A ‘REDD+iness’ program for Papua New Guinea:

A strategy to promote sustainability and growth

A report for PNG Forest Industries Association

November 2010

ITS global
CONSULTANTS ON GLOBAL ISSUES

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Independent Expert Reviews

Two development experts on PNG were invited to undertake an independent review of this report. They were Ron Duncan, Emeritus Professor at the Crawford School of Economics and Government, Australian National University, and Tim Curtin, associate on the Asia-Pacific program of the Australian National University and former development consultant in PNG,

Ron Duncan, Emeritus Professor

This paper makes excellent arguments for the need to clear additional forest area in order for the welfare of Papua New Guineans to be improved.

If the welfare of the vast majority of Papua New Guineans is to be improved, agricultural employment opportunities and incomes have to be greatly increased. Adding to this challenge is the rapid growth of the population. With population increasing at around 2.5 percent annually, just ensuring food security at the current level means that agricultural productivity has to increase at this rate or that the area of land farmed has to increase at around 2.5 percent annually. With earnings from coffee, palm oil, and cocoa the major source of cash incomes for the majority of rural people, increases in cash incomes for the growing population also depends on increases in the planted area of these cash crops or increases in their productivity. As the paper says:

> *Limiting or stopping the clearance of forest will condemn the rural population to declining standards of subsistence, while denying them the option to improve their standard of living in the future*.

Further,

> *Strong population growth in a rurally-based society is not compatible with restrictions on land use or land clearing. Access to cleared land is the critical ingredient for economic development in PNG.*

The paper also makes an excellent argument for the development of palm oil in PNG. The global market for palm oil is very promising, with both China and India generating strong demand as their incomes increase. For this reason, the opportunity cost of not increasing palm oil production is higher than for other crops. Therefore, to analyse the benefits of REDD+ on the basis that the opportunity cost of not clearing is subsistence cropping is significantly underestimating the value of the clear forested areas.

The report also raises strong doubts in the reader's mind about the credibility of information about the amount of carbon sequestration through REDD+ and the effectiveness of management of a REDD+ scheme in Papua New Guinea.

Ron Duncan, Emeritus Professor

Crawford School of Economics and Government, ANU College of Asia and the Pacific

Tim Curtin, Associate

This is an excellent review.

However I feel there is a case for inserting much more material on the structure of REDD, and also for a discussion of some of the ethical issues that are inherent in REDD. The first of these is the danger that REDD payments if any ever materialise will have the character of "sit-down" money, whereby persons currently engaged in productive activities that generate incomes may well be induced by REDD to abandon work, resulting in the welfare dependency that, as Australia's indigenous population knows from bitter experience, is morally degrading.

The second, even more important, ethical consideration was highlighted by a recent seminar at the ANU, when three Indonesians challenged the basis of AusAid's REDD project in their country, which as they put it is nothing more than an evasion of Australia's responsibilities for reducing its own emissions, by using the carbon credits generated by its REDD schemes to secure emission reductions in Indonesia to justify maintaining Australia's emissions.[1]

Tim Curtin, Associate, Asia-Pacific program, Australian National University

[1] Teguh Surya, Muliadi and Arie Rompas, 2010, *Implications of Illegal Logging for Deforestation and Forest Degradation,* Joint RMAP and Indonesia Project Seminar presentation at Australian National University

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Executive Summary

The economic impact of cessation of clearance of forest land

The agriculture sector contributes one-quarter of PNG's gross domestic product (GDP) and drives much of the rural economy. The commercial agriculture sector is based around plantation tree crops and is a major exporter, including crude palm oil. The oil palm sector is important for generating jobs and incomes in rural areas of PNG.

Over 80 percent of the Papua New Guinea (PNG) population directly depends on their local environment for their daily needs through subsistence agriculture. With current population growth averaged at 2.8 percent a year and continued growth expected, there is a need to convert primary forest to expand agricultural production as well as to accommodate expansion of subsistence agriculture and settlements to house the expanding population. Strong population grown in a rurally-based society is not compatible with restrictions on use or clearing of forest land, particularly in PNG's case where ample provision is already made to set forestry aside for conservation.

Drafts of the report "Climate-compatible development for Papua New Guinea" which is being prepared by the Department of Environment and Conservation concede primary forest needs to remain available to support extension of agriculture, but proposes this should not apply in the case of Palm Oil.

Cessation on conversion of primary forest to oil palm would mean that PNG would deny itself the considerable prospective economic benefits that expansion of its oil palm estates would deliver. While further research on the carbon cycle of Palm Oil is required, current indications are that over time, the change in sequestration by converting primary forest to Palm Oil would be only a small decrease, or more likely an increase, as there are field data showing that oil palm trees sequester far more CO_2 per hectare per annum than tropical forest. This is easily confirmed by the fact that PNG's annual exports of refined palm oil contain far more carbon per tonne than is present in either standing timber or logs. Palm oil has an annual fuel oil yield per hectare that is more than double the next best (coconut oil), and FOUR times more than corn (maize, heavily subsidised by the USA government). [2]

The oil palm industry has expanded at a faster rate than other tree crops, and is now the top agriculture export earner. Over the next decade, the prices for vegetable oils are expected to be more than 40 percent higher in real terms than they were over the period from 1997 to 2006. As the expansion of oil palm offers the most promising economic prospects for PNG and its rural population, PNG cannot afford to restrict development opportunities for those forest areas (all in lowland coastal areas) that are suitable for conversion to oil palm from an agronomic perspective.

This is amply illustrated by the consequences of denying availability of primary forest (not reserved) for palm oil. An oil palm project on 12,000 hectares of land in East New Britain is capable of yielding revenue of almost K3 billion over 25 years and creating 3,000 jobs annually. The development would support a community on existing forest estate earmarked for conversion, of 15,000 persons. Estimates of available primary forest suitable for palm oil and oil palm expansion vary. A conservative estimate is that oil palm plantations could expand by 422,000 hectares over 25 years. The current national area of oil palm plantation is

[2] Oak Ridge National Library, "Bioenergy Conversion Factors", accessible at http://bioenergy.ornl.gov/papers/misc/energy_conv.html

estimated at approximately 128,000ha. Extending the model referred to above, this would yield revenue of over K104.3 billion to the PNG economy over 25 years. It would also create 105,500 direct jobs annually and impact 537,500 people in households, who rely on income from the production of palm oil. If one million hectares is restricted from being converted, this cost increases to over K247 billion in lost revenue over 25 years, 250,000 direct jobs annually and would negatively impact the lives of over 1.25 million people. This is the benefit potentially foregone if available primary forest is denied conversion to oil palm.

Rates and causes of deforestation in PNG

There is plenty of land available for oil palm plantations, even after land is set aside for conservation. Approximately 30 million hectares (67 percent) of PNG land area is forested and much of this forested area is located in rugged, hilly or inaccessible terrain. As a result approximately 30 percent of total forest land (137 000km^2 is commercially viable for logging or conversion into agricultural lands according to Forest Inventory Mapping. In addition, almost 20 000 km^2 is legally protected under the Department of Environment and Conservation framework (equivalent to 4 percent of total PNG terrestrial area and approximately 15 percent of total forest area suitable for commercial logging). The proportion of agricultural land in PNG is small, just over 2 percent of PNG total land area. The amount of land currently used for oil palm plantations is also minimal – an estimated 1300km^2.

Deforestation rates in PNG have been overstated in a politicised environmental campaign. Forest clearing in PNG is largely contained and any further restrictions on forest conversion are unnecessary. Population growth and the need for economic development in PNG require some natural forest land to be used for other purposes.

Commercial forestry and agricultural expansion are not driving deforestation in PNG. Drivers are specific to geographic, social, economic and political contexts – there is no one universal cause of deforestation, as causes are both myriad and specific to time and place. A moratorium on forest conversion of primary forest would achieve few measurable conservation goals, while creating incentive for destructive and illicit practices and have negative impacts on PNG's economy and economic development.

State of knowledge of carbon emissions from PNG

The commitment of the Government of PNG to become carbon neutral by 2050 is laudable, PNG's emissions are small and, as advised by leading development economists[3], developing countries should not initially undertake stringent carbon mitigation emissions because of the damage that will do to economic growth, but rather begin with modest measures and expand them gradually over time as their economic capacity to pay for them rises.[4]

PNG is ranked 153rd out of 196 countries in terms of carbon emissions per capita, by the World Bank. Carbon emissions from PNG have been decreasing in recent years, with current emissions less than those in the 1970s.

As noted in the draft DEC report, there is little research on carbon emissions and carbon stock in PNG. What little research there is available is often based on weak and unreliable science. Specific scientific studies measuring carbon emissions from PNG are extremely limited. The Australian Centre for International Agricultural Research on the environmental

[3] Such as Professor Willian Nordhaus, the Sterling Professor of Economics at Yale University.
[4] See for example, World Growth December 2007 "The Real Climate Threat to Developing Countries – Early Deep Cuts in Emissions, http://www.worldgrowth.org/assets/File/WG_The_Real_Threat.pdf

sustainability of oil palm cultivation in PNG found that there is no detailed knowledge of carbon sequestration and GHG emissions in PNG.

Preliminary estimates of carbon stocks in PNG have been conducted by the University of PNG Remote Sensing Centre[5], however the results have been criticised as being unreliable as the study has been found to overestimate both the initial area of intact primary forests and the actual rate of logging, while it ignores the capacity of regenerated forests to absorb carbon dioxide.[6]

Prospects for economic gains for PNG from sequestration and trading in carbon

REDD+ is based on the concept that countries such as PNG will define a baseline of future rates of deforestation and forest degradation. This has obvious implications for legitimate measurements of GHG inventories and policy responses may be unfairly biased against deforestation.

If a permit trading approach is used, consumption, production technologies and emission levels will be indirectly affected. That will have adverse consequences for the future capacity of the PNG economy to improve living standards.

Palm Oil is recognized by the World Bank as one of the most successful crops for reducing poverty and establishing economically self-sustaining livelihoods. This means the potential economic gains considerably exceed the initial returns cited above.

Policy measures that affect the prospects for rural sector growth need careful assessment. PNG does not have the economic wealth to impose highly restrictive environmental policies that curtail development.

[5] Shearman P., Ash, J, Mackey B, Bryan J.E, and Lokes B, *The State of Forest in Papua New Guinea: Mapping the Extent and Condition of Forest Cover and Measuring the Drivers of Forest Change in the Period 1972-2002*, University of Papua New Guinea, Port Moresby, 2008.

[6] Filer, C., Allen, B.J., Keenan, R.J. and McAlpine, R.J., Deforestation and Forest Degradation in Papua New Guinea, *Ann. For. Sci.* Vol.66, No. 8, 2008.

1. Introduction

Papua New Guinea is developing a strategy to prepare for participating in REDD+ programs to improve sustainability of forestry and land use in PNG and to support a strategy to enable PNG to contribute to global programs to reduce the impact of climate change.

The REDD+ initiative attempts to assist developing countries in implementing strategies to reduce carbon emissions through the reduction of deforestation and forest degradation. Common presumptions in global strategies to reduce carbon emissions include that:

- forestry and plantations are contributing to significant emissions of greenhouse gases because of the methods of harvesting, including development on peat land; and
- a moratorium and even a full cessation of clearance of forest land is necessary.

This report examines the implications for the PNG economy of adopting measures which halt or restrict conversion of primary forest land for other purposes.

It also provides a brief overview of the three issues which are considered as relevant to the case for imposing a moratorium or permanent restriction on conversion of primary forest. They are:

- prospects for economic gains for PNG from sequestration and trading in carbon;
- rates and causes of deforestation in PNG; and
- the state of knowledge of GHG emissions from PNG.

2. The economic impact on the PNG economy of cessation of clearance of forest land

Papua New Guinea (PNG) is one of the most heavily forested countries in the world and has the largest area of tropical rainforest in Oceania. It is also one of the poorest.

Over 80 percent of the PNG population directly depend on their local environment for their daily needs through subsistence agriculture.[7] Hunting and gathering provide people in rural areas with meat, fungi, and building materials. They grow the rest of their food by clearing patches of forest to grow yams, taro, and other staple vegetables. Each garden is cultivated for a few crop cycles before being abandoned and a new patch of forest cleared to replace it. In the absence of animal or mineral fertilisers, such a system of land rotation is essential — abandonment allows the forest to regenerate thereby restoring the fertility of the soil.

While the rural standard of living in PNG has sometimes been characterised as one of 'primitive affluence'[8], the central problem with any system of subsistence agriculture is that it does not allow for an increased standard of living. Indeed if population growth outstrips the carrying capacity of the countryside, a decline in living standards and out-migration are the most likely consequences.

To raise living standards, developing countries have actively sought to accelerate their economic development. Among other things, this has involved their development of commercial agricultural sectors with a strong export orientation. Where developing countries are fortunate enough to have a significant forest estate, this can be complemented by the parallel development of a commercial forestry and plantation sectors. Unlike manufacturing and services, both of these natural resource-based sectors have the capacity to raise living standards in rural areas.

The extension of subsistence agriculture to cope with population growth and the development of commercial agriculture to raise their living standards necessarily involve changes in land use. These changes in land use can be significant and can involve the permanent removal of the original forest cover. The same is true for the development of commercial forestry as well as the maintenance and extension of the roads system on which all successful economic development ultimately relies.[9]

Limiting or stopping the clearance of forest will condemn the rural population to declining standards of subsistence, while denying them the option to improve their standard of living in the future. In PNG there is no conflict with policies to protect the environment or biodiversity. Ample forest land has already been set aside for those purposes.

2.1 Impact on subsistence agriculture

Almost 70 percent of PNG's total rural population lives in Momase and the Highland regions. Within the Islands, the Highlands and the Southern region more than 90 cent of the

[7] National Statistical Office, *PNG Census 2000 National Report*, National Statistical Office of Papua New Guinea, Port Moresby, Papua New Guinea, 2000.

[8] Ernest K Fisk *New Guinea on the Threshold: Aspects of Social, Political and Economic Development*, Australian National University Press, Canberra, 1966.

[9] In PNG the construction of roads, bridges and culverts in rural areas can require the extensive use of logs and timber due to the absence of economically viable substitutes.

population lives in rural areas. Only Rwanda, Bhutan, Nepal and Uganda have a greater proportion of people living in rural areas than PNG.[10]

The rural population lives off 25.6 percent of the land area of PNG.[11] Around 98 percent of the cultivated area in PNG is used for subsistence agriculture, albeit with wide variations in the intensity of its use by the local population (the balance is used for commercial agriculture). At any time, the vast majority of PNG's cultivated land is in fallow, covered by secondary forest at varying stages of regrowth. To those unfamiliar with shifting cultivation systems, such land may appear to be unused.

The Government's Medium Term Development Strategy focuses on expanding both subsistence and commercial agriculture to meet the needs of a rapidly growing rural population.[12] Population growth is one of the constraints identified by the Strategy.

PNG has a population growth rate well above the average for developing countries. Between 1980 and 2000, it averaged 2.8 percent a year.[13] Subsequent estimates suggest that the PNG population has continued to grow strongly.[14] Rural population growth has been especially strong in the Highlands region where the economic development options are even more restricted.[15]

Population growth increases the need to convert primary forest to expand subsistence agriculture and provide settlements to house the additional people. Accordingly there is a strong correlation between population growth and land use changes.[16]

PNG is also experiencing high levels of internal migration from one province to another, which add to population pressures in the receiving provinces.[17] Significant numbers of people are moving temporarily and permanently, largely for economic reasons. Young men migrate more often than young women but increasingly whole families are moving.

The 1980 Population Census revealed there was net emigration from the Gulf, Simbu, Manus, Central, Southern Highlands, East Sepik, Enga and Milne Bay provinces over the decade to the previous Census.[18] In 2000 the major population losses were in the Gulf (27.6 percent of its population over the previous decade), Manaus (17.6 percent), Simbu (16.6 percent), and East Sepik (16.1 percent). West New Britain, Bougainville, and Western Highlands provinces all gained migrants. Similar patterns were evident from the 1990 and 2000 Censuses. The major gains were in the National Capital District (76.9 percent), West New Britain (30.1 percent), Morobe (8.0 percent), and New Ireland (6.8 percent). [19]

Strong population growth in a rurally-based society is not compatible with restrictions on land use or land clearing. Access to cleared land is the critical ingredient for economic

[10] Bourke, R., and Harwood, T., *Food and Agriculture in Papua New Guinea,* Australian National University, Canberra, 2009.
[11] Ibid, Table 1.2.1, p. 36
[12] Ministry for National Planning and Monitoring, *Medium Term Development Strategy 2005-2010*, Strategy prepared for the PNG 2005 National Budget, Port Moresby, Papua New Guinea, 2004.
[13] ITS Global estimates based on the PNG Censuses for 1980 and 2000, National Statistical Office data
[14] FAO (Food and Agriculture Organisation of the United Nations), 'PopSTAT', *FAO Statistical Database on Population*, FAO, Rome, 2009a
[15] Bourke and Harwood
[16] Ningal, T., Hartemink, A.E., and Bregt, A.K, 'Land Use Change and Population Growth in the Morobe Province of Papua New Guinea between 1975 and 2000, *Journal of Environmental Management,* 87, 2008, pp. 117-124.
[17] Bourke and Harwood
[18] Net migration measures the difference between the population movements into and out of a given province.
[19] Bourke and Harwood

development in PNG. Over time such restrictions will simply intensify land use pressures. If local opportunities for subsistence agriculture, rural employment, or participation in the formal economy are artificially limited, the pressure for people to migrate from their village areas will increase.

2.2 Impact on commercial agriculture

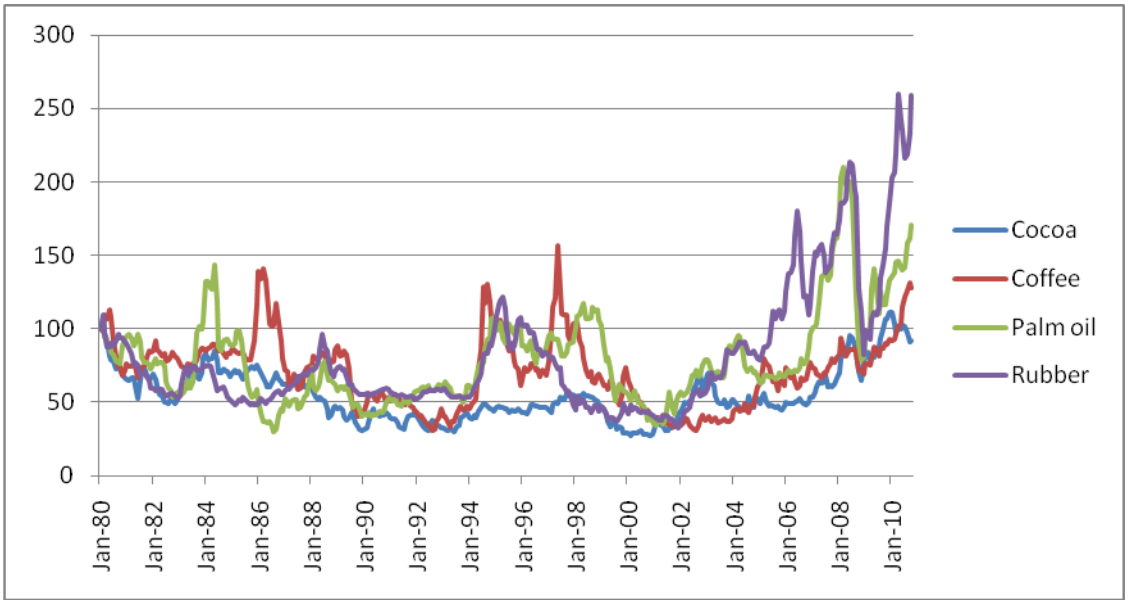
The agriculture sector contributes one-quarter of PNG's gross domestic product (GDP), which drives much of the rural economy. The commercial agricultural sector is dominated by both plantation and small holder production of tree crops and is a major exporter, mainly in the form of crude palm oil, coffee, cocoa, and copra products. In 2008, the sector accounted for around 15 percent of all PNG export earnings, made up of:

- crude and refined palm oil — K1,012 million;
- coffee —K520 million;
- cocoa — K346 million; and
- copra — K248 million. [20]

Since 2005 the value of PNG's agricultural exports has surged, led by crude palm oil (up 159 percent), copra (up 123 percent), cocoa (up 74 percent), and coffee (up 10 percent). The strong export performance reflects the increases that have occurred in world commodity prices over the period in question, as well as the significant expansion of oil palm plantings that has occurred over the past decade.

Chart 3.1 shows indices of the monthly prices in US dollars for cocoa, Arabica coffee, crude palm oil and rubber since January 1980. Since 2001 world prices for rubber and palm oil have more than trebled in nominal terms and are currently well above their January 1980 levels.

Chart 3.1: Index of monthly prices in US dollars, selected agricultural commodities



Source: IMF (2010)

[20] Bank of Papua New Guinea, *Quarterly Economic Bulletin*, June 2009, QEB statistical tables

The growing importance of smallholder producers in each of these industries is an indicator of the increasing involvement of rural villagers in commercial agriculture. Over time rural people are using more of their communal land to produce cash crops. As the population grows, expansion of smallholder tree crops will be important for the future growth in real incomes for rural households.

Access to appropriate forest land for the establishment of new tree crop plantations is a critical part of the development process for PNG. Hence any restrictions on changing rural land use will adversely affect rural populations both directly and indirectly. Both will be felt by smallholders

2.2.1 Impact on smallholders

The development of the export agricultural sector has been based on the nucleus estate and smallholder (NES) model. This model involves a developer establishing a large scale plantation estate with downstream processing facilities. The developer also facilitates establishment of smallholder plots on land surrounding the estate. The estate undertakes to purchase and process their output and provide technical advice to the smallholders in question.

The plantation development generally involves provision of infrastructure and services that not only directly facilitate the operation of the estate but also benefit the local community in other ways. The infrastructure generally includes roads and bridges, community centres, health services, education services, and telecommunications. Recent research has shown that there is a strong link between infrastructure development and poverty alleviation in rural areas of PNG.[21]

While large scale plantations of tree crops are important for generating jobs and incomes in rural areas of PNG, smallholders are now the main producers of most of PNG tree crops. They currently account for 84 percent of coffee, 90 percent of cocoa, and 33 percent of crude palm oil output. Over the period from 1990 to 2006 their shares of production of coffee and cocoa have increased progressively from 73 percent and 64 percent respectively.[22]

The World Bank has estimated that the cash returns to smallholders from oil palm in PNG are equivalent to about K2,793 per hectare per annum or K130 per working day. The cash returns from cocoa production are K1,136 per hectare or K21 per working day, while those from coffee are K2,058 per hectare or K13 per working day. A smallholder working a two-hectare plot of oil palm would receive a cash income of K5,586 a year, which is 74 percent higher than a full-time worker on the minimum wage can expect to earn in a year (K3,200).[23]

The regional production of plantation tree crops varies due to regional differences in growing conditions. Coffee is an important source of village income in the Highlands; coconut cultivation is restricted to coastal locations. Oil palm and cocoa are grown in particular lowland areas with adequate rainfall.

[21] The World Bank, 'PNG: Improved Infrastructure brings Economic and Social Growth', World Bank Group, Washington, DC, 12 January 2008
[22] Bourke and Harwood
[23] The Inspection Panel, *Report and Recommendation: Papua New Guinea: Smallholder Agriculture Development Project (SADP) (IDA Credit No. 43740-PNG)*, Report No. 53280-PG, The World Bank Group, Washington, DC, 10 March 2010,

As a consequence, the Government's Medium Term Development Strategy recognises the need for PNG to continue to establish large-scale, efficient NES plantation projects so as to increase the agricultural sector's contributions to GDP and to employment in rural areas. [24]

2.2.2 Impact on expansion of oil palm in PNG

The oil palm is very well adapted to the soils and climate of the areas of PNG in which it is grown and productive cultural techniques are well established.[25] Cessation of conversion of primary forest to oil palm would mean that PNG would forego the considerable prospective economic benefits from expansion of its oil palm estates to take advantage of the buoyant international outlook for crude palm oil.

Over the next decade, the prices for vegetable oils are expected to be more than 40 percent higher in real terms than they were over the period from 1997 to 2006.[26] PNG therefore cannot afford to restrict development opportunities for those forest areas that are suitable for conversion to oil palm from an agronomic perspective.

The World Bank has estimated that the economic returns to the PNG community as a whole from smallholder plantings (2 hectares) of oil palm are high, ranging from 13 to 18 percent a year with an average of nearly 17 percent a year.[27] On the basis of its estimates the Bank concluded that: 'Few alternative investments exist in rural PNG that have a higher rate of return'.[28]

The private returns to PNG smallholders from oil palm, however, are even higher. The World Bank has estimated them to range from 22 percent to 27 percent a year.[29] These results represent higher rates of return than any alternative smallholder investment opportunities. As a consequence, incomes are higher in the oil palm growing areas of PNG compared to other rural areas in the rest of the country.[30] It has also led the International Development Association to conclude that oil palm is the best vehicle for an investment project to improve rural livelihoods and boost exports in PNG.[31]

On this basis we conclude that the expansion of oil palm offers the most promising economic prospects for PNG and its rural population. This is underlined by the fact that oil palm has expanded at a faster rate than other tree crops and is now the top agricultural export earner. Although palm oil production is concentrated in a few regions of PNG, there is considerable scope to expand production into new areas provided expansion is not blocked by inappropriate restrictions on forest clearance.

Government estimates the increase in land area for palm oil at 5-6 percent annually. At this growth rate, the current estimated oil palm plantation area of 128,000ha[32] could reach almost 550,000ha in 25 years (an increase of 422,000ha).[33] Based on a case study of an oil

[24] Ministry for National Planning and Monitoring, 2004
[25] World Bank (2007)
[26] OECD (Organisation for Economic Co-operation and Development) and the FAO (Food and Agriculture Organisation of the United Nations), *Agricultural Outlook 2010-2019,* OECD and FAO, Paris and Rome, 2010.
[27] These results were insensitive to large changes in input prices (fertilizer and labour) and were not particularly sensitive to moderate changes in palm oil yields and prices. Overall the Bank considered that its estimates and assumptions were conservative (World Bank, 2007).
[28] World Bank, 2007.
[29] Ibid
[30] Ibid
[31] Ibid
[32] Bourke and Harwood
[33] Anecdotal evidence from people in the industry estimate potential land available for oil palm conversion at roughly 1 million hectares.

palm development of 12,000ha in East New Britain (see Case Study), cessation of conversion of primary forest to oil palm could cost the PNG economy K104.3 billion in lost revenue over 25 years. Restrictions would also cost 105,500 direct jobs annually, at a value of K562.7 million in lost wages and impact 527,500 people in households who rely on income from the production of palm oil.[34] The financial impact will increase dramatically when taking into consideration indirect benefits such as revenue to government, indirect employment and job creation, improved infrastructure and community facilities, improved delivery of basic services, etc.

The impact could easily be worse, in its 1998 Annual Report the Papua New Guinea Forest Authority made an allowance for an additional 4.4 million hectares of forest land to be converted to agriculture within 50 years[35]. The cessation on conversion to oil palm of an additional 1 million hectares of forested land could cost K247 billion in lost revenue,[36] 250,000 annual direct jobs and impact over 1.25 million people.

[34] Assuming an average household size in East New Britain of 5 persons
[35] This figure assumes an available 39.3 million hectares of forested land, of which 15.2 million hectares is productive and 24.1 million hectares is classified as protected or other.
[36] Based on the revenue of the East New Britain Project over 25 years

Case Study: Benefits from a Palm Oil Estate on converted forest from East New Britain

Land owners in East New Britain, wish to lease back forest land of 45,000 hectares for planned development, including an initial 12,000 hectares of oil palm over 5 years. If developed the project will produce the following benefits.

Total revenue from oil palm for the project is estimated at almost K3 billion.[37] The project will also generate financial benefits to local land owners in the form of rental fees on the land used by the project, royalties and levies on the palm oil, and the dividends paid on their equity in the project, etc. Other benefits to land owners come in the form of infrastructure and community development programs to be undertaken by the project, such as roads, bridges, culverts and wharf & jetties.

The oil palm project is also estimated to employ a workforce of approximately 3,000 local people annually, involving a local wages bill of around K16 million per year. In addition, labour will also be required for initial construction of infrastructure such as housing, buildings, roads, etc. It is expected that the developer would utilise approximately 1000 man-years of local labour during the construction phase.

Other expected economic benefits from the project include:

- spin-off businesses to local community;
- educational incentives on technology transfer when jobs are created and people are employed;
- increased revenue to the district and the province;
- improvement in delivery of basic services – schools, health centre, banking facilities, telecommunication, etc;
- export earnings (revenue) for the country;
- human resource development; and
- other indirect benefits in the form of long term and sustainable financial security, good shelter, better access to transportation and communication facilities, enhanced educational assurance for schoolchildren, contribution to the government's internal revenue, and export/foreign exchange earnings.

The project also has the possibility of further expansion to 30,000 hectares, commencing on the 6th year onwards.

[37] Revenues have been updated based on increases in market prices for oil palm

3. Rates and causes of deforestation in PNG

A significant area of forested land in PNG is legally protected. The country's physical geography – specifically rugged, mountainous and inaccessible terrain – serves to protect much of the remainder.

However, environmental groups have conveniently ignored these facts. They continue to mobilise international pressure to restrict forest conversion. In the case of PNG, they have also overstated the rate of deforestation. The proposed solution – a moratorium – is a political, rather than scientifically based conservation measure. Current rates of deforestation do not warrant a moratorium and the consequences of restricted forest conversion on PNG development.

A moratorium on forest modification will only address the symptoms, not the root causes of deforestation. Science demands that conservation measures are targeted, rather than blanket. The marketing mantra – 'one size fits all' – should not be the basis for developing complex environmental policy.

3.1 An overview of PNG land use

A large proportion of PNG is forested, yet much of this area is either officially protected or inaccessible to logging. Large-scale restrictions on forest conversion are superfluous and will have little measurable effect on biodiversity conservation. Papua New Guinea has a total terrestrial area of approximately 460 000 km^2. Of that, approximately 25 percent is cultivated lands, and another 5 percent uncultivated (predominantly grasslands and sago stands). Forested lands constitute the remaining area.[38]

Fig 3.1 Breakdown of Land Use – Cultivated, Uncultivated, Forested

Land-Use Category	Area (km^2)	% of Total Land
Cultivated land (total)	117 858	25.6
Uncultivated (total)	22 465	4.9
Forest	319 531	69.5
Total	**458 854**	**100**

Source: Bourke and Harwood 2009

Current and reliable data on PNG land use is scarce. Nonetheless, there is a general consensus as to the area of forested land in PNG. Some estimates have suggested approximately 30 million ha (67 percent) of the PNG land area is forested,[39] while other studies have suggested the area may be closer to 70 percent.[40]

The Forest Inventory Mapping (FIM) system calculates PNG's gross forested area at 330,000 km^2.[41] Much of this forested area is located in rugged, hilly or inaccessible terrain. As a result, only a small percentage is commercially viable for logging or conversion into

[38] Bourke and Harwood
[39] PNGFIA (Papua New Guinea Forest Industries Association), *Economic Analysis and Potential of PNG Forestry Industry*, Report prepared by PricewaterhouseCoopers, 2006.
[40] Bourke and Harwood
[41] Filer et al

agricultural lands. The Forest Inventory Mapping system calculates the potential production forest area at 137,000km^2 (approximately 30 percent of total forest land).[42] A significant portion of the forest available for commercial forestry operations is also protected through legislation and operating codes. The PNGFIA estimates that around half the land currently being acquired for commercial forestry utilization (some 60 000 km^2 out of concession areas totalling 122 000 km^2) is inoperable and will not be logged as it falls outside the operating limits imposed by PNG Government's Logging Code of Practice.[43]

Furthermore, almost 20 000 km^2 across 53 sites is already legally protected under the Department of Environment and Conservation framework (equivalent to 4 percent of total PNG terrestrial area and approximately 15 percent of total forest area suitable for commercial logging).[44]

3.2 Rate of deforestation in PNG

Deforestation rates in PNG have been overstated in a politicised environmental campaign. Forest clearing in PNG is largely contained; any further restrictions on forest modification are unnecessary given PNG's vast forested areas. Despite claims by NGOs, the conversion of forested areas to agricultural land in PNG has not been dramatic.

Traditional PNG agricultural techniques are based on shifting cultivation. This system involves a land use rotation process with a lengthy fallow period. During the fallow period regrowth occurs until the land is resumed for agricultural purposes. Most of the land categorised as 'cultivated' (Fig. 4.1) is extremely low intensity or left fallow.[45] As regrowth is occurring on this fallow land, much of this land constitutes modified and regenerated forest.

The proportion of agricultural land in PNG is therefore small. FAO data indicates that just over 2 percent of PNG total land area is agricultural.[46] The growth in agricultural land areas has not been excessive - it has increased by just 1630 km^2 since 1990.

Fig 3.2 Break down of PNG Land Use – Agricultural, Forestry and Other uses

		1990	*1995*	*2000*	*2005*	*2007*
Agricultural land	*'000 ha*	877	934	1 005	1 030	1 040
	change	..	57	71	25	10
*Forestry land **	*'000 ha*	31 523	30 828	30 133	29 437	29 159
	change	..	-695	-695	-696	-278
*Other land uses ***	*'000 ha*	12 886	13 524	14 148	14 819	15 087
	change	..	638	624	671	268

** Includes land used for commercial logging and other forest areas.*
*** Residual of total land area of 45,286 thousand ha - includes other wooded land and areas used for housing, infrastructure etc.*

Source: FAO 2009

[42] Ibid
[43] Operating restrictions under the Logging Code of Practice include provisions for establishing buffer zones and logging prohibitions on sloped terrain (PNGFIA).
[44] Department of Environment and Conservation (2010) Papua New Guinea's Fourth National Report to the Convention on Biological Diversity
[45] Bourke and Harwood
[46] FAO (Food and Agriculture Organisation) *ResourceSTAT – Land*, FAO statistical database on land & other resources, 2009.

In some cases, the land used for oil palm developments was previously used for forestry and fallowed land from subsistence agriculture. The amount of land currently used for oil palm plantations is minimal – an estimated 1300km^2.[47]

Deforestation rates in PNG have been overstated.[48] Forested land is still the dominant component of the total land area in PNG. Forested areas have declined since 1990 but the rate of change could not be described as a serious concern. Current rates of deforestation are derived by extrapolating trends from earlier inventory studies. According to the Forest Inventory Mapping system, between 1975 and 1996 the PNG forested area was permanently reduced through logging and land clearance by about 4 percent - within that, a significant area (almost 20 000km^2) is regenerating.[49]

Environmental NGOs have raised concerns about commercial logging activities but, in the context of the total forest area, the amount of land involved is small. The concerns are an overreaction - the amount of timber taken from the concessions is controlled and the government has a monitoring role in forest management agreements.

Population growth and the need for economic development in PNG require some natural forest land to be used for other purposes. It is necessary to recognise that neither forestry production, nor conversion to agricultural land, is a major driver of deforestation in PNG. Clear felling of land for forestry is not permitted in permanent production forest areas, while timber is removed selectively based on size and merchantability criteria. There is a formal allocation of land areas available for forest use and comprehensive legislative framework operating in the country.

3.3 Politicised conservation measures

Commercial forestry and agricultural expansion are not driving deforestation in PNG. The root causes of deforestation in PNG are more nuanced. A meta-analysis of the scientific literature identified that the causes of deforestation are both myriad and specific to time and place.[50] While there may exist some consensus of the proximate causes of deforestation – such as agricultural expansion, wood extraction, and infrastructure extension – the underlying drivers are complex social, political, economic, technological, and cultural variables. Causes are varied, but can include weak law enforcement, accessibility to technology (such as chainsaws), poorly defined property rights, and infrastructure developments that allow access and harvesting of previously remote forested area. It has been noted that poverty can drive the search for wood-fuel and clearing of land for subsistence farming, while population growth, urbanisation and industrialisation have been identified as underlying causes of forest conversion. The list of hitherto identified causes is indeed vast.

[47] Nelson P.N. et al *Environmental sustainability of oil palm cultivation in Papua New Guinea,* ACIAR Technical Report 75, Australian Centre for International Agricultural Research: Canberra, 2010.
[48] Filer et al
[49] In Bourke and Harwood
[50] Helmut Geist and Eric Lambin, *What Drives Tropical Deforestation?* University of Louvain, Belgium, 2001.

4. State of knowledge of carbon emissions from PNG

4.1 Deficiencies in carbon cycle methodologies

There are two key perspectives on the role of forest land in carbon emissions which underpin the REDD+ concept. Firstly, that restricting deforestation would allow the preservation of existing carbon sinks. Secondly, that forestry regeneration and the adoption of sustainable forestry practices would allow an expansion in carbon sinks. Consequently, the rate of selective tree removals from native forests, burning trash from clear felled forests and the draining of peat forest lands have become prominent points of discussion.

Most carbon assessments, including the UNFCCC accounting rules, do not adequately cover the full carbon cycle effect from changes in land use involving native forests. Forestry re-growth and the replacement of native forests with plantation tree crops are generally not considered. Such studies which measure carbon emissions from land-use change generally use gross changes in carbon stock – which assume that most or all of the carbon store of removed biomass is emitted. They do not include reductions for carbon sequestered in the vegetation of the replacing land-use or allow for carbon stores which are not emitted when trees are converted into other forms.[51]

The state of scientific knowledge of the contribution of forestry in tropical developing economies to GHG emissions is weak. According to the World Resources Institute, deforestation accounts for 12.2 percent of global greenhouse gas emissions and 15.9 percent of global CO_2 emissions (with a margin of error of ±50 percent)[52]. This report has been criticised by some experts who suggest it understates the extent of climate change and others suggesting it overstates the problem.

Research has shown that forest carbon stores[53] and carbon dioxide emissions from the conversion of tropical forests may be significantly overestimated.[54] Rainforests may actually store much less carbon than has been originally thought. Satellite mappings and ground surveys by the Carnegie Institute for Science have shown large variability in the density of apparently similar forests. The study found that in an area of forest that should have had approximately 587 million tonnes of carbon stored; only 395 million tonnes was actually stored – a third less.[55] Measurement of the amount of carbon stored in natural forest land with variable tree cover continues to be an issue in the global deliberations.

Additional research has also shown that oil palm plantations can actually increase carbon storage and that oil palm is more effective as a carbon sink than rainforests. For example, Tan and Lee (2009) found that oil palm plantations are more effective than rainforests as a carbon-sink, with oil palms capable of absorbing up to 36.5 tonnes of dry matter per hectare annually as compared with only 25.7 tonnes by rainforests. In addition, the annual net assimilation of carbon dioxide was shown to be higher for oil palm plantations as compared

[51] Skog and Nicholson found that wood and paper products in use and in landfills in the United States, had a carbon stock equal to over 15 percent of total carbon contained in all forest trees.
[52] World Resources Institute, *Climate Analysis Indicators Tool (CAIT)* Version 7.0, Washington D.C, 2010.
[53] Pearce, F., *Forest Carbon Stores may be massively overestimated,* NewScientist, 2010.
[54] Adam, D., *CO_2 from forest destruction overestimated – study,* The Guardian, 2009 .
[55] Pearce

with rainforests – 64.5 tonnes of CO_2 per hectare per annum for palm oil as compared with 42.2 tonnes.[56]

Measurement of carbon in agriculture becomes even more complex with traditional subsistence farming practises in countries like PNG. Transient agriculture means the natural forest is partially cleared and used for a limited period. It is then fallowed for a period of time and some forest regeneration occurs. There is a carbon absorption effect during this period.

4.2 Studies measuring carbon emissions from palm oil

Studies specifically targeted to measuring emissions from palm oil are concentrated on Indonesia and Malaysia. One literature review on the measurement of emissions from palm oil found large variations in existing estimates of carbon emissions and that not all measurement methods are reliable for measuring emissions.[57] In addition to large discrepancies in estimates, the margin of error used within existing studies was also found to be significant.

Even large global studies have been found to be inconsistent and unreliable. For example, oft-quoted figures on emissions from land use changes rely on research by the World Resources Institute[58]. It has been acknowledged by the author that the analysis has some weaknesses. The analysis calculated net sources and sinks of carbon resulting from land-use change in 9 world regions. It was based on data for rates of land use change and per hectare changes in carbon storage from the land use changes. Regional estimates were subsequently used to develop national estimates. Measurement uncertainties suggest the errors associated with the national estimates of emissions could be substantial:

- carbon emissions from tropical countries may be high by a factor of two;
- carbon stock estimates for tropical forests have an error margin of ±50 percent; therefore
- the estimates of national sources and sinks of carbon from land-use change have an error margin of ±150 percent.

4.3 Carbon emissions in PNG

PNG is not a significant emitter of GHG emissions. In fact, the World Bank ranks PNG 127th of 196 countries for total carbon emissions, and 153rd in terms of per capita carbon emissions – one of the lowest emitters in the world. The World Bank has also estimated that carbon emissions have been decreasing in PNG in recent years, with PNG emitting 3,363.6kt (0.5 metric tonnes per capita) of carbon in 2007, less than its emissions in the second half of the 1970s.

There is little research on carbon emissions and carbon stock in PNG, but recent analysis indicates that carbon stocks in PNG forests are generally lower than other forests[59]. Filer et al (2008) found that when estimates (of 84 and 125 tonnes per hectare in cut-over and primary forests respectively), are combined with the relatively low levels of deforestation in

[56] Tan, K., Lee, K., and Bhatia, A. 'Palm oil: Addressing issues and towards sustainable development', *Renewable and Sustainable Energy Reviews,* Vol 13. 2009, Pgs 420-427

[57] Brinkman Consultancy, *GHG emissions from palm oil production: Literature review and proposals for amendments of RSPO Principles and Criteria,* Draft Report prepared for RSPO, 2009.

[58] Houghton, R.A. *Revised estimates of the annual net flux of carbon to the atmosphere from changes in land use and land management 1850- 2000. Tellus*, *55B*(2), 2003, 378–390.

[59] Filer et al

PNG, carbon dioxide emissions are likely to be much lower than in commonly used estimates.

Sherman et al (2008) outlined preliminary estimates of carbon stocks in PNG conducted by the University of PNG Remote Sensing Centre by integrating field measurements of above and below ground live biomass from across PNG, a high resolution forecast map of PNG, and bioclimatic indices. The assessment found that there were approximately 4.7 billion tonnes of carbon stored in PNG's primary forests and secondary forests in 2002, stating that deforestation between 1972 and 2002 resulted in the release of a net 926.5 Mt of carbon (3,397 Mt of CO_2). However, the University of PNG study has been criticized in that it contains basic errors that are not supported by available evidence[60]. A review of literature by RSPO found that most technologies, such as remote sensors, have a 'medium to high' uncertainty as regards to quantitative results. The review also found that relying solely on ground assessments was not optimal. Conclusions drawn for similar ground assessments may also be unreliable as literature, such as Pearce, has found that there can be vast variability in the density of apparently similar forests.

Filer et al (2008) found that Sherman et al (2008) ignored the capacity of regenerated forests to absorb carbon dioxide, assuming that areas impacted by harvesting or shifting cultivation will inevitably degrade and become non-forest is also not supported by observation of cutover forest in PNG, and that a considerable proportion of cutover forest areas will recover carbon stocks after harvesting. In addition, the study incorrectly overestimated the initial area of intact primary forests and the impact of traditional land use practices on forest cover – stating that much of what is considered as deforestation is part of a cycle of traditional clearance for farming, fallow and regrowth that has been occurring for hundreds of years.

The World Resources Institute estimated that PNG's carbon emissions (for emissions sources other than from land-use change and forestry, principally fossil-fuel use and agriculture) are only 9 million tonnes of carbon dioxide equivalent (in contrast Australia's emissions are around 600 million tonnes). Emissions from land-use change and forestry, were estimated to be 146 million tonnes of carbon dioxide, however, this figure is doubtful as it was based on a global study[61] which is based on limited FAO data and has been acknowledged by the author that the analysis has some weaknesses.[62] Filer also criticise Houghton's findings, stating that it was derived from a global assessment of emissions on the "rather crude assumption" that all "rainforest nations" had similar rates of deforestation/forest degradation.

Specific scientific studies measuring carbon emissions from palm oil in PNG do not exist. A study by the Australian Centre for International Agricultural Research on the environmental sustainability of oil palm cultivation in PNG found that there is no detailed knowledge of carbon sequestration and GHG emissions in PNG, stating "there is only sketchy information for palm oil production systems and no systematic studies of the complete greenhouse gas balance".

[60] Ibid
[61] Houghton
[62] Howes, S. 'Cheap but not easy: the reduction of greenhouse gas emissions from deforestation and forest degradation in Papua New Guinea', *Pacific Economic Bulletin*, Vol. 24, No. 1, 2009

A study conducted by Hooijer et al (2006) included PNG as part of an assessment of South East Asian peatland carbon store[63]. The report found that forested tropical peatlands in South East Asia store at least 42,000 mega-tonnes of soil carbon. However, as there is no peat being developed for oil palm in PNG[64] the finding has little impact for carbon emissions in PNG. There are also methodological flaws in the report's basis for the 'rate' of deforestation as it calculates the trend as a linear relationship between two different sets of data and while it considers this conservative, it does not consider the methodological differences in the collection of each set of data which may skew the trend.

Clearly, there is insufficient data on carbon emissions from PNG and scientific knowledge and technical analysis behind general claims about the GHG emissions from forestry land use is not strong enough to make sound policy judgements. These deficiencies make it difficult to judge the net effectiveness of a REDD+ scheme to reducing GHG emissions in economies like PNG. It raises questions about the capacity of these economies to develop a carbon baseline from forest land use.

[63] Hooijer, A., Silvius, M., Wösten, H., & Page, S. *PEAT-CO2: Assessment of CO2 emissions from drained peatlands in SE Asia.* Delft Hydraulics report Q3943, 2006.
[64] Nelson et al

5. Prospects for economic gains for PNG from sequestration and trading in carbon

5.1 Deficiencies in carbon cycle methodologies: Implications for a carbon market

REDD+ (Reducing Deforestation and Forest Degradation) is a proposal developed by donors and developing economies to assist in implementing strategies to reduce deforestation and forest degradation. It is based on the concept that PNG will define a baseline of future rates of deforestation and forest degradation. The definition of a baseline for PNG requires reliable estimates of emissions based on quality and consistent data. Currently, reliable estimates of carbon emissions from PNG, including the oil palm carbon cycle, are very limited. Estimates of emissions from palm oil are not specific to PNG and vary greatly based on the source; they generally have large margins of error, creating uncertainty on the reliability of any such estimates.

With no specific agreement on how the REDD+ program is to be implemented in PNG, questions have been raised about the complexities of:

- the measurement of carbon sequestration and release rates;
- the time period, geographical location and definition of avoided deforestation;
- verification and compliance;
- determining the opportunity costs – and respective compensation arrangements – of avoided deforestation; and
- the need for a global administration or assessment agency and its implications for country sovereignty issues.

Despite the deficiencies in current methodologies there has been a tendency for climate change policy advisers to accept measurements and methodology, without adequate scrutiny. This has obvious implications for the GHG emission reduction strategies, such as the global trade of carbon, of forested developing economies such as PNG. If existing techniques are accepted as legitimate measurements of GHG inventories, policy responses may be unfairly biased against deforestation and commercial forestry as the way to reduce emissions. A suggested policy response has been to curtail the growth of the agriculture industry (including palm oil) by reducing the conversion of natural forests to oil palm plantations, through mechanisms such as a market for carbon rights. That market would need as a minimum to generate alternative income streams at least equal to those currently enjoyed by smallholders and employees of the existing oil palm operations. Such policies, over time, could lead to food security concerns and limit the prospects for employment and income growth to accommodate a growing population.

5.2 Problems with deriving benefit from the global carbon market

REDD+ is based on the concept that countries such as PNG will be able to 'sell' the rights to refrain from actions that will alter specified areas of natural forest. These rights may be 'exchanged' for direct aid funded by the tax payers of developed economies. Such direct aid payments are high risk to the recipients, as donor country governments are unlikely to guarantee future flows. Alternatively, they could be sold to domestic or overseas commercial interests seeking emission permits, and if the rights are sold as emission credits reliable methods of carbon measurement and the real net effect on global emissions will be essential.

If a permit trading approach is used, a cost is paid by producers of goods and services, indirectly affecting consumption, production and emission levels. If most land use changes are forestry and subsistence agriculture, the economic returns from locking up particular forest areas may be well below the returns available from those areas in terms of both food and cash crops.

The purchasing of carbon credits by developed economies is unrealistic and disagreement surrounding implementation, coupled with unreliable data and measurement techniques, makes the global trade in carbon permit appear to be unfeasible and not practical in the foreseeable future. The prospects for PNG deriving benefit from the global carbon market are poor. Even Shearman et al (2008) found that *"the current state of forest management and lack of effective governance means that PNG is a long way from being able to meaningfully participate in the carbon economy."*

Donors and officials recognize that there may be economic loss from halting deforestation and have proposed aid as compensation. If an aid exchange approach is used, behavioural change is confined to recipient countries. Funding programs from international agencies and aid donors have been established to assist in the implementation of the REDD+ initiative. Despite uncertainties surrounding the practicalities of the REDD+ concept, PNG and other forested developing economies have been invited to consider implementing a scheme. With the availability of new sources of aid money there may be an inclination to embrace the concept without adequately considering the by-product effects for economic development and social welfare – there is a significant opportunity cost for PNG from foregoing its most productive avenue to economic development and wealth creation.

The focus of UNFCCC deliberations has naturally centered on the environmental aspects of global warming. However, there is an overriding requirement that emission reduction strategies should not impede economic development. This concept is reflected in the 'Bali Mandate' which set the agreed terms of reference for the current negotiations among parties to the UNFCCC.

Environmental NGOs and some development agencies consider that a REDD+ scheme will lead to benefits for all participants. On the one hand they claim it offers a way to compensate or create financial incentives for developing countries in tropical regions to end deforestation and forest degradation, and potentially reduce GHG emissions. On the other hand commercial interests in the developed economies could gain a new source of emission permits if the scheme becomes part of a global trade in credits.

However, a REDD+ scheme that restricts land use options is unlikely to provide significant economic and development benefits for PNG. It will have consequences for the future capacity of the PNG economy to improve living standards. Population growth and land use constraints that curtail the growth of rural industries do not promote economic growth and appear contrary to poverty alleviation efforts. The rate of employment and income growth

will be constrained leading to social issues associated with food security concerns and higher rates of rural-urban labour migration.

Policy measures that affect the prospects for rural sector growth need careful assessment. PNG does not have the economic wealth to impose highly restrictive environmental policies that curtail development. Land use management practices in the forestry and agricultural industries are essential for sustainable long term growth. An appropriate balance is required between development needs and environmental considerations.

6. Conclusions and recommendations

6.1 Conclusions

Cessation of the clearance of forest land would limit the expansion of agriculture including food crops and export cash crops and commodity and plantation crops. With increased global demand and prices, the expansion of oil palm offers the most promising economic prospects for PNG and its rural population.

Cessation of clearance of primary forest would have no measurable impact on the level of sustainability of forestry in PNG. Measures to protect endangered species or habitats do not require across the board cessation of forest conversion; they require designation of scientifically demarcated conservation areas and establishment of deliberate conservation strategies.

PNG is unlikely to derive an economic benefit from programs to sequester carbon in forests commensurate with the opportunity costs of locking up its forests against more productive uses. There is also no evidence that it would ever realise significant revenue from trading carbon credits generated by avoided deforestation: who would buy them, and for how much per tonne?

The quantity and rate of emissions of Greenhouse gases from PNG is likely to be low in the absence of any significant industrial production, and its three biggest mines have minimal emissions, as Porgera uses gas from the nearby Hides gasfield, Ok Tedi has its own hydroelectric power, and Lihir utilises geothermal power.

6.2 Recommendations

The initial focus of a 'REDD+iness' strategy should be on measures to improve sustainability and management of sustainability by PNG authorities. That should include an assessment of the prospects for increasing carbon sequestration by the PNG forest estate through the expansion of sustainable commercial forestry in PNG, whereby mature trees absorbing little new carbon are replaced by younger trees with faster annual absorption rates.

PNG's rates of emissions are low globally. Strategies to reduce emissions should be very long term, ensuring that actions are not taken early which will reduce prospects for growth. Decisions on the rates and pace of reductions should be deferred until PNG has an independent, scientifically-based assessment of the extent, rate and source of emissions.

A blanket ban on conversion of primary forest to agricultural purposes, including Palm Oil should be avoided. The opportunity cost to PNG of not fully utilizing the resource available in primary forest for cultivation would be quite large.

PNG should determine that its policy will be guided in accordance with the terms of the UNFCC, specifically that action to adapt to climate change and mitigate emissions should not jeopardize economic growth and development in PNG.

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