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10 Papua New Guinea's Response to Climate Change: Challenges and Ways Forward

10.1 Introduction

The developing nations of the Pacific are already affected by climate change, as evidenced by the impact of rising sea levels and the increasing intensity of cyclonic events in the region in the past few years (Walsh et al, 2012). These phenomena are intensifying within the region and are likely to continue intensifying for many decades to come unless serious action is taken by the international community to combat climate change. Therefore, every country in the Pacific should build resilience to the adverse effects of climate change and contribute to the international effort to combat climate change. This chapter details the responses of the government of Papua New Guinea (PNG), and its endeavours to match domestic implementation to international initiatives.

Climate change has posed specific and significant challenges for Pacific governments, and has had important impacts on a range of national contexts. In particular this chapter describes the gaps between the way Papua New Guinea has responded to international rationales that provide and incentivise funding for climate change in certain ways, and the weaker rationales and successes in implementing processes internally as a nation. By presenting the details and realities of one Pacific government's endeavour to respond to climate change through the policy process, the chapter portrays the limitations of taking climate change as a small set of simple issues, and instead exposes the required groundwork and the real interface of matching international and grassroots perspectives.

PNG, the biggest country in terms of land area and population in the Pacific, is a recognized leader on Reducing Emissions from Deforestation and Forest Degradation (REDD and REDD+¹⁰³) on the international stage. The broad form of the REDD concept (Costa Rica and PNG, 2005) was masterminded by PNG and Costa Rica and presented at the 11th annual Conference of the Parties to the United Nations Framework Convention on Climate Change (COP 11) in Montreal in 2005. The former

103 REDD+ includes reducing emissions from deforestation and forest degradation, sustainable forest management; and the role of forest conservation and carbon stock enhancement.

Prime Minister of PNG, Sir Michael Somare, has been a staunch advocate of REDD and has appeared in many international forums to present PNG's position on its implementation. At COP 13 in Bali, Indonesia, PNG's Climate Change Ambassador, His Excellency Kevin Conrad, told the world's largest economy, the US, to take the lead or to get out of the way, contributing to the eventual endorsement of REDD by the United Nations Framework Convention on Climate Change (UNFCCC) (Revkin, 2008). Despite being recognized as a world leader on REDD+, PNG has not adequately addressed climate change adaptation and mitigation issues at both the international and national levels. Much of the hype on climate change by PNG at the national and international levels has been rhetorical, while little to nothing constructive has been done to date to address critical climate change issues. Alongside the physical impacts of climate change, and the social impacts of adaptation and mediation, then, this chapter shows that climate change has also had profound impacts on the political economy of PNG: this chapter discusses these impacts in terms of the way a Pacific government has appropriated the science, funding and international views of itself, and of the issues PNG faces, and the way it has responded in terms that whilst geared to the external views and expectations, operates through some awkward relations with other policies, with the realities on the ground, and of course with landowners. Such impacts suggest that these important national interfaces have been eclipsed by the international interfaces.

10.2 Challenges and *Ways Forward*

This section takes up a series of twelve issues, and firstly, outlines each challenge and secondly, comments in *italics* on suggested ways forward.

10.2.1 Adaptation Issues are Sidelined

Since 2008 I have attended most seminars, workshops and conferences on climate change in PNG. However, most of these gatherings were about mitigation issues such as REDD+ and carbon trade, while few have been about adaptation issues.

The Carteret Islanders of the Autonomous Region of Bougainville in PNG have been affected by sea level rise since the 1980s, which now threatens to displace many of the inhabitants. However, very little has been done by the PNG government (GoPNG) to address this problem. The only help accorded the Carteret Islanders by GoPNG has been an injection of K2 million (about USD 720,000) to the Autonomous Regional Government of Bougainville in 2007 (Legatis, 2011). In the absence of substantial help from above, the Carteret Islanders have had to take matters into their own hands through a local association known as Tulele Peisa, which (appropriately) means "sailing the waves on our own."

A nationwide assessment needs to be carried out to identify risks and vulnerabilities of people, property and public infrastructure to the potential adverse impacts of climate change. Then the documented information can be used to develop policies and strategies to counteract the potential adverse impacts of climate change.

10.2.2 Climate Change Efforts Lack Coordination

The Office of Climate Change & Development (OCCD) is the coordinating agency for climate change work in PNG (OCCD, 2013). But judging by the way the office is handling climate change issues, it seems OCCD is the ultimate authority on climate change in PNG. OCCD had set up several technical working groups on adaptation and mitigation under its structure, and people from stakeholder groups were invited to join the various technical working groups. Forums are regularly held by OCCD with the agendas set by the office, while stakeholder representatives are expected to attend and provide the input of their respective organizations.

As the coordinating agency for climate change work in PNG, the OCCD has failed to define “who is to do what” in terms of climate change. The OCCD continues to handle all climate change issues, while other government departments and NGOs act as data collectors and have done little to address climate change issues within their respective areas. In terms of training needs and capacity building, the OCCD seems to have training for its own staff while other government departments and NGOs have been left to their own devices. Training and capacity building for stakeholders through a coordinated effort by the OCCD is non-existent at the moment.

The OCCD needs to define its role as the climate change coordinator and stick to the responsibility of coordination, while other stakeholders should be given climate change activities that fall within their jurisdictions to deal with. OCCD should identify the roles of the other stakeholders and delegate their responsibilities to deal with; the delegation of climate change responsibilities to different stakeholders will facilitate PNG's climate change endeavour.

10.2.3 Key Climate Change Documents are Biased and Ineffective

McKinsey & Company, an international consulting firm, was brought in by GoPNG to draft several key climate change documents for the country. These key documents were drafted with local expertise sought from within the OCCD. Consultation with other stakeholders was minimal, so McKinsey and OCCD were criticized by civil society organizations and other government departments on the manner in which these key climate change documents were drafted. NGO and civil society groups have claimed that the legislation and policy drafted by OCCD were carried out with influence from foreigners with vested interest in climate change activities in PNG.

Consequently, McKinsey exited from PNG on a low key and the OCCD now handles the drafting of all key climate change documents for the country.

While employed to draft key climate change documents for PNG, McKinsey was paid millions of PNG Kina by GoPNG; in September 2010, McKinsey was paid K1.37 million (about USD 500,000) by GoPNG in addition to another K2.2 million (about USD 800,000) that was paid earlier to the company (PNGexposed Blog, 2011). Although substantial amounts of PNG tax payers' and donor money was paid to McKinsey, these key climate change documents have not made any difference for PNG at the national and international levels. Presentations made to the Norwegian Government and the UN-REDD Program for REDD+ funding using some of these key documents have not secured much REDD+ funding or technical assistance for PNG as yet.

Commercial logging, subsistence agriculture, mining, plantations (mainly palm oil) and forest fires are the drivers of deforestation and forest degradation in PNG, with commercial logging (48.2%) and subsistence agriculture (45.6%) being the major drivers of deforestation and forest degradation (Shearman et al, 2008). Despite GoPNG's commitment on reducing emissions from deforestation and forest degradation at the international level, some of the key climate change documents produced so far have advocated for Reduced Impact Logging as a mitigation measure for the logging industry while nothing has been done to place a moratorium on log exports (Babon, 2011). New timber permits continue to be issued for logging while Forest Clearance Authorities (aka FCAs) for Special Purpose Agriculture Business Leases (aka SABLs), which are more or less logging activities in the guise of agriculture projects, continue to be issued by GoPNG. This is a case of the left hand not knowing what the right hand is doing.

The OCCD should mobilize stakeholders to define the Terms of Reference for climate change activities in PNG. Then these activities will have to be evaluated and the critical ones should be identified and relevant documents developed to address them. Wider stakeholder participation should be encouraged, with a level playing field developed for all stakeholders to be involved.

10.2.4 Participation in International Negotiations Fails to Deliver Results

PNG is by far the biggest nation in the Pacific in terms of land area and population. Besides Australia and New Zealand, many island nations in the Pacific look up to PNG as the big brother when it comes to regional issues. However, in terms of climate change issues there is a great divide between PNG and the other island nations of the Pacific. At international forums on climate change, the smaller island nations in the Pacific are addressing climate change as part of the Alliance of Small Island States (AOSIS) with their main focus being on adaptation issues while GoPNG seems to be more interested in the mitigation issue of REDD. What is ironic about this is the fact

that arguably the world's first climate change refugees are from the Carteret Islands in PNG (IRIN, 2008; Morton, 2009).

At international negotiations there seem to be two groups of people representing PNG. One group is usually led by the foreign-born PNG citizen Kevin Conrad and his foreign entourage, while another group is usually led by indigenous PNG citizens. One of the country's daily newspapers reported that at the COP 15 meeting the PNG delegates were pushed aside, with Kevin Conrad and his Italian advisers, lawyers, and support staff running the show (*The National*, 18 December 2009; cf. Babon et al, 2012).

Millions of PNG Kina has been spent on sending large delegations to international forums on climate change since 2005; in 2009, it cost GoPNG K2 million (about USD 720,000) to send 30 delegates to COP 17 in Copenhagen (Tanos, 2009). However, the presence of large delegations from PNG at international forums on climate change has not made much difference in terms of securing climate change funding and technical assistance for PNG to date. Moreover, it is not known what these large delegations at international forums are there to do in terms of climate negotiations.

The use of foreigners to negotiate for PNG and sending large delegations to international climate change forums has proven to be futile so far. PNG has to change the trend and send a small delegation of highly qualified Papua New Guineans to negotiate for PNG at international forums on climate change. Moreover, experiences from past negotiations should be used to fast-track issues and activities that PNG wants to be negotiated at international forums. In the past PNG more or less negotiated on its own, but this time around PNG should work in concert with the smaller island nations of the Pacific and push for adaptation and mitigation issues relevant to the Pacific.

10.2.5 REDD Projects Fail to Achieve Additionality

Four REDD+ demonstration sites for PNG have now been selected (Babon, 2011). The Papua New Guinea Forest Authority (PNGFA) is responsible for the development of these 4 REDD+ projects. The object of any carbon project is to benefit the environment and the climate. Therefore, any REDD+ project must be established with the intention of reducing emissions from deforestation and forest degradation and alleviating climate change, and as such, REDD+ projects should conform to the definition of the term "additionality." That is to say, any REDD+ project that is to be implemented must not constitute "business as usual"; it must not be an action that would have been implemented anyway without the use of REDD+ funding. For any REDD+ project to be implemented within a Forest Management Agreement (FMA), the tool that is to be used to reduce emissions from deforestation and forest degradation must meet this definition of "additionality" so that there is additional benefit for the environment and climate.

The PNG Forest Policy 1991 (Ministry of Forests, 1991), PNG Logging Code of Practice (Government of Papua New Guinea, 1996), ITTO Target and Indicators for Sustainable Forest Management (ITTO, 2005) and Convention on Biodiversity (CBD Secretariat, 2013) are tools that have been adopted for Sustainable Forest Management by GoPNG. However, what is contained in these different policy documents is “business as usual” for PNG in terms of sustainable forest management. Therefore, what is additional about these 4 REDD+ projects?

Reduced Impact Logging (RIL) has been suggested as an “additional” activity for reducing emissions from deforestation and forest degradation in PNG (Government of Papua New Guinea, 2010: p. 18). However, there is no definition given for the term RIL within the context of PNG. Therefore, what is meant by RIL is vague because sustainable forest management practices contained in the different policy documents adopted by the GoPNG already cater to RIL. So what sort of practice(s) other than crawler tractor logging and the requirements for sustainable forest management already contained in the different policy documents would be additional in a REDD+ project within an FMA?

The country's Sustainable Forest Management policies and practices should be reviewed to determine what is additional and what is not additional under REDD+. RIL has been identified as a climate change mitigation measure in PNG, but the term remains undefined within the PNG context. Precisely defining the term would facilitate the design and development of forestry projects that would truly reduce the contribution of logging to climate change.

10.2.6 Subsistence Agriculture Complicates REDD Efforts

Subsistence agriculture is the second highest driver of deforestation and forest degradation in PNG, accounting for 45.6% of forest change (Shearman et al, 2008). However, the regulation of subsistence agriculture in PNG is a complex issue for several reasons. Firstly, subsistence agriculture is practiced on customary land and the government has no direct legal control over these lands and the forms of forest changes that may be taking place there. Secondly, rural people generally lack government services and need their land to sustain themselves

Therefore, if the government is to place large areas of customary land under REDD+ and carbon trade without the people's consent, this would be an injustice to the customary landowners. The idea of implementing REDD+ on a national scale in PNG (GoPNG, 2010) without the free, prior and informed consent of customary landowners is an action that can be seen to have breached basic human rights and should be condemned.

Several NGO groups in PNG work with customary landowners on Land Use Planning (LUP). One of these NGO groups is The Nature Conservancy (TNC), which has developed LUPs for several land owning groups in a district in the Madang Province (The REDD Desk, 2013). TNC intends to upscale its LUP work to a provincial

level and wants to develop a provincial LUP for the Madang Province (US Aid and LEAF, 2012).

TNC has contributed to only a few small-scale projects in PNG, and in order to upscale its work it would need more financial support from GoPNG. At present GoPNG does not provide direct funding to NGO groups for community development work, and there is anecdotal evidence that some politicians and government officials view NGO groups as being anti-development.

The implementation of LUPs at the community level therefore offers a legal and justifiable means by which subsistence agriculture can be controlled to some extent to alleviate deforestation and forest degradation in PNG. These community LUPs are developed with input “by the people, for the people.” Under a community LUP, land would be allocated for gardening, forest biodiversity conservation, small-scale agriculture, commercial agriculture, settlements and other land uses. And as such, subsistence agriculture would be practiced in the area designated for gardening and not carried out on an ad hoc basis. Thus, deforestation and forest degradation through subsistence agriculture can be limited to some extent.

In order to further limit deforestation and forest degradation from subsistence agriculture, the use of genetically improved crop cultivars with high yields (from conventional breeding), the use of improved fallow systems, and allocation of sufficient land for gardening should be used in conjunction with subsistence agriculture practices (Bingeding, 2012b). By using improved fallow systems customary landowners continue to reuse the same piece of land without the need to clear more primary forest areas for gardening. In using genetically improved crop cultivars with high yields, customary landowners would produce a much higher yield of crop on a small piece of land in contrast to using a low-yielding crop cultivar that would produce the same amount of yield on a much larger piece of land. By gardening on the piece of land designated for subsistence agriculture through the community LUP and utilizing sustainable land use practices such as improve fallow systems, customary landowners do not have to clear more primary forest land on an ad hoc basis and would therefore contribute to the alleviation of deforestation and forest degradation.

As far as climate change work is concerned in PNG, nothing has been put forward in terms of policy by GoPNG on LUP at the community level and how subsistence gardening could be controlled to reduce deforestation and forest degradation in the country. It seems the country does not know where subsistence agriculture fits into the REDD+ domain in terms of climate change mitigation.

The Nature Conservancy project in Madang Province has proven that the concept of community LUP is a viable option for limiting deforestation and forest degradation to some extent on customary land in PNG. This approach should be adopted throughout the country. The use of sustainable land use practices such as improved fallow systems and genetically improved crop cultivars with high yields should complement community LUP to enhance the country's capability to reduce emissions from deforestation and forest degradation.

10.2.7 Logging Concessions May Not Generate Significant REDD Credits

PNG has a land area of 46.17 million hectares, of which 71% of the land was covered by forest in 2002 (Shearman et al, 2008). However, in terms of commercial logging, 15.0 million hectares are considered production forests (Ministry of Forests, 2009). Of the 15.0 million hectares of production forests, the PNG Forest Authority is currently dealing with some 4-5 million hectares while another 2.5 million is yet to be allocated (Bingeding, 2012b), with another 6-7 million hectares logged out and the lands already returned to its customary owners.

Commercial logging is one of the major drivers of deforestation and forest degradation in PNG, accounting for 48.2% of forest change (Shearman et al, 2008). Little reforestation has been carried out in logging concessions in PNG to date, making carbon stock replenishment for the logged-over concessions largely unknown. Although the Forest Policy 1991 calls for reforestation to be carried out as a means to maintain a permanent forest estate to supply existing and new forest industries (Ministry of Forests, 1991), little reforestation has been carried out to date because it is much easier for companies to pay reforestation levies into trust accounts and move on than to engage in reforestation exercises (Bingeding, 2008).

Deforestation and forest degradation within timber concessions is envisaged as an avenue from which much of PNG's REDD+ credits will come. GoPNG has legal jurisdictions over timber concessions; therefore, the government sees timber concessions as being an opportunity area for REDD+ revenue that will end up in the national purse. However, much of the timber concessions have been logged out and the lands have been returned to customary landowners, meaning that GoPNG no longer has jurisdiction over these timber concessions. Moreover, some of the current timber concessions were acquired prior to 1990—the baseline year for CO₂ emissions under the UNFCCC (UNFCCC, 2013)—meaning that only timber concessions acquired after 1989 are eligible for REDD+. Therefore, how many current timber concessions are eligible for REDD+ and the number of REDD+ credits that can be generated from these concessions are unknown quantities; and the number of REDD+ credits that could be generated from timber concessions may be minimal.

PNG needs to evaluate its current logging concessions and determine how many of them are eligible for REDD+ schemes. In this way, it would be possible to determine how many REDD+ credits will come out from current logging concessions rather than work on assumptions when the actual REDD+ credits from current logging concessions may be minimal.

10.2.8 Stakeholders Lack Interest in Forest Plantation Development

PNG currently has 69,000 hectares of forest plantations, but forest plantation development has been erratic. There are several reasons for this. Firstly, GoPNG

collects a large amount of revenue from log export but allocates very little money for forest plantation development. Secondly, the land rent paid to customary landowners for the use of their land for forest plantation development is low, which probably contributes to customary landowners' unwillingness to lease more of their land for this type of development. Thirdly, land disputes between rival clans or tribes, and between the state and customary landowners, have stalled forest plantation development in some areas of the country. Fourthly, there is lack of incentives such as business partnerships or shareholdings by landowners in forest plantations and timber processing mills, further reducing landowners' interest in leasing more of their land for forest plantation development. Lastly, for most forest tree species customary landowners have to wait for more than six years (*Ochroma lagopus* [Balsa] is the only tree species harvested at 4-6 years of age) before they see any substantial monetary gains from development of forest plantations on their land. Customary landowners would rather lease their land for activities that derive annual economic turnover than to give it away for long-term tree crops.

In the past forest plantations were developed for timber production and to rehabilitate degraded grasslands in some lowlands and highlands provinces of PNG (Srivastava, n.d.). While some forest plantations in the country are used for sawn timber, woodchip and veneer production, forest plantation resources are insignificant in comparison to natural forest resources (PNGFA, 1997). Moreover, some of the current plantations may be uneconomical due to a lack of demand for the log sizes available from a plantation in its early age; some of the plantations may have low timber yields because successive thinnings have not been carried out on time due to lack of markets for sizable logs.

Forest plantations can now be managed for timber production as well as for carbon sequestration. Therefore, forest plantation owners can now benefit from the sale of timber, carbon credits and the provision of other environmental services. The Clean Development Mechanism now provide opportunities for landowners and businesses to develop forest plantations on degraded grasslands and other degraded landscape for the sale of timber, fuel wood, carbon credits or the provision of other ecosystem services. The management of forest plantations on degraded grasslands for production of timber, fuel wood, carbon credits and the provision of other ecosystem services is actually killing many birds with one stone. Consequently, forest plantation development in PNG seems more economical now than in the past.

PNG has 6.7 million hectares (Shearman et al, 2008) of degraded grasslands, of which some of these areas can be developed into forest plantations. Nevertheless, there is lack of enthusiasm in developing forest plantations in PNG at the moment. This is despite the fact that forest plantations are more economical now than in the past due to the fact that carbon trade offers the opportunity to grow trees for the sale of timber, fuel wood and carbon credits.

The PNGFA, as the government agency responsible for forest plantations should take the lead in venturing into large scale forest plantations on degraded grasslands throughout the country to enhance the country's forest areas and carbon stock. Moreover, the government should also facilitate forest plantation development in the country and encourage local companies, multinational corporations, super funds and customary land owners to venture into forest plantation development.

10.2.9 The Role of Conservation under REDD Is Underappreciated

In an area less than 1% of the world's total landmass, PNG harbors 5% of the world's biodiversity (Wikimedia, 2013) and is therefore regarded as one of the world's biodiversity "hotspots." Conservation of terrestrial biodiversity has been carried out in PNG since colonial times through the different acts required for Protected Area establishments (e.g., Fauna (Protection and Control) Act (1966)). However, to date, only around 2% of PNG's landmass has been placed under some form of conservation (Wikimedia, 2013). This achievement is well below the internationally accepted target of 10% and the 16.8% recommended by Faith et al (2001).

Conservation of forest biodiversity is a land-use activity that has been competing with mining, logging and commercial agriculture in PNG for some time now. However, the success of forest biodiversity conservation has been minimal possibly because conservation activities cannot put up incentive packages that can compete with mining, logging and commercial agriculture. When funding is available for conservation activities and a conservation organization is present in an area, landowners buy into the concept. But as soon as conservation funds cease and a conservation organization moves out of an area, landowners abandon conservation and return to their previous ways of life. While no major economic activity is present in an area that is under conservation the concept is embraced by the people, but as soon as an economic activity like logging turns up within the vicinity of the area people easily switch sides because they see better incentives in logging than in forest biodiversity conservation. Consequently, the biggest issue with the success of biodiversity conservation in PNG has been the lack of economic incentives.

Today, however, forest conservation is included under REDD+. Thus, there are now economic and non-economic incentives, and so forest biodiversity conservation activities can put together packages that can compete with logging and commercial agriculture; the opportunity cost of mining, however, may be greater than that of forest biodiversity conservation. However, the tools that have to be used for forest biodiversity conservation under REDD+ must be additional so that they benefit the environment and climate—forest biodiversity conservation activities must not be business as usual.

Conservation under REDD+ is not additional for the different conservation tools under Protected Areas (e.g. Wild Life Management Areas). This is because these tools for forest biodiversity conservation are already required by the country's laws to be established and would have been established anyway without funding from REDD+. These forest biodiversity conservation activities would be business as usual and would not have additional benefit for the environment and climate, thus innovation is needed to enhance these activities. However, due to the lack of knowledge on where forest biodiversity conservation in PNG fits into the REDD+ domain, there has been little effort put in by the government to use forest biodiversity conservation activities as tools for reducing emissions from deforestation and forest degradation.

In order to enhance forest biodiversity conservation in PNG and tap into the economic and non-economic incentives provided under REDD+, the country needs to determine the role of forest biodiversity conservation within the REDD+ domain in PNG and how it can meaningfully contribute to national development as well as the international effort to mitigate climate change. Only then can forest biodiversity conservation be seen by customary landowners and other stakeholders to be a socio-economic activity that is viable and can sustain the socio-economy of the country as well as the environment and contribute to climate change mitigation.

10.2.10 Payment for Ecosystem Services

Payment for Ecosystem Services (PES) requires imminent threat(s) to an environmental service before a service buyer would be willing to pay a service provider to forego an economic or social opportunity so that the targeted environmental service is maintained or enhanced. In addition to that, a market must be established for the targeted environmental service to be traded.

PES has been advocated for in PNG for some time now, but due to lack of knowledge on PES little effort has been put into defining environmental services and establishing markets for them to be traded. One environmental service that already has the potential for a PES market to be established in PNG is water. For example, in 2010 the World Bank and PNG Pawa Limited (PPL), the state-owned power supplier, collaborated on a project to increase power supply to the city of Port Moresby. The World Bank provided the technical input while PPL did the ground work. In one of the meetings with landowners from where the dam for an 80MW turbine was going to be built, landowners from the watershed area also turned up for the meeting and surprised the PPL and World Bank delegates. The dam was going to be built on Koiari people's land in the Central Province, while the watershed area was on Efogi people's land in the Oro Province. Thus, the customary landowners from Efogi wanted to know if they would also be paid for the water that their watershed would provide for the dam. This example shows that customary landowners are now aware of environmental services that their lands and forests can provide and what

would be the economic benefits for them. Therefore, under the PES system, the customary landowners from the watershed area can forgo subsistence agriculture to conserve their watershed area. In order for the watershed area to be conserved for water supply to the dam, PPL could incorporate the opportunity cost of subsistence agriculture into the cost of electricity so that power users in Port Moresby pay for it. In return, PPL can then use power rents to pay the Efogi landowners for conserving their watershed and supplying water to the dam for electricity production.

Water already has a market in terms of PES in PNG, and this potential needs to be harnessed now for the conservation of the terrestrial environment and climate change mitigation. However, a nationwide assessment should be carried out to determine other potential markets for terrestrial PES that may exist in PNG so that these too could be harness for the benefit of the environment and climate.

10.2.11 Lack of Will to Reduce the Adverse Impact of Mining on Terrestrial and Marine Environments

The mining sector contributes only 0.6% of the deforestation and forest degradation in PNG and is only a minor driver (Shearman et al, 2008). However, this figure is an underestimate because mining developments contribute to increase in forest clearance for gardening to feed mine townships and associated communities (Dambacher et al, 2007: cf. Shearman et al, 2008), and 150,000 hectares of forest die-back along the Fly River is associated with mine discharge from the Ok Tedi Mine (Higgins, 2002: cf. Shearman et al, 2008).

Despite the adverse impact of land based mines on terrestrial and marine ecosystems and the loss of the country's forest carbon stocks due to deforestation and forest degradation by large scale mining in PNG, the government continues to issue licenses for more exploration and mining in PNG. There are already some ten large scale mines in PNG, but some 7.0 million ordinary people in PNG struggle to make a living on a daily basis while the government struggles amidst plenty of money to deliver the much-needed services to the people. Therefore, what is the rationale behind destroying more of the country's forest and biodiversity through mining activities when mining has little positive impact on the lives of the ordinary people at large?

In recent years GoPNG licenced Canadian company Nautilus Minerals Limited (Nautilus) to explore the sea beds of the Bismarck and Milne Bay waters for sulphide deposits. Then in the year 2012 GoPNG licensed the company to begin mining the country's sea beds for minerals (*The Guardian*, 2012), but due to opposition from NGOs and other stakeholders the operations of Nautilus were scaled back. However, GoPNG has now acquired 15% share in Nautilus (Sukman, 25 April 2014), and is a partner in the development of the deepsea mining; therefore, the project will go ahead soon.

Sea grass, seaweed and coral reefs take in carbon dioxide from sea water and use that with sunlight to photosynthesize and store carbon in their tissues. However, with the build-up of greenhouse gases in the atmosphere it is now known that the oceans are taking in about one-quarter of the atmospheric carbon dioxide (Great Barrier Reef Foundation, 2013). Therefore, the oceans are now acidifying due to build-up of carbonic acid in seawater, and as a result coral reefs are being bleached. Moreover, increased ocean surface temperatures due to global warming have also bleached coral reefs (Stanford University, 2012).

The protection of marine carbon sinks for mitigation of climate change is very important because sea grass, seaweed and coral reefs have the potential to be used for carbon sequestration. Mining the sea beds of the Bismarck and Milne Bay waters poses further threats to PNG's coral reefs and the marine ecosystems through sedimentation and further acidification of the seas (Bingeding, 2012). Despite the threats posed by deep sea mining, there seems to be little concern by GoPNG for the protection of coral reefs and other photosynthesizing marine organisms for carbon sequestration and climate change mitigation in PNG.

If the mining industry is to contribute meaningfully to the sustainable development of PNG and the international effort to mitigate climate change, the role of the mining sector within the context of REDD+ should be determined for PNG. In determining the role of the mining sector within the REDD+ context in PNG, the country can implement mining activities on a sustainable scale so that there is minimal adverse impact of mining on the people and the environment while the sector contributes to sustainable development of PNG and climate change mitigation.

10.2.12 Lack of Vision to Reduce Fossil Fuel Emissions and Develop Clean, Renewable Energy

Diesel and gas generators make up about 50% of PNG's power generation capacity (www.reegle.info/actors/3922/department-of-petroleum-and-energy.htm). Diesel generators produce 710 GWh of electricity annually, while natural gas generators produce another 400 GWh of electricity annually (Table 10.1). However, the government now intends to increase the capacity for natural gas power generation to 390 MW and slightly increase diesel power generation by the year 2030 (Oxford Business Group, 2012).

In terms of annual greenhouse gas emissions diesel and gas generators would emit 0.466 MtCO_{2e} and 0.132 MtCO_{2e} respectively (Table 10.1). However, since PNG endeavors to be carbon neutral by the year 2050 (GoPNG, 2010), innovations must be sought to reduce the country's fossil fuel emissions. This can be done by developing renewable energy sources that would have minimal adverse impact on the environment and people.

Table 10.1: Diesel and natural gas power generation and greenhouse gas emissions

Fossil fuel	Installed power generation capacity (MW)	Annual electricity generation (GWh)	Annual greenhouse gas emission (MtCO ₂ e)
Diesel	217.09	710	0.466
Natural gas	82.06	400	0.132

Currently PNG faces a chronic power shortage problem. And in order to meet the country's demand for more power, the government plans to build more gas power stations and hydropower dams to generate enough electricity.

Nevertheless, there are several issues with gas power stations and hydropower dams regarding climate change. Firstly, natural gas is a fossil fuel and does emit greenhouse gases and volatile organic compounds that are dangerous to human health and the environment. Secondly, hydropower can be a form of clean, renewable energy if grassland areas are flooded to produce electricity or water from the spillway of an existing dam is reused to produce electricity. However, if substantial areas of forested land are going to be flooded for power generation this could lead to more deforestation and forest degradation and other environmental and social problems, and the power produced may not be regarded as clean energy.

There is now an ambitious plan by the PNG and Queensland (Australia) governments to dam the Purari River in the Gulf Province to generate 1800 MW of power for both Queensland (Australia) and PNG (Reegle, 2013). It is claimed that this hydropower dam will generate enough renewable energy for use and create job opportunities for both PNG and Queensland. Nevertheless, nothing has been said about the environmental impact the dam will have on the forest that is going to be flooded, large wetland ecosystems that lie below the dam, and the rich fish stocks in the Gulf of Papua. But in terms of climate change the adverse social and environmental impacts of renewable energy generation must also be taken into consideration when attempting to generate clean electricity.

The potential to generate electricity from renewable energy sources in PNG is enormous (Table 10.2). However, despite the availability of these renewable energy sources and the tradability under the Clean Development Mechanism of the Kyoto Protocol, little has been done to tap into clean, renewable energy sources in PNG to date. This is due to lack of vision by GoPNG to reduce emissions from fossil fuels and to develop clean, renewable energy for the country.

PNG must evaluate all of its renewable energy sources to determine their social, economic and environmental impacts on the people and the environment. Once this evaluation is done, those renewable energy sources that have minimal social and environmental impact on people and the environment should be developed for the country's clean energy needs as well as to contribute to a carbon neutral economy by the year 2050.

Table 10.2. Renewable energy sources in PNG

Type of Energy	Source(s)
Solar	Sun
Wind	Wind
Tidal	Sea
Biogas	Municipal effluent, palm oil mill effluent, animal manure (pigs, cattle and goats), spent oil palm fruit bunches, municipal solid waste, and coffee mill biomass (pulp) and effluent
Hydropower	Rivers, streams
Geothermal	Volcanic springs
Biomass	Fuel wood, thinnings from forest plantations, waste wood from timber mills (off-cuts and sawdust)
Biodiesel	Coconut trees, Jatropha trees, seaweed, waste oil from restaurants and food bars

10.3 Key Points and Conclusions

This chapter has discussed a series of important issues, contexts and initiatives that have directly impacted upon PNG's endeavors to address climate change at both the international and national levels. Several key points of the impacts that have been brought about by PNG's appropriations of climate change were discussed: although PNG had the world's first climate change refugees, the country tends to focus more on REDD+; although PNG has established an office to coordinate climate change issues in the country, this has led to uncertainties in the delegation of responsibilities and action; although PNG has developed several key climate change documents, neither climate change legislation or policy have been endorsed by the government; although PNG has been represented (often by foreign advisors) at international climate change forums since COP 11, this has not led to securing funding or technical assistance for climate change work in the country.

Subsistence agriculture is the second highest driver of deforestation and forest degradation in PNG, but the key climate change documents put out so far by the office of climate change have not proposed an integrated policy for the community or national level. GoPNG envisages that logging concessions provide an avenue where much of PNG's REDD+ credits will come from, but most of the timber concessions have been logged out and the lands have been returned to its customary landowners—consequently, REDD+ credits from current timber concessions are unknown and could be minimal.

Biodiversity conservation has been lacking in PNG in the past due to lack of economic incentives, but REDD+ and PES now provide both economic and non-economic incentives for biodiversity conservation and other ecosystem services.

However, due to lack of knowledge on the role of biodiversity conservation and other ecosystem services under REDD+ and PES, there has been little effort put into using biodiversity conservation for climate change mitigation in PNG. Forest plantations can be developed for carbon sequestration and for timber and fuel wood production, thus forest plantation development in PNG is now more economical than in the past. However, less attention has been given to forest plantation development as a tool for mitigating the adverse effects of climate change in PNG.

Mining activities pose threats to PNG's terrestrial and marine carbon sinks. However, the government continues to issue exploration and mining licenses and seems to have little concern for its terrestrial and marine carbon sinks and the need to mitigate climate change. About half of PNG's power supply is generated from fossil fuels. Nevertheless, due to lack of vision to reduce fossil fuel emissions and exploit the country's enormous sources of renewable energy for the development of clean energy, there are now plans to increase the country's future power supply using more gas power stations and hydropower dams. This is likely to increase fossil fuel emissions and the rate of deforestation and forest degradation respectively. In setting out the detail and pragmatics of the policy context, and a vivid picture of the PNG state's capacities, interests and responses, the chapter has also discussed a series of limitations. The picture which emerges disrupts the wishful thinking character of much international discourse about climate change, and shows that as much as PNG has appropriated, and made appeals to, this sphere, it has also paid less attention to turning international expectations into an equally energetic internal process.