The Costs of Stopping Deforestation in Papua New Guinea†

A report for the Department of Environment and Conservation,

Government of Papua New Guinea

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ABBREVIATIONS

BAU = Business as usual

C = Carbon

CO_2 = Carbon dioxide

FAO = Food and Agricultural Organisation

FIA = Forest Industries Association

FOB = Free on board

Ha = Hectare

K = Kina

LNG = Liquid natural gas

M = Million

m^3 = Cubic metres

PNG = Papua New Guinea

PNGFA = Papua New Guinea Forest Authority

P.V. = Present value

REDD = Reduction in Deforestation and Forest Degradation

T = Tonnes

UNFCCC = United Nations Convention on Climate Change

SUMMARY

INDUSTRIAL LOGGING FOR EXPORT

Log export production and value is expected to recover from the 2009 slump caused by the global financial crisis. However, there is a good deal of uncertainty associated with the future of the industry. The recovery of the industry could be limited in scope by the shortage of accessible good-quality timber resources, and by inflation and deterioration in the terms of trade.

The nominal value of log exports will increase, but the contribution of the sector to government revenues will be less than in years prior to 2009 due to a decrease in the rate of log tax on a reduced value of logs. A decline in the relative benefits of the log export sector to the government receipts will be exacerbated by an increase in receipts from other sectors in a growing economy.

Landowner benefits are expected to rebound in the 'high' and 'medium' scenarios with the recovery in production, together with the increases in direct royalty plus indirect development benefits legislated from 2007 and 2008 respectively. The actual benefits to landowners of the development levies depend on their effective investment in regional projects.

A developing but robust methodology in a companion report to the Papua New Guinea Department of Environment and Conservation allows an estimate to be made of business as usual emissions and net emissions due to the logging post-2009. At the medium level of logging for export projected there are relatively large quantities of emissions generated, peaking at 39 million tonnes of carbon dioxide equivalent (CO_2e) in 2017. It is expected that the potential for abatement will be exhausted in 2026 after the accessible log resource runs out in 2025 under the 'medium' scenario.

The estimated present costs, in terms of income foregone from export logging , are in the range US$3.00 to US$4.40/T CO_2 to stakeholders, and US$5.00 and US$7.70/TCO_2 in terms of export and national income.

It is in PNG's national interest that a compensation scheme delivers national and regional benefits at least equal to industrial logging. This would involve compensation ranging from US$735 to US1,400 million in present value terms, with a medium estimate of US$1,081.

PALM OIL

The palm oil industry in Papua New Guinea will continue to expand rapidly, from an area under oil palm of 134,000 hectares in 2008, to 330,000 hectares in 2037, under a 'medium' growth scenario.

The regional economic impacts of oil palm will continue to be important, given its dispersal, the high level of expenditures on goods and services and labour by companies, together with the involvement of smallholders. The palm oil industry has begun to make an important contribution to the national and regional economies. Its future seems assured in that global demand for palm oil is likely to remain high. However, the regional impact could eventfully be dampened by lower profitability in the smallholder sector if the Papua New Guinea government fails to quarantine a large proportion of the foreign exchange earned by the LNG project.

Emissions from the sector are positive but relatively minor due to the small area of land affected compared with export logging; at the same time the palm oil industry generates a high level of income per hectare compared with logging. Employment is also high, at twice the level (over 16,000 people in 2008) of that in the industrial logging sector.

The opportunity cost of replacing palm oil under a REDD scheme would be very much greater than for industrial logging. It is estimated that the cost will be US$18.43/T$CO_2$ to stakeholders and between US$36.00 and US$37.00 to export income and national income.

INTRODUCTION

The country's tropical forests of approximately 293,000 km^2 are subject to logging and conversion to agriculture (Filer at al. 2009) and thereby are the source of greenhouse gases emissions.

Papua New Guinea is classified by the World Bank (2009:353) as a "low income country", with an average annual income per capita of US$1,800.[1] The poorest sections of the community command a very small proportion of national income. Key social indicators such as life expectancy and literacy rates are very low; moreover HIV aids affects 1.8 per cent of the population (World Bank 2009: 353, 355). The population of about 6 million is predominantly rural and in semi-subsistence. An improvement in social indicators requires development and service delivery in regional areas.

The Kyoto Protocol omits the reduction in deforestation and forest degradation (REDD) from the suite of mitigation activities that attract credits under the Clean Development Mechanism, even though it was thought responsible for about 17 per cent of total greenhouse gas emissions.[2] After Stern (2006) reported that compensating for returns from logging and agriculture could abate emissions at relatively low cost there was a heightened focus at the 2007 Bali climate change conference on the pivotal role that REDD could play.[3] This notion was reinforced in the case of PNG and Indonesia, where abatement would be fast (Garnaut 2008a) and cheap (Garnaut 2008b).

Much effort and speculation followed on how REDD might be included in post-Kyoto arrangements for climate change mitigation under both market and funds approaches. Meanwhile, however, the major emitters, with the exception of the EU, had failed to adopt national emission targets and abatement schemes. As a consequence, the Copenhagen climate change conference in December 2009 was unable to deliver a new protocol to mandate the cuts in emissions that would have stimulated the necessary investment needed for REDD credits to enter the global market. Nevertheless, the Copenhagen Accord (UNFCCC 2009: Clause 5) agreed on the need for positive incentives for REDD-plus through a

funds approach[4,5] enabled by the mobilisation of financial resources from developed countries.

The Copenhagen Accord contains a collective commitment by developed countries to provide additional resources for climate change adaptation and mitigation in developing countries, including forestry, approaching US$30 billion for 2010-2012, and rising to US$100 billion a year by 2020 (UNFCCC 2009; Clause 8). At the same time, Australia, the United States, France, Japan, Norway and Britain pledged US$3.5 billion to support immediate steps to implement the Accord (Reuters 2009).

Given the considerable financial resources being mobilised for REDD, this paper focuses on clarifying the costs of REDD to tropical developing countries and to potential investors, whether under international or bilateral arrangements.

SOURCES OF EMISSIONS FROM LAND USE CHANGE IN PNG

PNG takes a national approach to reduction of emissions, including transport, power generation, and mining and fire as areas where mitigation actions can be taken (Conrad 2010:4). However, PNG is already a very low carbon economy and there is minimal potential abatement from these sectors.

In the case of PNG's forests, their carbon content has for the first time been the subject of a robust assessment of the above-ground carbon (C) stocks for PNG's tropical native forests: Fox et al. (2010: 7) estimated the above-ground carbon in lower montain forests in PNG at 121 T/HaC and in selectively logged forest at 90 T/HaC.[6]

The major causes of deforestation in PNG are commercial agriculture (both estate and smallholder) as well as logging and subsistence or shifting agriculture. In the case of logging and subsistence agriculture the forest regrows. The secondary forests that regenerate after logging may or may not be revisited by the logging companies that hold concessions over that area. The secondary forest that follows shifting agriculture will be cleared again, the length of the fallow interval depending, among other things, on population pressure (Bourke and Harwood 2009).

Almost all of PNG's land and forests are under customary ownership and the bulk of the population still depends for its livelihood on indigenous farming systems. Some 23.5 per cent of PNG's total land area was found to be used by local farmers, 50 per cent being left in fallow for periods of more than 15 years, 43 per cent in fallow for 5-15 years and 7 per cent in fallow for less than 5 years. Tall secondary forest was the typical fallow vegetation cleared for cultivation, primary forest was being cleared at only a few sites (Allen et al. 2001). Where the fallow period has been too short in successive cycles, the land is converted to grassland or shrubs.

While Shearman et al. (2009) claim that subsistence agriculture is a major driver of deforestation, it is erroneous to assume that the logging and subsistence agriculture lead to permanent deforestation. At any one time there is a loss of carbon from newly logged concessions, plus that from previously logged-over areas and from new village gardens being created, but there is also a simultaneous and countervailing sequestration of carbon on most of the area previously used (Keenan 2005; Filer at al. 2009).

Government has little or no capacity to change local farming practices which are already characterised by a high degree of innovation, enabling food supply to keep pace with a growing population in most locations (Filer at al. 2009; Bourke and Harwood 2009). Therefore it is not profitable to speculate on the reduction in carbon emissions that might take place from changes in cultural practices in subsistence or smallholder agriculture. Production of oil palm, cocoa, coffee and rubber by smallholders has been growing over the last two decades while estate agriculture has been contracting, except for oil palm and tea; but, again, there is no comprehensive information on impacts of these trends on the carbon cycle.

It is concluded (see Filer at al. 2009; Shearman et al. 2009) that logging is the only area in which deforestation can be readily avoided. In this case the PNG government can intervene in persuading landowners to surrender their rights to the carbon in their forests, in exchange for future rewards, rather than for logging. See Appendix 1 for a review of abatement opportunities in PNG forestry.

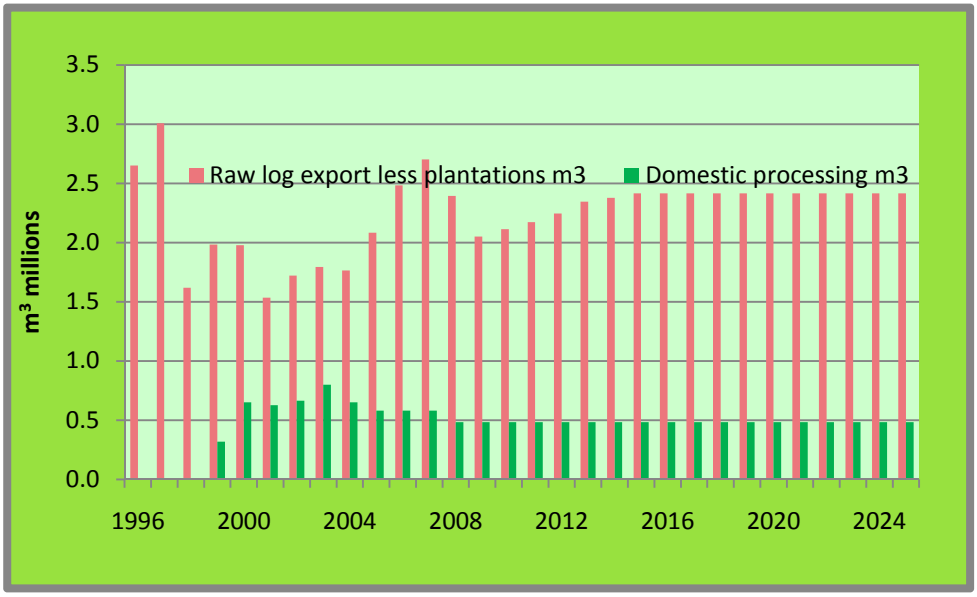
The analysis in this paper is facilitated by an assessment of the carbon contained in PNG forests (Fox et al. 2010) and by modelling of the loss of carbon due to selective logging[7], as well as the loss of carbon associated with the rapidly expanding area under oil palm (Fox et al. 2009).

METHODS

The aim is to derive the costs per tonne of CO_2 emissions avoided by reducing the removal of trees for raw log exports, as well as the conversion of forest to palm oil plantations. In the case of logs and palm oil, PNG is a price-taker but no account has been taken of commodity price rises that would likely accompany widespread and successful efforts to halt deforestation.

In modelling the level of log extraction that would take place under a business as usual (BAU) scenario, it is necessary to take into account market conditions for raw logs and the availability of the resource for exploitation by logging companies. The market for raw logs has been impacted since mid-2008 by the global financial crisis, and PNG production under a BAU scenario is expected to recover and plateau at almost 3 million m^3. Of this, 2.5 million m^3 is raw logs extracted for export and 0.5 million m^3 is for domestic processing. Total log volumes extracted are in Figure 1.

FIGURE 1. VOLUME OF RAW LOGS EXPORTED AND PROCESSED, ACTUAL TO 2008, MEDIUM BAU PROJECTED TO 2025

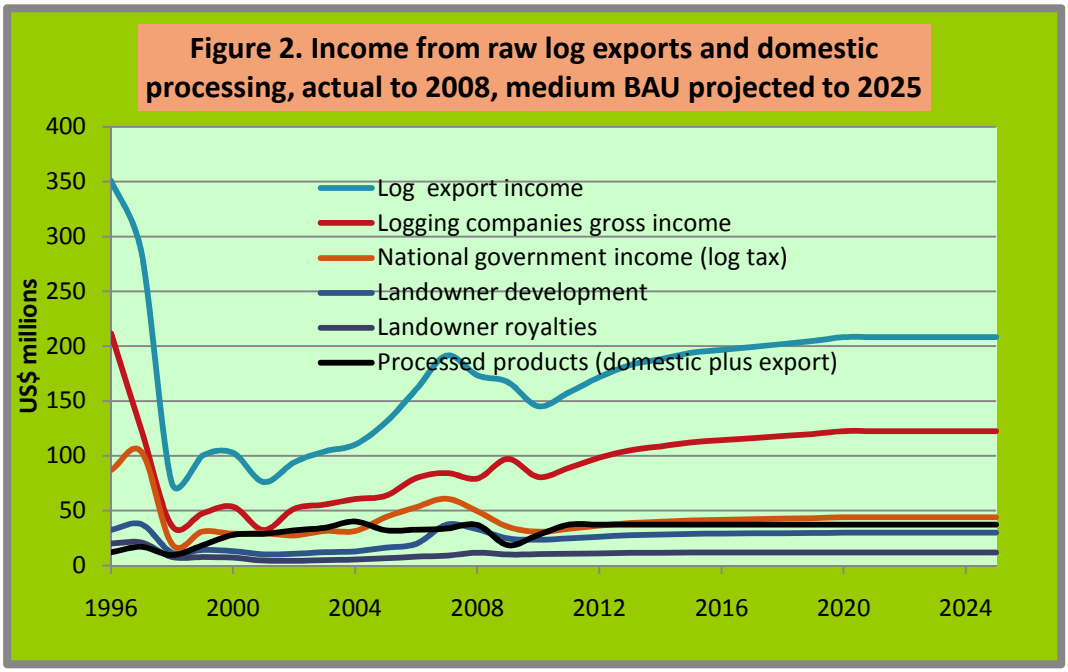


Sources: Bank of PNG (various); Author's projections from 2009.

The free on board (fob) value of log exports and the shares to stakeholders, logging companies, landowners and government, both historically and under a BAU scenario, together with the value of processed product, are show in Figure 2.

The compulsory levy system that gives rise to tax revenues, landowner benefits and other revenues is in Appendix 2. The regional benefits of export logging are further examined in Appendices 3 and 4.

FIGURE 2. INCOME FROM RAW LOG EXPORTS AND DOMESTIC PROCESSING, ACTUAL TO 2008, MEDIUM BAU PROJECTED TO 2025



Sources: Various to 2008; Author's projections from 2009.

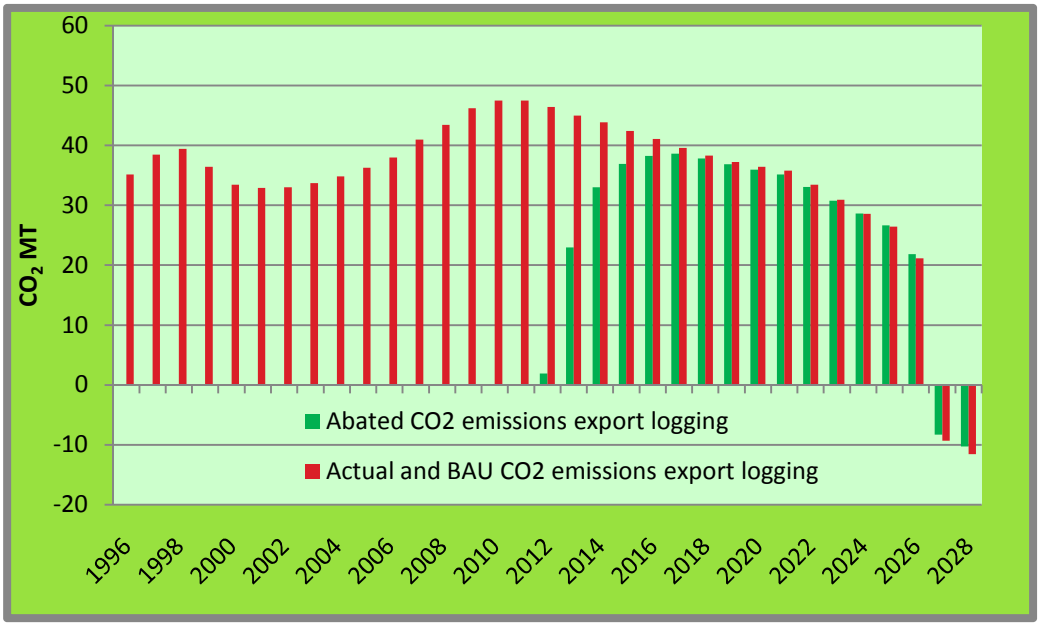
A gradual recovery in export income, and consequently in the incomes of logging companies, government and landowners is expected as the effects of the global financial crisis dissipate.

Fox et al. 2009 estimate that, on average, selectively-harvested forest has 50T C/ha less above ground live biomass than primary forest immediately after harvesting.[8] The Fox et al. (2009) model of carbon dioxide CO_2 (the main greenhouse gas) emissions takes account of

not only the removal of biomass in the form of logs, but also the CO_2 emitted by the decomposition of smallwood and largewood resulting from collateral damage, emissions from timber harvesting and transport operations, together with the rate of carbon sequestration on areas of successful forest regeneration as well as the storage of carbon in wood products.

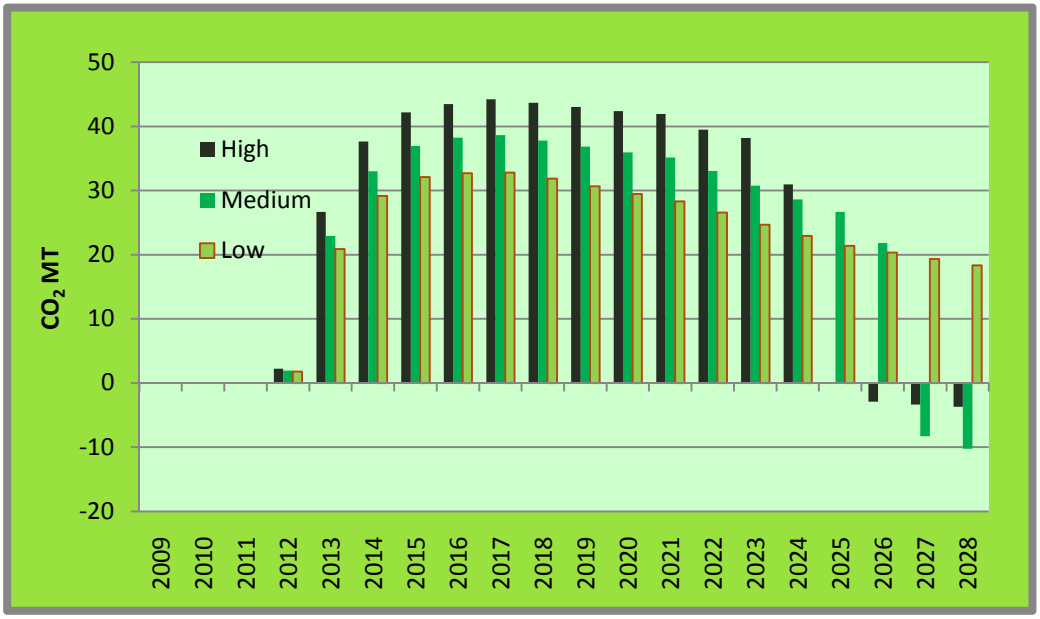
Actual and modelled abated emissions under the medium BAU scenario are in Figure 3. The decline in actual and abated emissions after 2014 is caused by the cumulative impact of carbon sequestration in successful regeneration. Emissions abated under the high, medium and low projections are in Figure 4.

FIGURE 3: CO_2 EMISSIONS FROM LOGGING, ACTUAL TO 2008, MEDIUM BAU ABATED FROM 2012



Sources: Fox et al. (2009); Author's projections from 2009.
Note: Abatement does not match the cessation in logging in 2012 due to the delayed release of CO_2 emissions after logging.

FIGURE 4. POTENTIAL ABATEMENT FROM EXPORT LOGGING



Sources: Fox et al. (2009); Author's projections.

Note: The abatement becomes negative in later years due to the fall in emissions after the exhaustion of accessible supplies of logs for export, while sequestration in revegetating logged areas continues.

THE OPPORTUNITY COSTS OF A CESSATION OF LOGGING IN 2012 IN PNG

A REDD scheme in PNG could be expected to be designed to reduce the export of raw logs in preference to a reduction in the production of logs for the domestic market; the latter would have greater consequences for employment and supply of timber in the domestic market.

Government revenues benefit from log taxes while landowners benefit directly from royalties and indirectly from development funds set aside from export revenues based on the volume and fob value of logs. Logging company's benefits are their net profits earned, but logging company annual reports of the twenty or so mainly foreign-based companies are not accessible. Net profits are therefore estimated at 30 per cent of gross incomes. It is likely that the compensation paid to logging companies would be based on net profits expected to be earned from their concessions by 2025.[9] It is unlikely that there would be a cessation in logging before 2012 given that arrangements would need to be in place, not only for compensation for government and landowner revenues foregone and logging company profits foregone, but also for REDD-plus monitoring, reporting and verification.

The first method of assessment of the total opportunity costs per tonne of carbon dioxide (CO_2) through the cessation of logging from 2012 is based on the expected revenues of government and landowners, plus 30 per cent of the gross revenues of logging companies. The second method focuses on the opportunity costs of a cessation in logging in terms of reduced national income. Logging companies, government and landowners are expected to spend 100 per cent of their income. Half of all expenditure is on imports and half on consumption (goods, services and wages) in PNG.

The methodology for the estimation of the opportunity costs of the cessation of export logging is detailed in Appendix 5.

RESULTS FOR THE OPPORTUNITY COSTS OF LOGGING

The quantity of emissions estimated to be abated under the medium estimate for logging is 440 MT CO_2 and ranging from a high of 466 and a low of 423. The average annual abatement is also shown in Table 1.

The quantity of CO_2 emissions abated and results for the opportunity costs per tonne of CO_2 emissions avoided, by the cessation of export logging, for stakeholders (companies, government and landowners) under the medium projection is US$3.88, for export income is US$6.54 and national income is US$6.54. These results for the high, medium and low fob prices and export volumes of logs, as well as for the consequential high, medium and low incomes to stakeholders, and high and low emissions avoided are in Table 2.

TABLE 1: QUANTITY OF CO_2 EMISSIONS ABATED BY CESSATION OF EXPORT LOGGING IN 2012

	Abatement CO_2 TM		
	High	Medium	Low
Total	466	440	423
Average per year	24.5	23.1	22.3

Source: Author's projections.

TABLE 2: OPPORTUNITY COSTS PER TONNE OF CO_2 ABATED BY CESSATION OF EXPORT LOGGING IN 2012, P.V., US$

	High	Medium	Low
Logger net income	1.40	1.14	0.87
Landowners	1.41	1.36	1.03
Government	1.62	1.38	1.06
Total Stakeholders	4.43	3.88	2.96
Export income	7.71	6.54	5.02
National income	7.71	6.54	5.02

Source: Author's projections.

COMPENSATING STAKEHOLDERS AND THE NATIONAL ECONOMY

To compensate for the nation income or export income foregone would cost US1.08 billion in present value terms and at 'medium' projections of log export income. This would be distributed between stakeholders as follows: logging companies as compensation for net profits foregone, and landowners and government as compensation for income foregone; the balance being spent in the economy (see Table 3).

TABLE 3: COMPENSATION COSTS OF THE CESSATION OF EXPORT LOGGING IN 2012, NOMINAL AND PRESENT VALUES, US$, MILLIONS

	High		Medium		Low	
	Nominal	P.V.[a]	Nominal	P.V.[a]	Nominal	P.V.[a]
Logger net income	612	255	492	189	362	129
Landowners	608	257	574	224	429	150
Government	706	295	577	225	440	156
Total Stakeholders	1926	807	1643	638	1231	435
Export income	3354	1400	2790	1081	2076	735
National income	3354	1400	2790	1081	2076	735

Source: Author's projections.

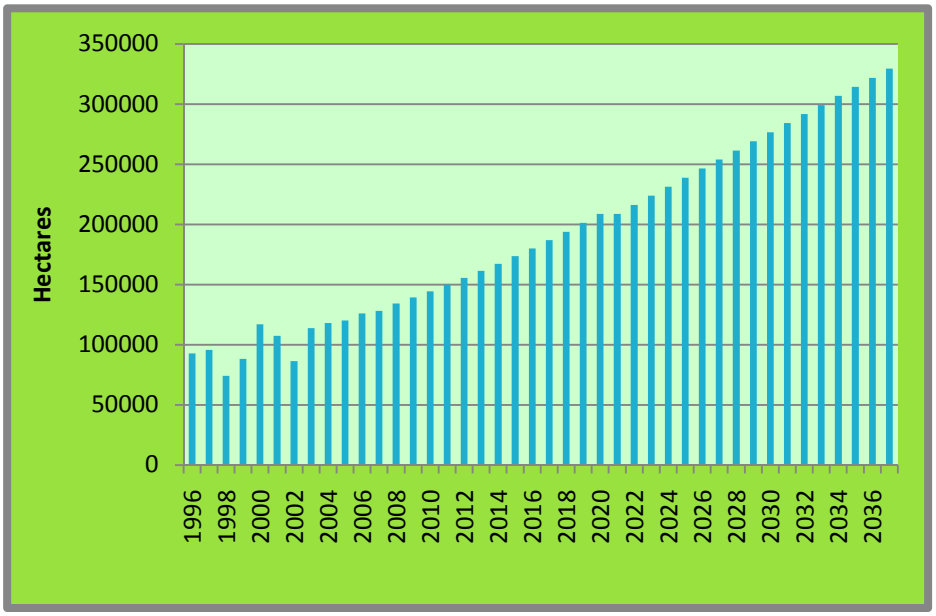
(a) *Note*: The discount rate is 10%.

THE OPPORTUNITY COSTS OF A CESSATION OF CONVERSION TO OIL PALM IN PNG IN 2012

The production of fresh fruit bunches is by company plantations surrounded by smallholders. Company mills, at the operational centres of the nucleus estates, process production from the estate and the peripheral smallholder plantations. The regional benefits of palm oil are examined in Appendix 6.

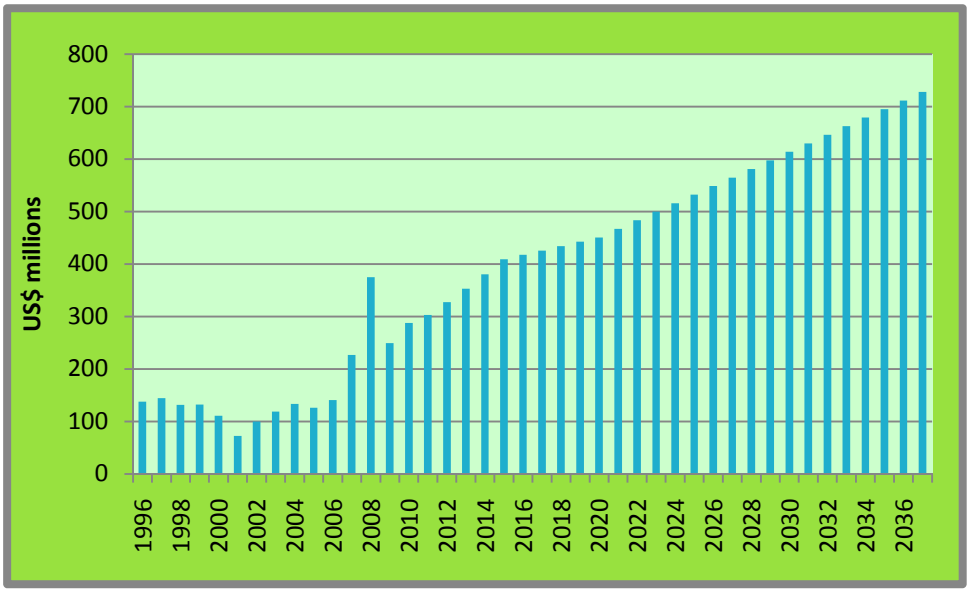
Figures 5 and 6 show the area of oil palm and export value of palm oil, actual and projected, respectively, for PNG. Expansion of the industry is expected to continue for the foreseeable future, given the strong demand for palm oil and palm oil products. Under BAU the area of oil palm is expected to reach about 33,000 hectares by 2037, and exports are expected to be worth over US$700 million.[10]

FIGURE 5: AREA OF OIL PALM, ACTUAL TO 2008, BAU PROJECTED TO 2037



Sources: PNG Oil Palm Research Association (2007; 2009); Author's projection from 2009.

FIGURE 6: VALUE OF PALM OIL EXPORTS, ACTUAL TO 2008, BAU PROJECTED TO 2037



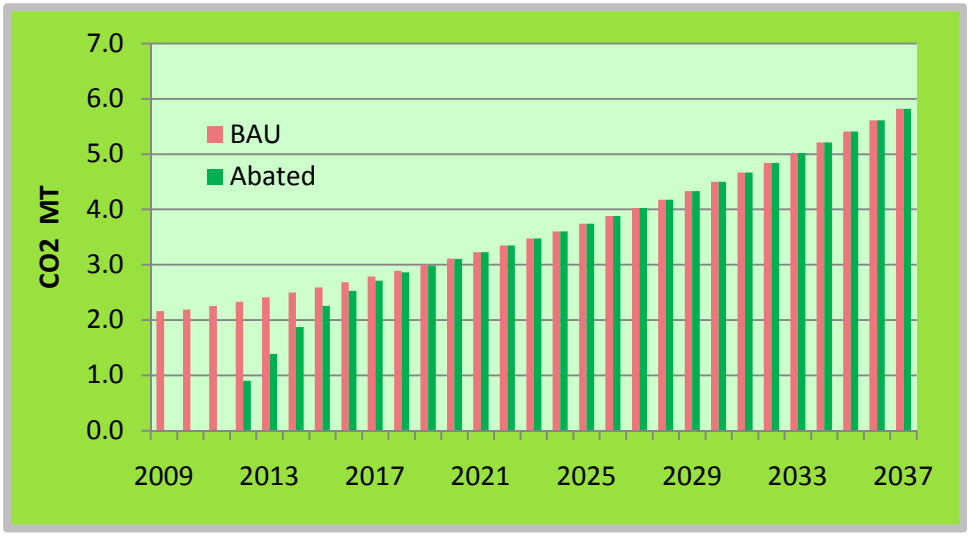
Sources: Bank PNG (various); Author's projection from 2009.

The annual reports for only one of the five production companies in PNG, New Britain Palm Oil, are publicly available. The annual reports of the four other companies, three owned by Minneapolis-based Cargill, are not accessible. However, New Britain Palm Oil is responsible for half PNG's production and export. Production, income, government tax and expenditure by PNG-based palm oil companies can thus be estimated with a reasonable level of confidence. Company expenditure on goods (including the production of smallholders) and services and wages, much at regional level in a decentralised industry, is estimated to total US$370 million in 2008. The profits of smallholders are estimated at 30 per cent of receipts.

Figure 7 shows the emissions from oil palm and the abatement achieved by a cessation of the establishment of new plantations from 2012. Emissions abated are expected to approach 6 million tonnes of CO_2 by 2037. Figure 8 shows the nominal values of the opportunity costs and the incidence of costs. National income foregone and export income

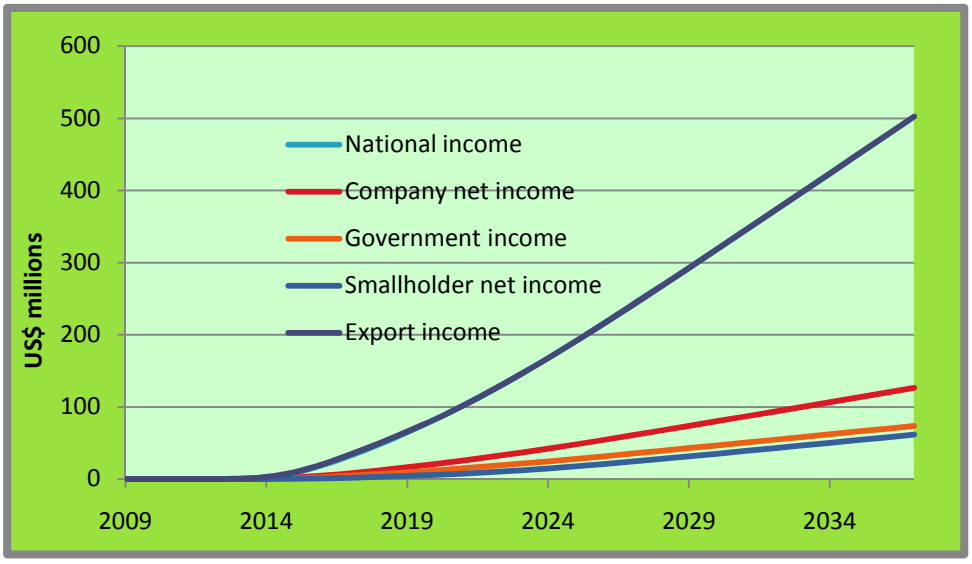
foregone are estimated to reach US$500 million by 2037. The method of the estimation of the opportunity costs of the cessation of oil palm establishment is detailed in Appendix 7.

FIGURE 7: CO_2 EMISSIONS FROM OIL PALM, ACTUAL TO 2008, MEDIUM BAU PROJECTED TO 2037 AND ABATED FROM 2012



Sources: Fox et al. (2090); Author's projections from 2009.

FIGURE 8: OPPORTUNITY COSTS OF CESSATION IN EXPANSION OF OIL PALM 2012-2037, NOMINAL VALUES



Source: Author's projections.
Note: National income and export income appear as one line.

RESULTS FOR THE OPPORTUNITY COSTS OF PALM OIL

The present value of the opportunity cost per tonne of CO_2 abated in the case of a cessation in the conversion of forest to oil palm is much higher than for logging. The opportunity cost in terms of export income and national income is US$36.54 and $36.39 per tonne of CO_2 respectively, in terms of stakeholders US$18.43, made up of palm oil company net profit $9.16, smallholder net profit US$3.93 and government tax US$5.34 (see Table 3).

TABLE 4: QUANTITY OF CO_2 EMISSIONS MITIGATED BY CESSATION OF CONVERSION TO OIL PALM AND OPPORTUNITY COSTS, 2012 TO 2037

Abatement CO_2TM		Opportunity Cost (P.V.) US$/T$CO_2$	
Total	95.5	Smallholders	3.93
Average per year	3.4	Government	5.34
		Companies	9.16
		Total Stakeholders	18.43
		National income	36.39
		Export income	36.54

Source: Author's estimates.

The industry aims to reducing its carbon footprint by establishing one third of new oil palm plantations on already cleared land (PNG Oil Palm Research Association 2009).

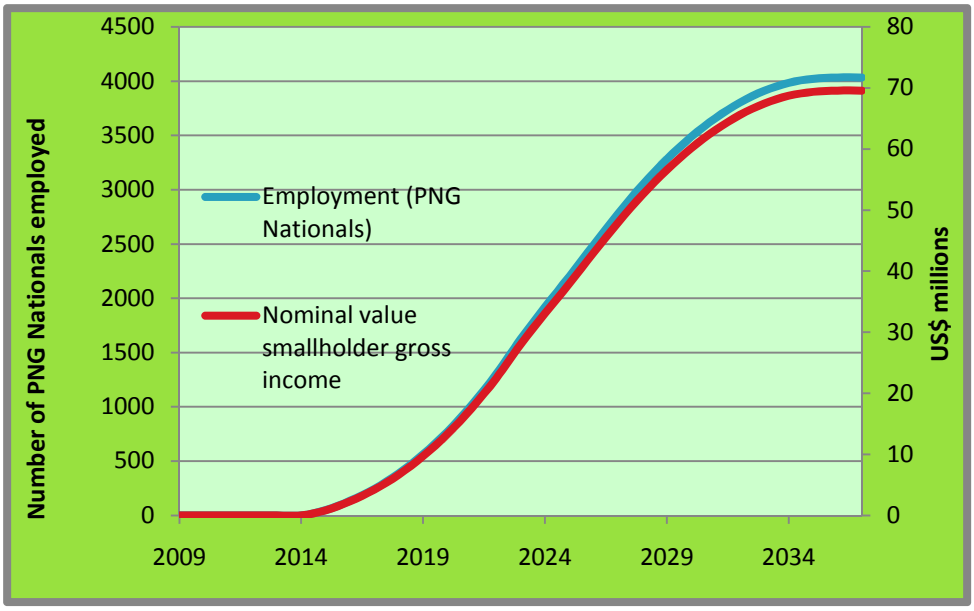
SOCIO-ECONOMIC OPPORTUNITY COSTS

Regional employment and incomes would be affected by a cessation in logging and new oil palm establishment. It has been estimated (FAO 2005) that 8,000 landowners at any one time receive monetary benefits through the provision of wage labour to logging companies.

In 2008 there were almost 14,000 PNG Nationals employed in the industry as well as 52,000 smallholders supplying the mills (PNG Oil Palm Research Association 2009).

An illustration of the social costs incurred by the cessation of new oil palm in 2012, is the estimation that the loss in employment by PNG nationals would peak at 4,000 and the loss in smallholder gross receipts at over US$70 million, as a result of the cessation in new oil palm plantings (see Figure 9). (No estimate is made in the increase in number of smallholder as this will depend on the expansion in area planted by existing smallholders.)

FIGURE 9: EMPLOYMENT AND NOMINAL VALUE OF SMALLHOLDER GROSS INCOME FOREGONE WITH CESSATION IN CONVERSION TO OIL PALM 2012-2037



Source: Author's projections.

ISSUES IN COMPENSATION

The incentive for stakeholders to accept REDD is the receipt of income at least comparable with that which they would have received under BAU. The national government must be concerned that compensation matches not only its tax revenue foregone, but that it is also paid at a level, and designed to be in a form, that generates a similar level of national income.[11] A developing country such as PNG might take the stance that export income, necessary for funding imports, is an important indicator of compensation.

In PNG, the likelihood is that the multinational companies involved in log and palm oil exports would move their investment and business offshore.[12] This would result in not only the loss of export income but also the cessation of the considerable spending by the companies on wages, goods and services that contribute to national income.

In addition to issues of national economy there are also imposing development issues in relation to REDD. The industries targeted for REDD, logging and palm oil, are both decentralised, contributing to regional employment and smallholder income generation, which are otherwise scarce, and to regional aggregate demand. The industries would appear to have an important role in restricting the drift to urban centres where there is high unemployment and a high level of crime.

A benefit of compensation to landowners for REDD is that it would be in the form of an annuity rather than as a one-off payment, as for logging royalty. In PNG, in the case of REDD compensation for logging, some US$40 million (in nominal terms) would be available annually for landowners. It is not immediately apparent what the regional development alternatives are that do not use the forest resources or land converted from forest. (An alternative is to pay the REDD annuity in cash to each landowner. But such cash annuities would be in even smaller amounts per landowner than log royalty, and would likely to be consumed.)

The discussion would be incomplete without reference to forestry activities that might increase as a result of a cessation in industrial export logging. These include illegal logging and small-scale forestry, emissions from which would go unrecorded and would undermine abatement under a REDD initiative.

While the administration of REDD scheme faces challenges in the negotiation of adequate national compensation that is also equitable for stakeholders, it also faces a challenge of ensuring that that REDD payments by donors to government actually reach the stakeholders.

ISSUES IN BIODIVERSITY CONSERVATION

There is asymmetry in the availability of funds for environmental services. Funds for carbon retention are not matched by funds for biodiversity conservation and REDD funds will tend to be deployed where abatement is cheapest regardless of the biodiversity value of the forest protected.

This bias needs to be corrected by incorporating in REDD schemes strategies that maximise biodiversity conservation, see for example Laurance (2008) and Venter et al. (2009).

CONCLUDING COMMENTS

The modelling of the expected business as usual trajectories of these industries enables the estimation of opportunity costs in terms of present value of income foregone, as follows:

- net profits and incomes of stakeholders (landowners, smallholders, governments, logging and palm oil companies)
- export income
- national income.

This approach recognises that opportunity costs are borne by stakeholders other than companies; that is, government, landowners and smallholders. Taking a national approach – an approach which it is argued is likely to be taken by PNG and indeed all tropical developing countries interested in receiving REDD compensation – means that compensation should deliver benefits at least equal to the benefits foregone by the nation. A regional approach is also required that recognises the considerable benefits foregone of a cessation of export logging. The regional benefits of export logging are analysed in some detail in the report.

In the case of oil palm in PNG, stakeholder and national opportunity costs are sufficiently high to rule out REDD as an economical option. That is unless there is a marked rise in international prices paid for CO_2 emissions abated.

While the cost of REDD compensation in the case of logging will likely exceed US1.00 billion, in present value terms, its price per tonne of CO_2 is still reasonable and delivers a large quantity of abatement. However, an enormous challenge for PNG is the design of management arrangements that delivers compensation that is effective in development terms. This is particularly the case for payments to the customary owners of the forest resource but also for spending that generates national income.

The likely relocation offshore of PNG and logging and palm oil companies raises the important issue of leakage and brings into focus the need for regional or even global approaches to managing abatement of emissions by REDD.

APPENDIX 1: ABATEMENT ALTERNATIVES IN PNG FORESTRY

While this paper focuses on a cessation of logging, the feasibility of the enhancement of carbon stock recovery in logged areas through post-harvest reforestation and through reduced impact logging need to be discussed, as both activities qualify under REDD-plus.

The collateral damage of logging causes large gaps in the forest canopy which encourages the growth of low-value pioneer tree species and shrubs. These gaps can be filled with transplants of desirable species, an activity termed enrichment planting or 'reforestation naturally'. Rehabilitation of logged-over areas should enhance the value of regenerating forest, making a second cut by loggers more economical and more likely. However, enrichment planting is hard to justify economically and has not been successful in PNG even though levies have been collected for that purpose. Moreover, such rehabilitation may not increase the sequestration rate of carbon by the forest given that pioneer species are faster growing than desirable species. And if rehabilitation does enable a second cut then the carbon loss and environmental losses incurred are increased.

Collateral damage from selective harvesting presently generates large quantities of decomposing biomass, including tree crowns, non-merchantable forest and adjacent trees killed, and was found to release 45 TC/ha (Fox et al. 2009). It is generally recognised that the most effective way to reduce emissions and enhance regeneration is to carefully plan and control the harvesting process. However, logging companies see no benefit in reducing collateral damage; the evidence is that adherence to the *Logging Code of Practice* (PNGFA 1995) is very patchy (Hunt 2002).

Payments to logging companies for reducing their carbon emissions through low impact logging would need to be relative to emissions under the logging code of practice, rather than against emissions under present practice. Estimating the abatement achieved in this way is likely to be technically difficult and high cost.

APPENDIX 2: COMPULSORY LEVIES SUMMARY

Royalties. Paid to landowners on whose land the trees were felled, at a fixed rate for each species and thus varying with the species mix being harvested. The gross royalty is calculated to average K13.86/m^3 country-wide (FIA 2009). Changes can be made by Ministerial notice to each permit holder. The PNG government applies a five per cent royalty 'withholding tax' to the royalty proceeds.

Project Development Benefit. A progressive levy based on FOB values. The levy is collected by the National Forest Service and distributed on the basis of outcomes of the responsible committees, the proportions of cash and development funds being negotiable. The PDB replaced the Producer Development Levy that specified the proportions of cash and development funds payable (see section *Royalties and Development Benefits* above).

Log Export Development Levy. A flat tax at K8.00/m^3 exported (plantation logs exempt). Administered by central government agencies and distributed on the basis of proposals submitted by provincial and local area governments. *Forestry (2007 Budget Amendment) Act 2006*, of the *Forestry Act 1991*, Section 121A, Log Export Development Levy.

Log Export Tax. A flat rate of 28.5 per cent of FOB values (plantation logs exempt). *Customs Tariff (2007 Budget Amendment) Act 2006*, Section 3.

Reforestation Levy. K2.00/m^3 raised by the PNGFA. Previously, 60 per cent was applied to project area and 40 per cent to PNGFA-owned plantations but its allocation is now at the discretion of the PNGFA.

Agricultural and 'Other' levies. Negotiated at project commencement and dispersed by provincial governments.

APPENDIX 3: REGIONAL BENEFITS OF EXPORT LOGGING

Forest resources have an important potential role in development given their regional distribution. The *Forestry Act 1991* and the *Forestry (Amendment) Act 1993* established a set of resource acquisition procedures designed primarily to safeguard the interests of customary landowners against the risk of being misrepresented by a small number of self-interested individuals. Under Section 46 of the Act the rights of the customary owners of the forest resources shall be fully recognised and respected in all transactions affecting the resource. Sections 54 to 60 of the Act prescribes a process of acquisition in which the Papua New Guinea Forest Authority (PNGFA) enters into Forest Management Agreements (FMAs) with the customary owners, whose title is either vested in land groups incorporated under the *Land Groups Incorporation Act* or registered under a law providing for the registration of title to customary land.

After the PNGFA has bundled together the forest resource in the FMA, it is allocated to successful private tenders for export logging under permit. The government then appropriates a proportion of the resource rent by means of export taxes, royalty and customs duties based on the FOB prices of logs and paid by permit holders. Once log revenue from the export of logs is generated, the landowners share is in two parts, a flat royalty and development levies. The royalty and a small development levy are based on log volumes, while the major development levy is based on the FOB price of logs. Royalties and levies are further analysed below and Appendix 2 summarises all forestry levies.

ROYALTIES AND DEVELOPMENT LEVIES

The royalty payment on volume harvested is made directly to landowners whose trees are felled and varies depending on species' value. It is estimated that the PNG-wide payment averages K13.86/m^3 before allowing for a government tax of 5 per cent (FIA 2009).
From January 1 2007, the Log Export Development (LED) levy raises K8.00/m^3 of total logs exported (with the exception of plantation logs). A Log Export Development Committee allocates monies from the trust account on the basis of acceptable plans for the purposes of

agricultural and infrastructure development in logging areas submitted by Local-level or Provincial government.[1]
The LED supplements the Project Development Benefit (PDB)[2] which from 1996 has been raised against FOB prices of logs on a progressive basis (see Table A.1).

TABLE A1: THE PROJECT DEVELOPMENT BENEFIT

FOB[a] value of export logs, Kina/m^3	Rate [b] of PDB, Kina/m^3
0-90	8
91-110	12
111-130	15
131-150	18
151-200	23
>200	23 + 7.5% of FOB>200

Note: (a) FOB=free on board.
(b) Rates applicable from 1998.

Unlike royalties and the LED, which are applied at a flat rate on volume exported, the PDB is based on FOB value and is progressive. Moreover, the kina amount received depends on the exchange rate. The PDB in 2009 was K23/m^3 on the current average price of K186/m^3. The price is derived from the FOB price in US$, converted at the Bank South Pacific TT buy rate every Monday.

A Project Development Levy (PDL) was designed to replace the infrastructure requirements in the earlier timber permits, specifying that 40 percent of proceeds was to be paid in cash to all groups in a concession, ostensibly to fund local social and business development,

[1] *Forestry (2007 Budget Amendment) Act 2006*, Section 121A. Log Export Development Levy.

[2] Previously known as the Project Development Levy (PDL).

while 60 percent was paid into Project Area Development Funds for the provision of infrastructure in actual project areas, the expenditure being managed by committees.

The PDL has since been revoked and succeeded by the PDB; rates were unaltered but the proportions paid in cash and development funds became negotiable between permit holders and landowners. See Appendix 2 for a summary of levies.

The establishment of the rate of the benefits received by landowners from the exploitation of their forest resources is made difficult by the negotiability of the PDB, both in respect to proportion of cash and project funds and the degree to which permit holders make cash payments as a supplement or as a substitute for project funds.

The Review Team (2004) estimated that the total value of landowner benefits in operational logging projects was K26/m^3 of log exports, which is only slightly above royalty plus PDB payment estimated by this report to be between K20/m^3 and K23/m^3 for the years 2002 to 2004. Another estimate by FIA (2007) puts the cash and in-kind payment at K14/m^3 in 2008.

The administration of the PDB is in the hands of Project Development Committees, comprised of landowner representatives, provincial forest management committee representatives (usually the Provincial Administrator or his nominee) and the project operator as observer. On the other hand, the LED is administered by the secretaries of National Planning and Finance and the Papua New Guinea Forest Authority.

A further complication in valuing development benefits is the uncertainty that surrounds the actual delivery, in the form of infrastructure or socio-economic benefits that have resulted from deployment of both the PDB and LED. Accumulated LED funds held in the Internal Revenue Commission's Trust Account should have amounted to K45 million in mid-2009 at the levy rate of K8/m^3. Accounting for such development funds dispersed to provincial governments may be problematic, however. For example, it was reported in the *Post-Courier* (2009) that the Gulf Provincial Government had failed to account for some K2.6 million kina received in Log Export Development Levies in 2007, and K2.1 million received in 2008, from five projects.

A conservative approach is taken in this report in the estimation of the benefits received by landowners from the logging of natural forests. No allowance is made for in-kind and cash benefits over and above royalty and development levies; in other words it is assumed that

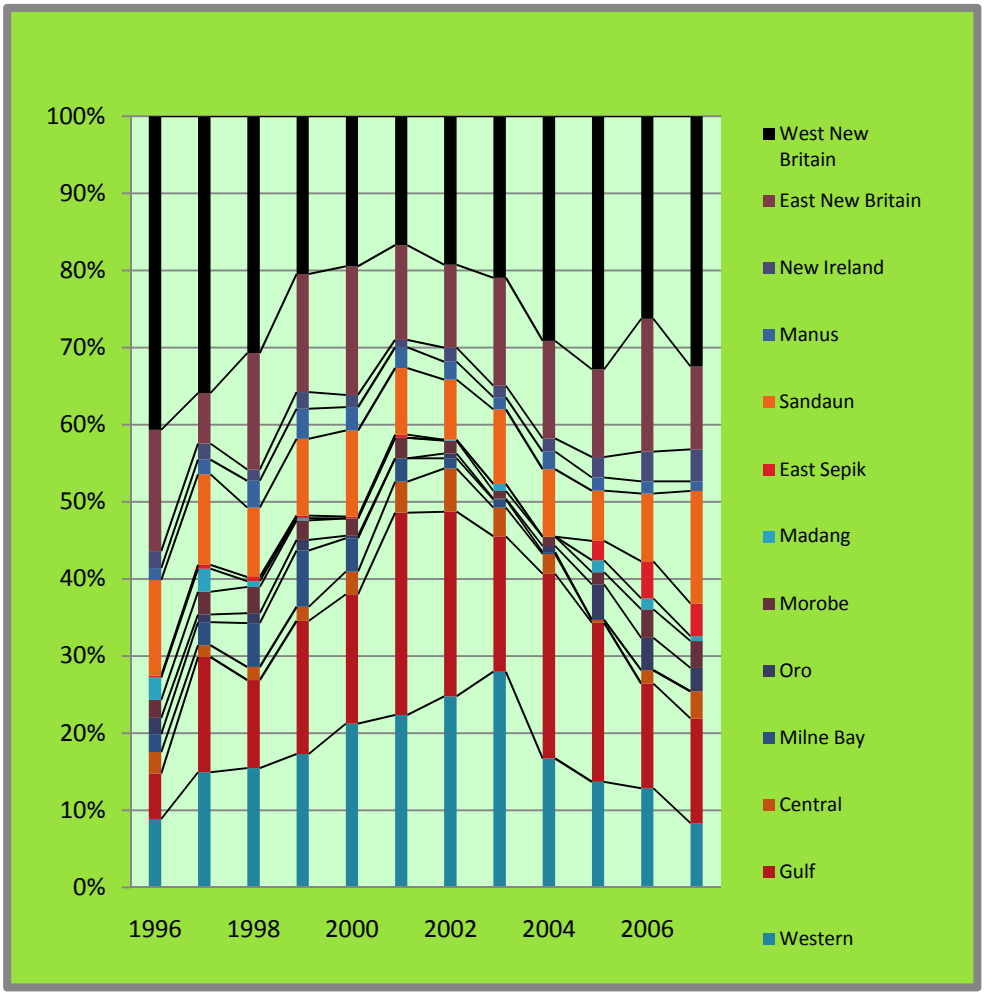
such benefits that were paid substitute for development levies. An analysis of the benefits received by landowners based on the above suggests that the landowner share of log export income has been fairly constant for the years 2000 to 2007 at 13 per cent (see Figure 2) rising in 2007 with log volumes, values and with the restructuring of the landowner royalty and levy. In the period 1996 to 2008 landowners received a total of K296 million in royalties and K309 million in development levies.

The expenditure of the cash and development payments at the local level has a multiplier effect given that a proportion of the payments received by local suppliers of goods and services will be spent locally. ACILTasman (2008), in an economic analysis of the proposed PNG LNG project, estimated that half the receipts of landowners would be spent locally. We have no information on expatriate wages. Assuming half of all landowner royalties and development levies have been spent locally, and that the multiplier is 1, then the regional benefit of landowner payments has averaged about K50 million annually since 1996.

DISTRIBUTION OF REGIONAL BENEFITS

While the relative regional contributions to log volumes have fluctuated since 1996, the provinces that have remained dominant as sources of export logs are West New Britain, East New Britain, Sandaun, Gulf and Western (see Figure A2.). The financial benefits in 2007 were received mainly by West New Britain, Gulf, Western, East New Britain, and Sandaun. (see Figure A3).

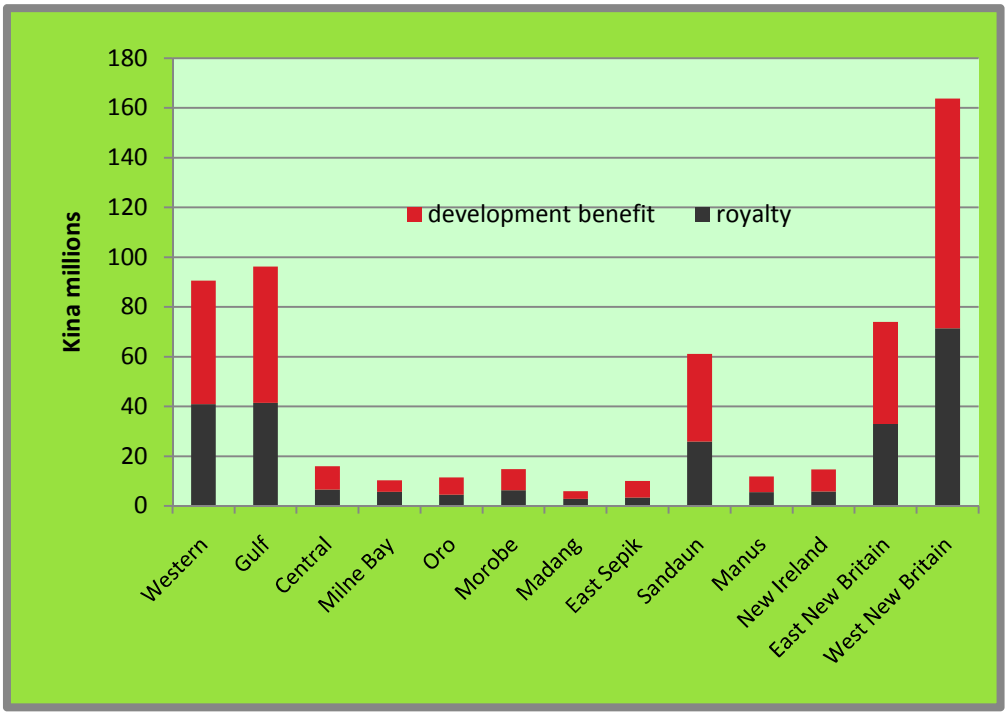
FIGURE A1. PROPORTION OF LOG EXPORT VOLUMES BY PROVINCE



Source: SGS (various).

On the assumption that landowner benefits have been proportional to log export volumes, the total financial benefits to landowners of log exports between 1996 and 2007 can be allocated to provinces. Figure A4. identifies the cumulative benefits by province, illustrating the dominance over time of West New Britain and of four other provinces, Sandaun, Gulf, East New Britain, and Western, as recipients of landowner income and benefits from log exports.

FIGURE A2. VALUE OF LANDOWNER ROYALTY AND DEVELOPMENT BENEFIT BY PROVINCE, 2007



Source: Various.

APPENDIX 4: THE NATURE OF REGIONAL BENEFITS OF INDUSTRIAL LOGGING

It should be emphasised that the forest resource in each Incorporated Landowner Group (ILG) is logged out in one or two years, so that the cash benefits are temporary. There are a limited range of investment opportunities locally, and the absence of local banking services hampers household and collective community investment and savings. Much of the money received is spent in a way that produces little visible long-term benefit, and spin-off businesses die when the project they rely on is completed (FIA Undated). The fall in income when the loggers have moved on is reflected in trade store purchases. Leklek (1996) measured trade store turnover before, during and after logging. He found a large increase in spending, falling away after logging but still remaining above pre-logging levels.

The development levies, on the other hand, should generate longer lasting regional benefits. As far as is known no audit has been carried out on the development impact or economic impact of these transfers. According to the Review Team (2004) landowners often resent the fact that they contribute to the costs of government but do not receive government services in return. A summary of reviews emphasised that landowner incomes were too small to have a development impact and that regional services were not provided by government in proportions to tax the log taxes it receives (Forest Trends 2006).

INFRASTRUCTURE BENEFITS

The World Bank emphasises the positive livelihood benefits of improved rural road infrastructure (World Bank 2007). Economic and social benefits to landowners of infrastructure associated with log harvesting and processing are not confined to roads. Bridges and culverts, airstrips, urban development, and forestry plantations created by logging companies are also important.

An audit of 49 logging projects by Groome Poyry (1998:33) confirmed that 30 had delivered infrastructure that qualified as a credit against the required payment of Project Development Levies, with a total of K43 million. While rural roads have positive poverty reduction benefits (Hughes 2005), logging roads typically have a limited life given that bridges are only temporary structures and the post-logging maintenance necessary to keep

dirt roads functional, especially in undulating country with high rainfall, is absent; '[T]he post-logging sustainability of these benefits is often questionable due to a lack of resources and inattention to infrastructure maintenance by government, once the logging companies withdraw' (FIA undated :1). A summary of industry reviews reached similar conclusions (Forest Trends 2006).

The Wawoi Guavi project in Western Province where Rimbunan Hijau has two timber processing plants, Panakawa and Kamusie, is one of few examples where the timber industry can claim to provide relatively enduring regional infrastructure, including roads, airfields, wharves, air services, health clinics, and schools. Global ITS (2006) presents data sourced from Rimbunan Hijau that shows that in the period 1993 to 2005 the Wawoi Guavi project in Western Province spent a total of K8.0 million on such infrastructure plus K92.9 million on road infrastructure, much of it of benefit to the local community. The air and medical services are used by local people and 100 children attended the Kamusi School. It is also claimed by ITS (2006) that such infrastructure spending in the project areas was greater than that provided by the provincial government and would not have been forthcoming from the provincial or national government.

According to the representative body of the logging industry, a disincentive to investment by logging companies in value adding projects elsewhere and in plantations, is the fact that land is held under customary tenure. The FIA (undated:1) stated that: 'Logging companies see themselves constrained by a lack of resource security to underpin major investment of capital in processing facilities and forest development, plantations and/or intensive post logging forest management.'

EMPLOYMENT BENEFITS

It has been estimated (FAO 2005) that 8,000 landowners at any one time receive monetary benefits through the provision of wage labour to logging companies. Survey data suggested a wage rate of K60 per fortnight (Siuta 1998, cited by Kocher Schmidt et al. 1999: Table 4) and an annual wage benefit of K12.5 million. If employment levels have been maintained and wages have kept pace with inflation then the 2008 wage benefit would have been about K30 million. Assuming a multiplier of 0.7 on local expenditure of K15m suggests a secondary benefit from wages of K10 million.

The large timber processing facility at Wawoi Guavi employed 1,500 people and another 300 contract workers. Accommodation and free medical water and power are provided the workers who are mainly recruited from elsewhere in PNG (ITS Global 2006: 39).

APPENDIX 5: ESTIMATION OF THE OPPORTUNITY COSTS OF A CESSATION IN EXPORT LOGGING IN 2012

The multiplier is as follows:

Multiplier $= 1 / 1- b_c+b_i$ (1)

Where:
b_c = marginal propensity to consume
b_i = marginal propensity to import.

Estimation of national income opportunity costs is in (2).

AD=(LE+T+R+D)*1 (2)

Where:
AD= Aggregate demand=National income
LE=Logging company expenditure
T=Government log export tax receipts
R=Landowner royalties
D=Landowner development
1= Multiplier

The present cost per tonne of emissions abated, in the case where government tax receipts, landowner royalties, landowner development benefits and profits to logging companies are foregone, is in (3).

The present cost per tonne of emissions abated, in the case where log export income is the opportunity cost, is in (4).

The present cost per tonne of emissions abated, in the case where national in the economy is the opportunity cost, is in (5).

$$OCS=\sum_{n=1}^{19}(T_n+R_n+D_n+(LE_n*0.3))/(1+r)^n/\sum_{n=1}^{19}CO_{2n}/(1+r)^n \quad (3)$$

$$OCEI=\sum_{n=1}^{19}EI_n/(1+r)^n/\sum_{n=1}^{19}CO_{2n}/(1+r)^n \quad (4)$$

$$OCNI=\sum_{n=1}^{19}AD_n/(1+r)^n/\sum_{n=1}^{19}CO_2n/(1+r)^n \quad (5)$$

Where:
OCS=Opportunity cost stakeholders
OCEI=Opportunity cost export income
OCNI=Oppotunity cost national income
EI=Export income
n=years 2012-2028
CO_2= CO_2 emissions abated
r= 0.1

APPENDIX 6: REGIONAL BENEFITS OF OIL PALM

Palm oil contrasts with other agricultural crops in Papua New Guinea in that, instead of production being mainly smallholder based and dispersed, it is concentrated around processing mills in 'nucleus estates' managed by the oil palm companies and supplemented by production from adjacent smallholder-managed blocks.

Most land in Papua New Guinea is held under customary tenure and the state is the only non-citizen body eligible under law to enter into dealings over customary land. The unwillingness of landowners to transfer their land to the state creates a shortage of agricultural land available for estate development. Nevertheless, the nucleus estates have been able to overcome this potential shortage and expand their areas under production through 'lease, lease-back' arrangements that give the estate developers freedom in management and security of tenure. The attractions of lease, lease-back to the landowners are the receipt of regular land lease and royalty on production payments from companies together with low labour opportunity costs. For a detailed description of lease, lease-back, see (Hunt 2002).

There are five established projects areas in Papua New Guinea; by far the largest is at Hoskins in West New Britain, where New Britain Palm Oil has 60,000 hectares under oil palm plantations out of a total area of 128,000 hectares in estates. Hargy Oil Palms at Bialla in West New Britain and Higaturu Oil Palms at Popondetta in Oro Province together make up a third of the total, while Milne Bay Estates and Poliamba Ltd in New Ireland make up the remaining sixth in area (Oil Palm Research Association 2007). Higaturu Oil Palms, Milne Bay Estates and Poliamba Ltd are all owned by the Minneapolis-based company Cargill.

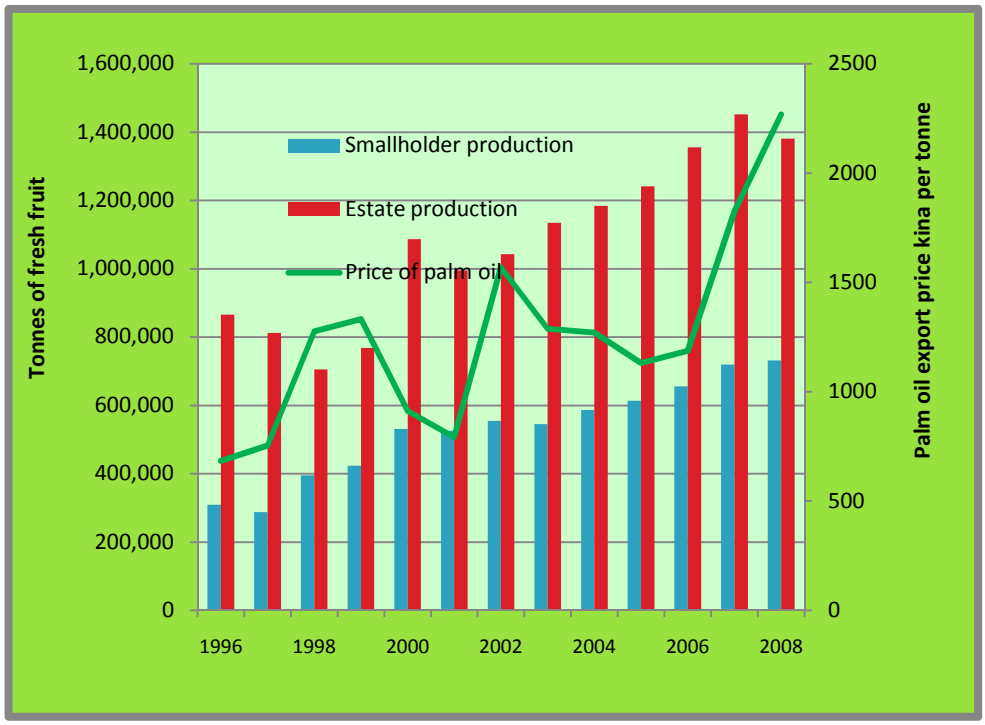
A number of new projects have recently commenced. Ramu Agri-Industries in the Ramu Valley began processing production from 6,500 hectares in 2008 and this is associated with a developing smallholder scheme in the Markham Valley. Planting has commenced in Bereina area of Central Province and the Aitape and Bewani areas in Sandaun Province. Feasibility studies have been conducted in other locations including the Sepik River in East Sepik Province, near Madang Town and on North West Bougainville Island (Bourke and Harwood 2009).

SMALLHOLDER SCHEMES

The smallholder scheme was initially based on a Land Settlement Scheme system which granted settlers 99-year leases over blocks of at least six hectares of land purchased from customary owners. Since the mid-1990s the Land Settlement Scheme has been supplemented by the Village Oil Palm System which provides smallholders with blocks of two to four hectares on customary owned land under a Clan Usage Agreement that gives the blockholder security of tenure and usage rights over the land. These formal arrangements have been further supplemented in West New Britain by informal arrangements between migrants and owners of customary land. A variation on the above is the Community Oil Palm Development Scheme at Bialla, where landowners have pooled their resources and manage their own plantations with the support of Hargy Oil Palm Ltd (Bourke and Harwood 2009).

The smallholders themselves plant, manage and harvest the fresh fruit which is collected and transported by the companies for milling; the companies also provide inputs and credits to smallholders. Smallholders need to maximise their labour output and a favourable characteristic of smallholder oil palm is that returns to labour are high relative to other crops (Bourke and Harwood 2009: Table 5.20.1). Because of financial, managerial and transport restraints, smallholder yields are usually less than for estate oil palm (World Bank 2007). Nevertheless, smallholder production has increased steadily over the last decade in response to higher prices (see Figure A.5), and production from smallholder blocks makes up 33 per of the total from 45 per cent of the planted area.

FIGURE A4. SMALLHOLDER AND ESTATE PRODUCTION OF OIL PALM AND THE NOMINAL PRICE OF PALM OIL, PNG



Sources: Bank of Papua New Guinea (various); PNG Oil Palm Research Association (2007; 2009).

The economic benefits of palm oil production in regional areas is enhanced by the employment of workers on the nucleus estates and at processing mills. The total workforce averaged 16,500 in 2008, the vast majority being PNG nationals (Oil Palm Research Association 2009). Extrapolating from the financial accounts of New Britain Palm Oil (2008: 33), on the basis that this company is responsible for about half PNG's production, suggests that several hundred million kina was spent in Papua New Guinea by palm oil companies in wages and payments to suppliers of product. The regional impact of spending wages and purchases of goods and services is enhanced by the multiplier (see Appendix 7).

INFRASTRUCTURE AND SOCIAL BENEFITS

The palm oil companies provide substantial infrastructure and social benefits in the regions in which they are located. A tax credit is available to the companies for approved expenditure on infrastructure; New Britain Palm Oil spent K5.7 million on roads in 2008 under this scheme. In addition the companies are important providers of education infrastructure and services, as well as public buildings such as police stations and staffed health centres (BSi Management Systems 2008: 35). New Britain Palm Oil provides health care for a total of 26,000 people, and had a total enrolment in its schools of 2,621 in 2008 (New Britain Palm Oil 2008: 22, 24).

APPENDIX 7: ESTIMATION OF OPPORTUNITY COSTS OF A CESSATION IN ESTABLISHMENT OF OIL PALM FROM 2012

Estimation of national income opportunity costs is in (6).

AD=(CE+T)* 1 (6)

Where

AD=Aggregate demand=National income

CE=Palm oil company expenditure

T=Government income tax receipts

1=Multiplier

The present cost per tonne of emissions abated, in the case where government tax receipts, and profits to palm oil companies and smallholders are foregone is in (7).

The present cost per tonne of emissions abated, in the case where palm oil export income is the opportunity cost, is in (8).

The present cost per tonne of emissions abated, in the case where national income in the economy is the opportunity cost, is in (9).

$$OCS=\sum_{n=1}^{28}(CP_n+S_n+T_n)/(1+r)^n/\sum_{n=1}^{28}CO_{2n}/(1+r)^n \quad (7)$$

$$OCEI=\sum_{n=1}^{28}EI_n/(1+r)^n/\sum_{n=1}^{28}CO_{2n}/(1+r)^n \quad (8)$$

$$OCNI=\sum_{n=1}^{28}AD_n/(1+r)^n/\sum_{n=1}^{28}CO_{2n}/(1+r)^n \quad (9)$$

Where:
CP=Palm oil company net profits
S=Smallholder net profits
T=Government income tax receipts
EI=Export income
n=years
CO_2= CO_2 emissions abated
r= 0.1

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ENDNOTES

[1] All dollars are US$.

[2] See Houghton (2003), Houghton (2005) and Canadell et al. (2007). More recent estimates are that deforestation and degradation generates about 12 per cent of anthropogenic CO_2 emissions (Le Quéré et al. 2009; van der Werf et al. 2009).

[3] Although Stern did add that "This level of financial incentive would offset lost agricultural income to producers, *although it would not reflect the full value chain within the country*" (emphasis the author's) (Stern 2006: 610).

[4] The underpinning principles of REDD-plus are:

- REDD-plus finance mechanisms should be sufficiently robust to deal with in-country and international leakage, use credible baselines, must achieve verifiable additionality, and result in value for money.

- REDD-plus should lead to real reductions in CO_2, enhance forest ecosystem functions and the supply of critical ecosystem services, protect and respect the rights of Indigenous Peoples and local communities, and ensure equitable benefit sharing.

- In addition to reducing emissions from deforestation and forest degradation REDD-plus finance mechanisms should also create incentives for additional actions in forest conservation, sustainable forest management, and the enhancement of carbon stocks REDD-plus processes should allow the broad participation of all stakeholders, on equitable terms, at the national and international levels (The Forests Dialogue, 2010).

[5] A market approach to REDD requires that a tonne of CO_2 abated by forest conservation equates a tonne abated by all other means. Given the idiosyncrasies of forests this will be difficult to guarantee, therefore a funds-based approach is most appropriate until the problems of abatement by REDD, in terms of monitoring, verification and reporting, are solved (Hunt 2009).

[6] This level of aboveground carbon is much lower than estimates for equivalent forests in South-east Asia, where estimates are for 240 to 260 T/ha (Fox et al. 2010:6). An explanatory hypothesis is that carbon stocks in PNG are reduced by the frequency of disturbances, including ENSO related droughts and associated fires, landslides and shifting agriculture (Fox et al. 2010).

[7] Harvesting is selective in that logging companies concentrate on removing high value species with diameters greater than 50 cm.

[8] One tonne of C=3.67 tonnes of CO_2.

[9] It is generally agreed among researchers in the field that the accessible forest resource will be exhausted by 2025 if the current rate of logging continues (Fox et al. 2010:1).

[10] This expansion does not include the possibility of conversion to oil palm under “special agricultural and business leases”, (also called agroforestry projects), recently granted to private companies, that have a combined area of 1,500,000 hectares and mostly not already logged (Filer 2009: 23,24,25). Such projects require infrastructure. In the case of oil palm development the need is for a palm oil mill in proximity to the plantations, necessitating a very large investment. Nevertheless, as Filer (2009) points out, if two or three of these

projects evolve into large-scale developments, the prospect is for even higher growth than has been forecast in this paper.

[11] Pagiola and Bosquet (2009) make the point that if compensation and forestry activities have different economic impacts then the opportunity cost needs to be adjusted accordingly.

[12] See Pirard (2008) for a discussion of the implications of post-REDD investment strategies of companies in the Indonesian pulp sector.