This volume is about half of what unlogged forests in Borneo or Sumatra produce, but the difference is due to a much higher percentage of tree species that are commercially acceptable in Indonesian dipterocarp forests. While the estimates of timber volume are restricted to trees over the minimum cut diameter of 50cm DBH, the biomass estimates need to include all tree sizes sampled, which in this case start at 20cm DBH. The analysis indicated a mean aboveground biomass of 349.86 t/ha with the statistics shown in Table 5.

Table 5 Aboveground tree biomass from 96 plots of 0.1ha each for Central Suau (trees >= 20cm DBH)

Mean Biomass (t/ha)	Std error (t/ha)	CV (%)	Sample Error* (%)
349.858	23.1016	64.7%	10.97%

* Sample error estimated using a 95% level of confidence.

The VCS AFOLU guidelines state that the sample error shouldn't surpass 10% at a 95% level of confidence. Table 5 indicates that the sample error slightly exceeds the maximum suggested by VCS. The GPS coordinates of the installed timber inventory plots haven't yet been provided by PNGFA; and it's necessary to examine the plot distribution throughout the forest of Central Suau to avoid any likelihood of false precision. If the plots were all grouped together in one area, then this would create false precision since the mean biomass may not be representative of the entire area. However, it should be kept in mind that a comprehensive biomass survey has been planned as part of the PDD; and if well designed the error will be under the suggested maximum. Additionally, several aspects need to be considered when evaluating sample error, one of which is false precision.

Table 6 provides an estimate of the mean extractable biomass for the trees greater than 50cm DBH.

Table 6 Biomass (t/ha) separated by commercial species groups and log quality for trees >50cm DBH.

Species Groups	Biomass (t/ha) by Log Form Factor A	B	C	D	Total Biomass
1	7.40	30.03	20.90	6.72	65.05
2	1.61	24.32	17.88	3.93	47.73
3	0.66	13.03	14.20	5.13	33.02
4	2.34	22.76	28.86	12.60	66.56
5	-	0.74	6.37	5.07	12.18
TOTAL	**12.01**	**90.88**	**88.21**	**33.45**	**224.54**

The biomass in commercial-sized trees (Table 6) was divided by the total biomass (> 20cm DBH), which indicated that 64% of the total biomass is composed of big trees and is consistent with unlogged forests in other tropical regions (Bryan and Sc 2012). Additionally, the total estimated biomass of ~350 t/ha is in the range of other publications that measured this parameter in PNG unlogged forest with the range of biomass measured shown in Table 7.

Table 7. List of published studies from PNG with estimates of aboveground biomass in unlogged forests (source: Bryan et al. 2010).

Name	Biomass (t/ha)	Annual mean temperature (°C)	Reference
Mt Hagen mixed 1	375	8.3	Powell, 1970
Mt Hagen mixed 2	411	10.2	Powell, 1970
Mt Hagen mixed 4	493	12	Powell, 1970
Mt Hagen *Nothofagus* 5	458	12	Powell, 1970
Chimbu mixed	350	13	Edwards and Grubb, 1977
Finschaffen	597	26.3	Abe et al., 2000
Madang Ramu	320	27.5	G. Weiblen (unpublished data)
Mt Bosavi	311	23.8	Shearman (unpublished data)
Mt Missim	428	19.1	Pratt, 1983
Nothofagus pulleii	333	12.2	Ash, 1988
Nothofagus grandis	296	14	Ash, 1988
Mixed forest	180	13.4	Ash, 1988
Montane conifer	118	10.4	Ash, 1988
Mixed (*Nothofagus*) Kutubu limestone	270	21.9	Ash, 1988
Mixed (*Nothofagus*) Kutubu volcanics	378	23.1	Ash, 1988
Vanimo 1	414	28.4	Cameron and Vigus, 1993
Vanimo 2	441	28.4	Cameron and Vigus, 1993
Kapiura 1	328	28.3	Cameron and Vigus, 1993
Kapiura 2	361	28.3	Cameron and Vigus, 1993
Kumusi 1	479	28.1	Cameron and Vigus, 1993
Makapa 1	305	25.5	Bryan et al. (submitted)
Makapa 2	230	25.5	Bryan et al. (submitted)

Table 8. Biomass (t/ha) of commercial-sized trees (>= 50cm DBH) for only tree species that are commercially acceptable and trees with merchantable log form factors.

Species	Biomass by Log Form		
Groups	A	B	TOTAL
1	7.40	30.03	37.44
2	1.61	24.32	25.93
TOTAL	9.01	54.35	63.36

Table 8 provides an estimate of the maximum biomass that could be extracted in one hectare, but trees that are inaccessible due to extreme micro-topography (i.e. in a steep gully etc.) should also be factored in; and this study uses a conservative deduction of 21%. Therefore, **50 t/ha would be a conservative estimate of the mean biomass of the trees that could be extracted each year from commercial logging.** However, additional information is needed, such as the fraction of biomass left in the forest from each felled tree. The logs are extracted, but the stumps and large branches are left to decompose, which for unlogged primary forest is assumed to be 30% of the biomass that is left in the forest to decompose. For the biomass that is extracted, VM0011 provides an equation to calculate the amount of carbon stock sequestered in long-lived wood products, and is shown in Equation 1 below.

$$C_{WP,i|BSL} = \sum_k \left(C_{EX,i,k|BSL} * (1 - WW_k) * (1 - SLF_k) * (1 - OF_k)\right) \qquad \text{Eq. 1}$$

Where:

$C_{WP,i\|BSL}$	carbon stock sequestered in wood products in stratum i as a result of planned timber harvest in the baseline scenario, in tC·ha^{-1};
$C_{EX,i\|BSL}$	mean carbon stock of extracted timber per unit area in stratum i, tC·ha^{-1};
WW_k	fraction of biomass carbon from wood waste immediately emitted as a by product of milling operations for wood product k, dimensionless; [17]
SLF_k	fraction of biomass carbon for wood product k that will be emitted to the atmosphere within 5 years of timber harvest, dimensionless; [18]
OF_k	fraction of biomass carbon for wood product type k that will be emitted to the atmosphere between 5 and 100 years of timber harvest, dimensionless; [19]
i	1, 2, 3 ...M strata; and
k	wood product classes (1. sawnwood, 2. wood-based panels, 3. other industrial roundwood, 4. paper and paper board, and 5. other).

Milne Bay Province has several sawmills, but no plywood or paper mills[6], and therefore; it can be safely assumed that the end product will be sawn lumber. Equation 1 indicates that about 16% of the carbon goes toward long-lived wood products, which is considered an emission sink in the carbon accounting.

7.2.2. BIOMASS LOST DUE TO MORTALITY, ROAD/SKID TRAIL, AND LOG DECK CONSTRUCTION

Data on mortality of residual trees was assessed from various studies in Malaysia and Indonesia and was conservatively set at 5% the first year, declining to 2% by the second year, and then by year 5, the last year that includes logging-inducted mortality, was set to 1%[7] (Sist et al. 2002, Cassarim et al. 2010). The percent area cleared for road/skid trails and log decks was set at 5 and 6% respectively (Cassarim 2010). One of the most comprehensive studies addressing biomass lost from selective logging in PNG is Bryan's PhD dissertation (2012) that indicated on average logging reduced the total biomass by 33%, including the extracted timber, mortality, and road and skid trails. Applying the abovementioned percentages for mortality, road, and log deck percentages combined with the 50 t/ha of biomass from logs that would be extracted indicates that 30% of the total biomass would be eliminated; very similar to Bryan's estimate. That percentage is considered conservative since other studies calculated that 50% of the biomass was lost from logging (Fox et al. 2011, Tangki and Chappell 2008).

7.2.3. BIOMASS REGROWTH POST-LOGGING

Regrowth post-logging is one of the most variable parameters with some studies showing a 2.5 tC/ha/yr. rate (Brown and Lugo 1990), while others indicate sequestration as high as 7.5 tC/ha/yrr to 10 tC/ha/yr. (Scatena et al. 1993, Hughes et al. 1999). Fox et al (2011) analyzed a series of PNG forest plots and measured a sequestration rate of 1.12 ± 3.41 tC/ha/yr, which was chosen for the baseline sequestration rate for this study. The same study in unlogged primary forest indicated a rate of 0.23 ± 1.57 tC/ha/yr.

Based on the biomass parameters discussed in the above subsections, a spreadsheet model was constructed to estimate the potential emission reductions with the results shown on the following page.

---

[6] Also there are no plywood and paper mills in any surrounding provinces

[7] The percentages are in addition to the natural (background) mortality found in unlogged forest.

Table 9 Baseline emission sources and sinks for the first ten years under an industrial logging scenario.

Baseline Activity Description	Project Life	Baseline biomass accounting (tons/ha dry matter)											Baseline CO_2 emissions (t/ha/yr)								TOTAL Baseline Emissions excl. sequest.
		Emission Sources									Emission Sinks								Emission Sinks		
		AG Biomass (tons dry matter)			Post-logging Biomass Components under Baseline						Sinks		Emissions Sources						sinks		
	Year	Total	Commercial	Non-Commercial	Removed as Timber	Dead logging debris	Mortality post-logging	Mortality yrs 2 - 10	Roads and skid trail	Log Decks and Landings	LLWP Deduction	Cumulative Regrowth	Extracted as Timber	Dead logging debris	Mortality to residual stand	Roads and skid trail	Landings	Total Sources	LLWP Deduction	Cumulative Sequestration	
No Logging	-	350.0	63.7	286.3	-	-	-		-	-	-			-	-	-	-	-	-	-	-
Logging	1	244.0	44.4	199.6	35.0	15.0	17.5	0	21.0	17.5	(5.6)	(0.5)	64.2	27.5	32.1	38.5	32.1	**194.3**	(10.3)	(0.8)	184.1
Logging	2	244.0	44.4	199.6	35.0	15.0	17.5	4.88	21.0	17.5	(5.6)	(2.2)	64.2	27.5	41.0	38.5	32.1	**203.3**	(10.3)	(4.1)	193.0
Logging	3	244.0	44.4	199.6	35.0	15.0	17.5	7.99	21.0	17.5	(5.6)	(4.5)	64.2	27.5	46.7	38.5	32.1	**209.0**	(10.3)	(8.2)	198.7
Logging	4	244.0	44.4	199.6	35.0	15.0	17.5	10.35	21.0	17.5	(5.6)	(6.7)	64.2	27.5	51.1	38.5	32.1	**213.3**	(10.3)	(12.3)	203.0
Logging	5	244.0	44.4	199.6	35.0	15.0	17.5	12.69	21.0	17.5	(5.6)	(9.0)	64.2	27.5	55.3	38.5	32.1	**217.6**	(10.3)	(16.4)	207.3
Logging	6	244.0	44.4	199.6	35.0	15.0	17.5	12.69	21.0	17.5	(5.6)	(11.2)	64.2	27.5	55.3	38.5	32.1	**217.6**	(10.3)	(20.5)	207.3
Logging	7	244.0	44.4	199.6	35.0	15.0	17.5	12.69	21.0	17.5	(5.6)	(13.4)	64.2	27.5	55.3	38.5	32.1	**217.6**	(10.3)	(24.6)	207.3
Logging	8	244.0	44.4	199.6	35.0	15.0	17.5	12.69	21.0	17.5	(5.6)	(15.7)	64.2	27.5	55.3	38.5	32.1	**217.6**	(10.3)	(28.7)	207.3
Logging	9	244.0	44.4	199.6	35.0	15.0	17.5	12.69	21.0	17.5	(5.6)	(17.9)	64.2	27.5	55.3	38.5	32.1	**217.6**	(10.3)	(32.9)	207.3
Logging	10	244.0	44.4	199.6	35.0	15.0	17.5	12.69	21.0	17.5	(5.6)	(20.2)	64.2	27.5	55.3	38.5	32.1	**217.6**	(10.3)	(37.0)	207.3

Table 10 With-project emission sources and sinks for first ten years under a protected forest (no logging) scenario.

Project Activity Description	With project biomass accounting (tdm)				With project CO_2e Emissions			
	AG Biomass (tons dry matter)				Total Biomass Growth			Sink
	Total	Commercial	Non-Commercial	Annual Increment (tdm)	Total	Commercial	Non-Commercial	w_Project Sequestration
No activitiy	350.0	63.7	286.3	-	641.7	116.8	524.9	-
No activitiy	350.5	63.8	286.7	0.5	642.5	116.9	525.6	-
No activitiy	350.9	63.9	287.1	0.5	643.4	117.1	526.3	0.8
No activitiy	351.4	64.0	287.4	0.5	644.2	117.2	527.0	1.7
No activitiy	351.8	64.0	287.8	0.5	645.0	117.4	527.6	2.5
No activitiy	352.3	64.1	288.2	0.5	645.9	117.6	528.3	3.4
No activitiy	352.8	64.2	288.6	0.5	646.7	117.7	529.0	4.2
No activitiy	353.2	64.3	288.9	0.5	647.6	117.9	529.7	5.0
No activitiy	353.7	64.4	289.3	0.5	648.4	118.0	530.4	5.8
No activitiy	354.1	64.5	289.7	0.5	649.3	118.2	531.1	6.6
No activitiy	354.6	64.5	290.1	0.5	650.1	118.3	531.8	7.5

Table 11. Estimate of potential credits (VCU) that would be generated from emission reductions

VCS Credit Generation per Hectare					
From logging	Net Sink (Cumulative Sequestration)	Subtotal Credits	Risk Withholdings	Leakage Deduction	Total Credits
-	-	-	-	-	-
184.1	(0.8)	**183.2**	(36.6)	(18.3)	128.3
193.0	(3.3)	**189.7**	(37.9)	(19.0)	132.8
198.7	(6.5)	**192.2**	(38.4)	(19.2)	134.5
203.0	(9.8)	**193.2**	(38.6)	(19.3)	135.3
207.3	(13.1)	**194.3**	(38.9)	(19.4)	136.0
207.3	(16.4)	**191.0**	(38.2)	(19.1)	133.7
207.3	(19.6)	**187.7**	(37.5)	(18.8)	131.4
207.3	(22.9)	**184.4**	(36.9)	(18.4)	129.1
207.3	(26.2)	**181.1**	(36.2)	(18.1)	126.8
207.3	(29.5)	**177.8**	(35.6)	(17.8)	124.5

7.3. POTENTIAL CARBON CREDIT GENERATION

Tables 9 – 11 provide estimates of emission sources and sinks for the first ten years of a VCS project. While VCS projects have typically a 30-year time period, only the first ten years is used in this feasibility study since VCS requires a new baseline be developed and validated after year 10. National policies can change over time that could strongly influence the additionality and baseline, and predicting further into the future than 10 years given the changes that can rapidly occur isn't practical.

A 35-year cutting cycle is used in PNG and implies that each year an area of roughly 965 ha will be logged and left to regenerate for 35 years. Both stand regrowth (emission sink) and mortality (emission source) will continue for years after logging; as such, these sources and sinks in each annual logging compartment have been accounted for in a cumulative manner. Table 12 indicates the method used to estimate cumulative biomass losses from mortality, which is added to the mortality occurring in the first year of logging in each logging compartment.

Table 12 Cumulative biomass losses (t/ha) due to mortality post-logging by annual logging compartment over 10 years.

	Cumulative biomass loss from post logging mortality by year of logging from year 2 to year 10									Cumulative
Project	2014	2015	2016	2017	2018	2019	2020	2021	2022	Baseline
Year	1	2	3	4	5	6	7	8	9	Source t/ha
0										
1										
2	4.88									4.88
3	3.11	4.88								7.99
4	2.36	3.11	4.88							10.35
5	2.34	2.36	3.11	4.88						12.69
6	-	2.34	2.36	3.11	4.88					12.69
7		-	2.34	2.36	3.11	4.88				12.69
8			-	2.34	2.36	3.11	4.88			12.69
9				-	2.34	2.36	3.11	4.88		12.69
10					-	2.34	2.36	3.11	4.88	12.69

Biomass regrowth on a cumulative basis was estimated the same way as in Table 12 for both the baseline and with-project scenarios and shown in Table 13.

Table 13. Biomass regrowth (t/ha) for the baseline scenario in the first 10 years.

	BASELINE Cumulative biomass growth post logging from year 2 to year 10									Cummulativ
Logging Yr	2014	2015	2016	2017	2018	2019	2020	2021	2022	Baseline sink
Year	1	2	3	4	5	6	7	8	9	t/ha
0	-									
1		-								
2	2.24									(2.24)
3	2.24	2.24								(4.48)
4	2.24	2.24	2.24							(6.72)
5	2.24	2.24	2.24	2.24						(8.96)
6	2.24	2.24	2.24	2.24	2.24					(11.20)
7	2.24	2.24	2.24	2.24	2.24	2.24				(13.44)
8	2.24	2.24	2.24	2.24	2.24	2.24	2.24			(15.68)
9	2.24	2.24	2.24	2.24	2.24	2.24	2.24	2.24		(17.92)
10	2.24	2.24	2.24	2.24	2.24	2.24	2.24	2.24	2.24	(20.16)

Net sequestration is accounted for in Table 11 (second column) where the with-project cumulative sequestration amounts are subtracted from the baseline amounts.

7.3.1. NON-PERMANENCE WITHHOLDING FOR RISKS

Under VCS rules, REDD projects are required to evaluate the risks that affect the permanence of the carbon stocks and include natural, political, social, and management related risks. A percentage withholding of credits is estimated based on the identification of the assessment of the most serious identified risk, and range from 10% to 30%, or at times higher for particularly risky projects. Table 11 applies a 20% risks withholding that is based on the results of three other IFM projects in developing countries in SE Asia that used the VCS tool for determining risks. The VCS tool is normally applied with the project proponents to accurately weigh the risks and at this stage of project development, it's too early to use. After five years of project implementation without major incident, a release of these withheld credits can be requested.

7.3.2. LEAKAGE

Leakage is the displacement of emissions from the project site to another site. Experience has shown that once increased funds are allocated and that leads to improved management, some of the activities that produced deforestation and degradation simply move to an area that doesn't have the same level of scrutiny. For IFM projects, there are two components to leakage – market-based leakage and project leakage. Market-based leakage addresses the demand at a provincial or national level for wood and to what effect stopping logging will have on that demand. Since Central Suau hasn't yet become an active logging concession, market-based demand and associated leakage shouldn't be a factor. Since this project will be undertaken on behalf of the communities in Central Suau, with the hope of providing significant income for participating communities, a likely assumption is that leakage from illegal logging would be quite small. However, in order to ensure that the final emission reduction estimates are conservative, a ten percent leakage deduction has been included.

The last column in Table 11 shows the verified carbon units (VCUJ after the risk withholding and leakage deductions have been included. First year emission reductions are predicted to be 128 VCU per ha and over ten years range from 124 VCU per ha to 136 VCU per ha.

8. COSTS/BENEFITS ANALYSIS

8.1. POTENTIAL REVENUE FROM VCU SALES (LOGGED-TO-PROTECTED)

The financial viability analysis factored in three price scenarios for the sale of VCU, ranging from \$3, \$6, and \$9 per VCU (tCO_2e). The price scenarios are pegged to what projects are currently receiving based on their stage of development. Projects that have completed a PDD but haven't yet been validated are receiving on average \$3 per ton CO_2e for forward-based sales. REDD projects that have been both validated and verified, with the credits ready to be issued received a mean price of \$9 per VCU in 2011 (Peters-Stanley and Hamilton 2012).

The land cover analysis conducted (Table 1) indicates that 41,700 ha are covered in primary and secondary forests. That amount differs slightly with the PNGFA Provincial Forestry Plan, which provided an estimate of 46,047 ha for Central Suau's forest cover. To maintain a conservative approach, the estimate done for this study was used to estimate the area of the annual logging compartments. Subsequent GIS analyses of slope suggest that 19% of the total area exceeds 40% slope. Slopes less than 40% are considered in many countries as the maximum that can be safely logged, and without undue environmental damage caused by heavy equipment. Therefore, deducting 19% from the total forest area provides for an approximate effective logging area of 33,800 ha. Since the PNGFA stipulates a 35-year cutting cycle the average logging compartment would be 965 ha/yr (33,800ha ÷ 35yr). Table 14 provides a rough estimate of potential gross revenues.

Table 14. Potential gross revenue for the first ten years applying three price scenarios for carbon credits (VCU).

	Price Scenarios VCU/Hectare			Gross Revenue by VCU price scenario		
				No. ha to be logged each yr.		965
	Low	Medium	High	Low	Medium	High
Total Credits VCU (t/ha)	$3	$6	$9	$3	$6	$9
-						
128.3	$ 385	$ 770	$ 1,154	$ 371,302	$ 742,604	$1,113,906
132.8	$ 398	$ 797	$ 1,195	$ 384,441	$ 768,881	$1,153,322
134.5	$ 404	$ 807	$ 1,211	$ 389,464	$ 778,929	$1,168,393
135.3	$ 406	$ 812	$ 1,217	$ 391,620	$ 783,239	$1,174,859
136.0	$ 408	$ 816	$ 1,224	$ 393,687	$ 787,374	$1,181,061
133.7	$ 401	$ 802	$ 1,203	$ 386,986	$ 773,972	$1,160,959
131.4	$ 394	$ 788	$ 1,183	$ 380,373	$ 760,746	$1,141,119
129.1	$ 387	$ 774	$ 1,162	$ 373,672	$ 747,344	$1,121,016
126.8	$ 380	$ 761	$ 1,141	$ 366,971	$ 733,942	$1,100,913
124.5	$ 373	$ 747	$ 1,120	$ 360,358	$ 720,716	$1,081,074

Table 14 indicates that on a per hectare basis, and applying three price scenarios for carbon credits (VCU) that a range in gross revenue from $385/ha to $1,154/ha could be expected. Multiplying that amount by the area of the annual logging compartment could generate a total gross annual revenue between $370,000 to $1,1 million. REDD projects in general and especially charismatic projects that generate significant biodiversity and social co-benefits, as would the Central Suau project, should command at least $5 to $6 dollars per VCU after VCS verification; and thus, the most likely revenue should be in the order of $750,000/year. It needs to be emphasized that the preceding revenue projections while conservative in nature are gross estimates and haven't factored in the transaction or operational costs, which is discussed in the following section.

8.2. ESTIMATED TRANSACTION AND OPERATIONAL COSTS

The costs of an IFM project can be broken down into two basic components, which are the origination and marketing of the carbon credits – often referred to as transaction costs, and annual operating costs that would initially include any infrastructure costs, such as the construction of guard posts, access roads or trails, etc. A rough estimate of the transaction costs is provided in Table 15.

Table 15. Approximate transaction costs to be able to sell carbon credits compliant with the Verified Carbon Standard (VCS).

Activity Description	Costs Estimate (USD)
VCS compliant biomass survey (sample error +/-10%)	50,000 – 55,000
Writing of full VCS PDD using new VCS/CCBA template	30,000
VCS validation	15,000
Annual monitoring using LANDSAT & Rapid Eye imagery (incl. only GIS/RS analysis) [a.]	25,000
Reporting	10,000
VCS verification	25,000
Registry and credit issuance fees	2,500
Technical support services/interaction with VCS audit body before/during validation & verification	25,000
TOTAL	**$182,500 – 187,500**

[a.] Patrolling and field-based monitoring assumed to be part of annual operating costs
[b.] Assumes over-the-counter transaction of credits and no additional costs included to list project on a carbon exchange.

Table 15 provides an approximate estimate of the transaction costs through the verification phase and issuance of the carbon credits. A typical timeframe for the completion of this process would be from three to five years. During this time, the carbon credits could either be sold under a 'futures' or 'forward sale' contract that could take place directly after VCS validation or could be held with the credits pooled together from multiple years. In any event, the accounting would take into account the number of years needed to obtain fungible credits subtracted by the transaction costs + operational costs.

Given that the participating Central Suau communities control the access points into the forest, an extensive system of guard posts most likely isn't necessary. The annual operating costs would mostly be comprised of community patrols and inter-village meetings for coordination and communication. Initially, these costs, if managed by the communities themselves shouldn't exceed $50,000 – 70,000/year. An additional cost would be in the establishment of a legal entity that could manage the funds that flow to the communities, but would be dependent on the form of revenue distribution (i.e. revenue flow to communities, or to individuals, or a combination of both). A REDD revenue distribution mechanism for communities hasn't yet been decided on by government and will need an extensive consultation process, but could benefit from the discussions that have already taken place about PES.

One cost not yet included would be to broker the credits. The majority of carbon credits generated by VCS projects are marketed through over-the-counter transactions, which essentially involves a buyer and seller of credits in addition to a broker. A broker's fees can vary depending on how the contract is structured and whether the broker contributes financing to develop the project. In this case, GIZ is providing much of the financing for the early project development through development of the PDD; and thus; the brokerage fees should be from 5 – 10% of the total contract amount.

Even under the assumption that short-term prices would be low at $3 per VCU, the gross revenues multiplied over three to five years would considerably exceed the transaction and operational costs. The real question is – are the revenues sufficient to provide significant income to the participating communities?

8.3. COSTS/BENEFITS FROM A COMMUNITY STANDPOINT

The latest data for Central Suau indicates that in 2008 the population was 6,619 inhabitants. Assuming a 2.7% annual growth rate implies that by 2012 the population has grown to 7,400. Revenue distribution would need to consider household and not total population and assuming five people per household implies that the project area would have roughly 1,500 households.

Assuming that the transaction and operating costs will be initially paid for by bilateral agencies and/or the PNG government, the brokerage fee deduction would be the only costs to be considered. An additional assumption is that all 1,500 households would be participating in this REDD initiative, and that the total net revenues will all flow to the communities. Table 16 provides an estimate of what the annual per household revenue would be.

Table 16. Estimated net revenue per household applying three VCU price scenarios. Assumptions are: 1,500 households and a 5% brokerage fee.

Years into Project	Net Revenue/yr. per Household		
	Brokerage fee 5%		
	Low VCU price	Medium	High
Year	$3	$6	$9
1	$235	$470	$705
2	$243	$487	$730
3	$247	$493	$740
4	$248	$496	$744
5	$249	$499	$748
6	$245	$490	$735
7	$241	$482	$723
8	$237	$473	$710
9	$232	$465	$697
10	$228	$456	$685

A disbursement of the revenue proceeds would most likely happen once a year and could range from $230 to $740 annually, if all households are participating. While $230 might not be a substantial amount, $500 to $750 provided annually to each and every household would be a significant contribution to their cash income. These communities have been fairly isolated from major cities with limited income opportunities. Additionally, the REDD project would generate jobs for about 100 to 200 inhabitants, roughly 10% to 20% of the heads of households could be employed in this REDD project.

RECOMMENDATIONS

1. Absolutely critical for the success of this initiative will be ensuring that the Incorporated Land Groups (ILG) process is inclusive, transparent, and supported with sufficient resources and personnel. Currently, there are only three land mediators for the entire Central Suau area and these positions are unpaid volunteers. The number and the training of these land mediators should be augmented.

2. PNGFA should reconsider the project type for Central Suau from a RIL to a Logged-to-protected type for the following reasons:
    a. Currently, there are no approved VCS methodologies for RIL, and thus a methodology would need to be developed and then go through a double approval process under VCS; a process that would take years and $300k to $400k in funding.
    b. Even if a RIL methodology did exists, and given that the effective logging area of Central Suau would be relatively small (~30,000ha after deducting for slopes exceeding 40%), the REDD revenue that could be disbursed to the communities wouldn't be significant. Probably in the order of 60% less than what was estimated under a 'logged-to-protected project type.
    c. In all of PNG, there isn't yet one timber concession that has been FSC certified. To the author's knowledge, Cloudy Bay Timber is the only concession that has scheduled a full FSC assessment for 2013, but will need substantial time to rectify the corrective action requests that they will most likely receive.
    d. An alternative RIL site could be Cloudy Bay Timber (or other concession with high operating standards) since that concession already has begun implementing RIL and will go through the FSC full assessment in 2013.

e. Less than 3% of Milne Bay's forest is protected. The Central Suau area is pristine with abundant biodiversity and functional environmental services. This coastal lowland forest type will increasingly be rare since access to logging in other areas is normally quite good.
f. If PNGFA would like to pursue low impact chain saw milling (and/or Lucas walkabout mills), then the issue is how to benefit the majority of the community when in the past similar operations were only done by a handful of people in each village. One serious constraint is that most of the high value timber that can be feasibly extracted by human power has already been cut. The Lailaifa road once completed to Fife Bay would open up new areas, but again the maximum distance that timber could be extracted under current practices is most likely 500m or so, and would involve only a few villages. In order to involve more people, options for appropriate technology for skidding longer distances would need to be explored and substantial investment in wood processing would also be necessary. While there are various examples from other countries where communities have used animal (oxen or water buffalo) skidding with success, experience working in Guatemala, Costa Rica, Bolivia, among other countries suggests that operating timber processing facilities on a community level has typically not been successful for various reasons.

3. The activity that will have the greatest benefit for the communities and lower emissions is improved agricultural practices that utilize low costs and appropriate technology. The villagers are increasingly farming on steeper and steeper slopes as they run out of land due to population pressure. The increasing number of landslides was repeatedly mentioned as a problem in several villages. With the improvement and construction of roads to Fife Bay and Modewa, various villages will have much better access to markets in Alotau and could grow crops that are in demand there or in other more urban areas.

   Increasing the time span in fallow and reducing the burning used to clear recently cut areas for the villagers' agricultural areas will reduce the emissions and could potentially generate carbon credits with the VCS category being Improved Agriculture, and may warrant an additional carbon project that could come on line later after an IFM project.

CONCLUSION

While it's highly doubtful that a REDD project type that focuses on RIL would be technically and financially feasible, this report's analyses did suggest that a logged-to-protected type would be feasible. Each of the 1,500 households in Central Suau could potentially receive up to $750/annually from REDD carbon credits without sacrificing their forest and environmental quality. Even applying a low price scenario for carbon credits provides several hundred dollars per year to each household. It should be emphasized that a conservative process was applied to estimate carbon credits and project gross income ten years into the future. While the projected per household annual revenues aren't enormous, it still represents a substantial amount for poor farmers, and the REDD project would generate various knock-on benefits, such as clear tenure rights from the ILG process, and enhanced social cohesiveness since all of the Central Suau villages would be participating.

From the policy and legality perspectives, there currently are no laws or regulations that govern the buying and selling of emission reduction credits. Additionally, how the State will view the taxation of credits isn't clear, nor the State's role in designing and monitoring the distribution of the benefits generated from REDD. All of the abovementioned policy issues will need to be resolved before substantial private sector investment can flow into PNG. Additionally, the roles between the Climate Change Office and PNGFA need to be clarified and collaboration between the two organizations enhanced before investors will feel secure allocating significant funds for REDD projects.

PUBLICATIONS CITED

Arnold, M, B Powell, P Shanley, and T C H Sunderland. 2011. "EDITORIAL : Forests , Biodiversity and Food Security." *International Forestry Review* 13 (3): 259–264.

Bryan, Jane, and B Sc. 2012. "The Potential Role of Cessation of Logging in Reducing Emissions from Deforestation and Degradation in Papua New Guinea by University of Tasmania" (May).

Keenan, Rodney J, Jim Grigoriou, and Cossey K. Yosi. 2010. *Financial Analysis of Small-scale Harvesting in Papua New Guinea*. Melbourne, Australia.

Leggett, Matt. 2012. *The Status of REDD + in PNG*. Bangkok, Thailand.

Peters-Stanley, Molly, and Katherine Hamilton. 2012. *DEVELOPING DIMENSION : State of the Voluntary Carbon Markets 2012*.