

PROTECTING AGAINST COASTAL HAZARDS IN MANUS AND NEW IRELAND PROVINCES PAPUA NEW GUINEA: AN ASSESSMENT OF PRESENT AND FUTURE OPTIONS



**STRENGTHENING THE CAPACITY OF VULNERABLE
COASTAL AND INLAND COMMUNITIES IN PAPUA
NEW GUINEA TO ADAPT TO CLIMATE CHANGE**

Wildlife Conservation Society – Technical Report

SNAP
Science for Nature
and People

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Front Cover Photo: Pere Village in Manus Province, by Siddharth Narayan

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Table of Contents

Executive Summary	i
List of Abbreviations	ii
1. Introduction	1
1.1 Goals Objectives and Method	1
1.2 Background	2
1.3 Data and Information	3
2. Field Report – Manus Province	5
2.1 Site Description	5
2.2 Characterisation of coastal hazards and assets	6
2.3 Current and future options for coastal protection	7
2.4 Social and cultural considerations	9
2.5 Coastal management, CCA and DRR policies	10
2.6 Role of Government, NGOs and CBOs in coastal protection.....	11
3. Field Report – New Ireland Province	12
3.1 Site description	12
3.2 Characterisation of coastal hazards and assets.....	12
3.3 Current and future options for coastal protection.....	14
3.4 Social and cultural considerations.....	15
3.5 Coastal management, CCA and DRR policies	16
3.6 Role of Government, NGOs and CBOs in coastal protection	17
4. Relevant findings from SNAP databases and analyses	18
5. Conclusions and Recommendations	19
6. Acknowledgements	21
7. References	22
Annexes	23
A1 Sample Workshop Agenda and Workshop Participant Lists	
A2 Factsheet for workshop breakout session 2 on coastal protection options	
A3 Manus Province Interview Summaries	
A4 New Ireland Province Interview Summaries	
A5 Manus Province Breakout Session Summaries	
A6 New Ireland Province Workshop Breakout Summaries	
A7 New Ireland Province 2008 King Tide Disaster Assessment Report	

EXECUTIVE SUMMARY

This report summarizes a field exercise conducted in Manus and New Ireland Provinces of Papua New Guinea to assess coastal hazards and provide an overview of the possible solutions, opportunities, barriers and constraints for sustainable coastal protection and climate change adaptation. The report makes recommendations for facilitating sustainable coastal development based on interviews with local government officials, stake-holder workshops and field visits.

Coastal communities in both Manus and New Ireland Provinces are highly and immediately susceptible to chronic and episodic coastal hazards, namely, erosion from waves and currents, frequent tidal inundation of low-lying villages and heavy episodic flooding from extreme surge events. Due to their reliance on the reefs and coastal environments almost all coastal communities live right on the shoreline and frequently within the inter-tidal zone, increasing their susceptibility to coastal hazards. Some communities on the northern coasts of the two provinces still experience the drastic impacts of an extreme surge event on December 10th 2008, commonly referred to as the “2008 King Tide”. Coastal communities situated behind reefs and close to mangrove forests benefit substantially from the protection (among other) services that these habitats provide. In general, the need for solutions that preserve the coastal environment rather than damage it is universally recognized among local communities. However, awareness of the value of the coastal protection services of these habitats is low. There are currently no measures to protect against flooding, though communities generally show a high degree of adaptation to low-intensity flooding. Coastal protection measures – engineered or natural – are invariably aimed at erosion control. Solutions that use local materials and for which local capacity exists – such as dry stone stack seawalls and/or mangrove afforestation are the easiest, quickest and most cost-effective in the short term. Seawalls of stone and timber are a popular measure for protecting important individual assets that are immediately threatened. Where the biophysical environment is suitable and the space is available, mangrove afforestation and conservation are viable longer term coastal protection alternatives that also provide other ecosystem services.

Coastal issues are a low priority at both provincial and local government levels. At local levels, awareness of different coastal protection options and their benefits and drawbacks is generally low and capacity to design and execute them effectively is lacking. Local NGOs play a critical role in providing communities with the capacity and training to develop project proposals and apply for funding. There are no national or provincial level laws that regulate development in the coastal zone. The most direct entry point for influencing coastal development in Papua New Guinea is through the Organic Law, which allows land-owning clans at the level of the Local Level Governments (LLGs) to enact legislations in their districts.

The main recommendations from the exercise are to extend and improve upon existing training, awareness and capacity building programmes in coastal communities. Incorporating issues such as identifying hazards, implementing effective solutions and monitoring changes will help provide local communities the means to identify potential problems early on and plan ahead in terms of coastal management. Other recommendations include using examples of best practices from elsewhere, such as the analyses being carried out within the Science for Nature and People (SNAP) Coastal Defenses Working Group and the Building with Nature project in Indonesia.

LIST OF ABBREVIATIONS

BwN:	Building with Nature (http://www.ecoshape.nl/overview-bwn.html)
CBOs:	Community Based Organisations
CCA:	Climate Change Adaptation
DRR:	Disaster Risk Reduction
LLGs:	Local Level Governments (Note: Governments in Papua New Guinea are arranged as: National, Provincial, Local Level, District, Ward and Village)
NGOs:	Non-Governmental Organisations
PNG:	Papua New Guinea
PRA:	Participatory Risk Assessment
SLR:	Sea Level Rise
SNAP:	Science for Nature and People (www.snap.is)
SRTM:	Shuttle Radar Topography Mission (a global topography database from NASA - http://www2.jpl.nasa.gov/srtm/)
TNC:	The Nature Conservancy
UNDP:	United Nations Development Programme
UNEP WCMC:	United Nations Environment Programme World Conservation Monitoring Centre
USACE:	United States Army Corps of Engineers
VPC:	Village Planning Committee (a designation used only in New Ireland Province)
WCS:	Wildlife Conservation Society

1. INTRODUCTION

1.1. GOALS, OBJECTIVES AND METHODS

This report describes the coastal climate change adaptation assessments undertaken for the provinces of Manus and New Ireland in Papua New Guinea (PNG). These assessments form a part of the Australian Government's Department of Foreign Affairs and Trade (DFAT) funded climate change adaptation (CCA) project undertaken by the Wildlife Conservation Society (WCS) PNG program. The overarching goal of the project is to ensure that the ecological, economic and social systems that support vulnerable communities in PNG are resilient to the impacts of climate change. This goal is achieved via three objectives: a) Improve information available for climate change planning and strengthen information sharing networks; b) improve food security, focusing on diversifying strategies for food gardening and better resource management; and c) improve tools and approaches to CCA planning.

Coastal hazards such as coastal erosion and flooding are an immediate and significant threat to the coastal communities in Manus, New Ireland and other maritime provinces and these hazards are likely to increase in intensity and frequency in the near future due to rising sea-levels. As a consequence, understanding the nature and characteristics of coastal hazards and assessing the feasibility of coastal protection solutions are essential for successful CCA within coastal communities. A wide range of coastal protection solutions exists, from 'hard' structural measures such as breakwaters and seawalls to more 'soft' measures such as improved zonation or the use of natural habitats like mangroves and coral reefs. Choosing an appropriate solution depends on the nature of the hazard, the local environment and local social and cultural contexts.

The goal of this exercise was to assess coastal hazards in Manus and New Ireland Provinces (Figure 2) and identify solutions, opportunities, barriers and constraints for sustainable coastal protection and CCA. This was achieved via three objectives: a) identification of coastal hazards and appropriate adaptation options based on field visits, interviews and stakeholder interactions; b) review of the feasibility of coastal adaptation options drawing on the SNAP Coastal Defenses and other coastal engineering projects; and c) recommendations for planning and decision-making in the context of using coastal protection to support broader CCA activities among coastal communities in PNG. In each province these objectives were achieved by a combination of workshops on coastal protection, interviews with provincial government officials, field visits and a review of relevant policies.

Open workshops on coastal hazards and coastal protection were conducted in both provinces. Workshop participants included officials from district and provincial governments, village representatives from the main islands and outer islands, as well as local and international Non-Governmental Organisations (NGOs) (see Appendix 6.2). Both workshops were structured as two sessions – the first on coastal hazards and the second on solutions. First an introductory session on coastal hazards was conducted. This was followed by a breakout activity where participants worked in groups to identify the main coastal hazards affecting three locations of their choice within the province and the key assets exposed to these hazards. A second session was then held on engineering and nature-based coastal solutions with a few case-study examples. Following this the participants went back to their groups to suggest solutions to the identified

hazards, describe the challenges in implementing these, and outline the role the provincial government could play in this regard. The workshop concluded with a wrap-up of the key messages from the sessions and breakout activities.

One-on-one interviews were conducted with provincial government officials of various departments that worked with the coastal zone or coastal issues in both provinces. These included, for example, the Disaster Relief Office, the Department of Environment and Climate Change, the Provincial Planning and Administration, the Department of Works and the Department of Fisheries. The interviews and workshops were further supplemented by field trips to coastal villages on the mainland and islands to survey the environmental and social contexts and constraints that informed coastal development and responses to coastal hazards. In addition, provincial and national level policies on issues related to the coastal zone were reviewed to assess their relevance to coastal protection and identify potential entry points for influencing future coastal development.



Figure 1 Participants work in groups to identify coastal hazards, at a coastal protection workshop in Lorengau, Manus Province.

1.2. BACKGROUND

Papua New Guinea lies within the ‘Ring of Fire’ and is susceptible to earthquakes and tsunamis. The provinces of Manus and New Ireland were chosen for this project since they are among the most vulnerable places in PNG to, among other threats, sea-level rise and storm surges. In addition communities in these provinces have limited ecological resilience to the impacts of climate change (Dhore, 2014).

Manus Province consists of the northern-most islands of the Bismarck Archipelago, located about 2° south of the equator and 250 km north of mainland PNG (Figure 2). It is a maritime province consisting of the main island of Manus and the island groups of the Western Isles, Ninigo and Hermit Islands. It is the smallest province in PNG in terms of land area and population. The provincial capital Lorengau is located on Manus Island, the largest island in the group. The province has a single district (Manus District), 12 Local Level Governments (LLGs) and 127 Wards. The majority of Manus Island's 54,000 residents rely on subsistence agriculture from food gardens in cleared forests and fishing on reefs and in mangroves. The vegetation generally comprises lowland rainforest with mangrove forests in coastal areas, particularly on the southern and western shores. Most of the coastal communities are located close to offshore coral reefs. Although a priority site for conservation for decades, little attention has been given to coastal conservation activities or sustainable development in the province.

New Ireland Province forms the eastern part of the Bismarck Archipelago, located about 2-4° south of the equator and 450 km east of mainland PNG (Figure 2). It is a maritime province consisting of the main island of New Ireland and numerous smaller islands and island groups with a total land area of around 9600 km². The provincial capital, Kavieng is located on New Ireland Island, the largest island in the group. The province has two districts (Kavieng and Namatanai), nine LLGs and 135 Wards. The majority of New Ireland's 118,000 people live along the low-lying coast. Communities on New Ireland Island largely subsist on food from local gardens and money from cash crops such as coconut, cocoa and palm oil. By contrast, the smaller islands are heavily dependent on marine resources for food and income. Vegetation generally comprises lowland inland rainforests with mangrove patches along the coast. Mangroves are present mainly along the western shores of New Ireland, eastern shores of New Hanover Island, Tatau Island to the north and Djaul Island to the south. Coral reefs are common along the coastline with most coastal communities situated directly behind the reefs. New Ireland Province has extensive mining, logging and monoculture plantation activity (mainly oil palm, coconut and cocoa), especially on New Ireland and New Hanover islands. The province has seen extensive deforestation and degradation (>53% forest cover) due to logging and monoculture plantations.

1.3. DATA AND INFORMATION

Despite the high vulnerability of coastal communities in PNG to flooding and coastal erosion there have been very few studies to date that specifically examine coastal issues. One reason could be the lack of accessible information on coastal hazards, records of past coastal flood events, and data on coastal assets and coastal elevations. A few studies have been conducted on previous extreme events in the region, most notably the 1998 tsunami (Tappin et al., 2008). An on-going national assessment of coastal flooding (the first such assessment) commissioned by the United Nations Development Programme (UNDP) as part of an international climate change initiative investigates the current and future threat of coastal flooding in different provinces across the country (Dhore, 2014). Anecdotal descriptions of coastal hazards are available from Participatory Rural Assessments (PRAs) conducted by the WCS in 10 sites and adaptive capacity surveys in 5 sites in Manus Province in 2014. Among other things, these

assessments describe significant events and weather-related hazards, including coastal hazards. Other data on coastal hazards and their impacts include reports from the Disaster Relief Office for the 2008 King Tide (available for New Ireland Province) and anecdotal evidence of coastal erosion and flooding from local communities in both provinces.

There is one long-term sea-level monitoring station for the country at Lombrum in Manus Province, as part of a larger Pacific region sea-level rise monitoring programme (Commonwealth of Australia Bureau of Meteorology, 2015). Coastal elevation data from satellite imagery is limited to an international 30 m resolution Shuttle Radar Topography Mission (SRTM) dataset (NASA and California Institute of Technology, 2014). A shoreline elevation mapping project is ongoing in some coastal communities in Manus Province and New Ireland (Kimagi, 2014, Unpublished). Information on infrastructure such as roads, bridges, schools, health centres and airstrips is available for the two provinces in the form of GIS layers (UPNG/GEFC, 2014). There is no collected information on coastal protection infrastructure though anecdotal information is available from coastal communities. Geographic information on coastal habitats is limited to 30 m resolution global datasets on coastal habitats from the United Nations Environment Programme World Conservation Monitoring Centre (UNEP-WCMC, 2010). Information on the past and present extent of local habitat cover is available anecdotally from the communities.



Figure 2 Map of Papua New Guinea with islands of Manus Province circled in red and islands of New Ireland Province in green (Source: <http://www.ezilon.com/maps/oceania/papua-new-guinea-road-maps.html>)

2. FIELD REPORT – MANUS PROVINCE

2.1. SITE DESCRIPTION

The coastlines of Manus Province are generally flat, characterised by sandy beaches, mangrove forests, patches of nearshore seagrass beds and offshore coral reefs. Manus island and the larger volcanic islands have a few rivers and show considerable elevation gain (> 50 m) behind the coastline. The atoll islands are relatively flat with elevations rarely exceeding 10 m. Most of the infrastructure – i.e. airports, roads and bridges are concentrated on Manus island. There is one airport for the province, Momote Airport, on the east coast of the island. The provincial capital Lorengau is a town of 6,000 people on the northern coast, 28 km west of the airport. Momote Airport and Lorengau are linked by a low-lying road that runs along the coast for most of its length. Road infrastructure is concentrated in the eastern half of the island, and there are plans to extend these to the western half. Government run schools and aid posts (health centres) are distributed throughout the province. Coastal communities live very close to the shoreline and mainly rely on fishing in the mangroves and reefs for their food and income.

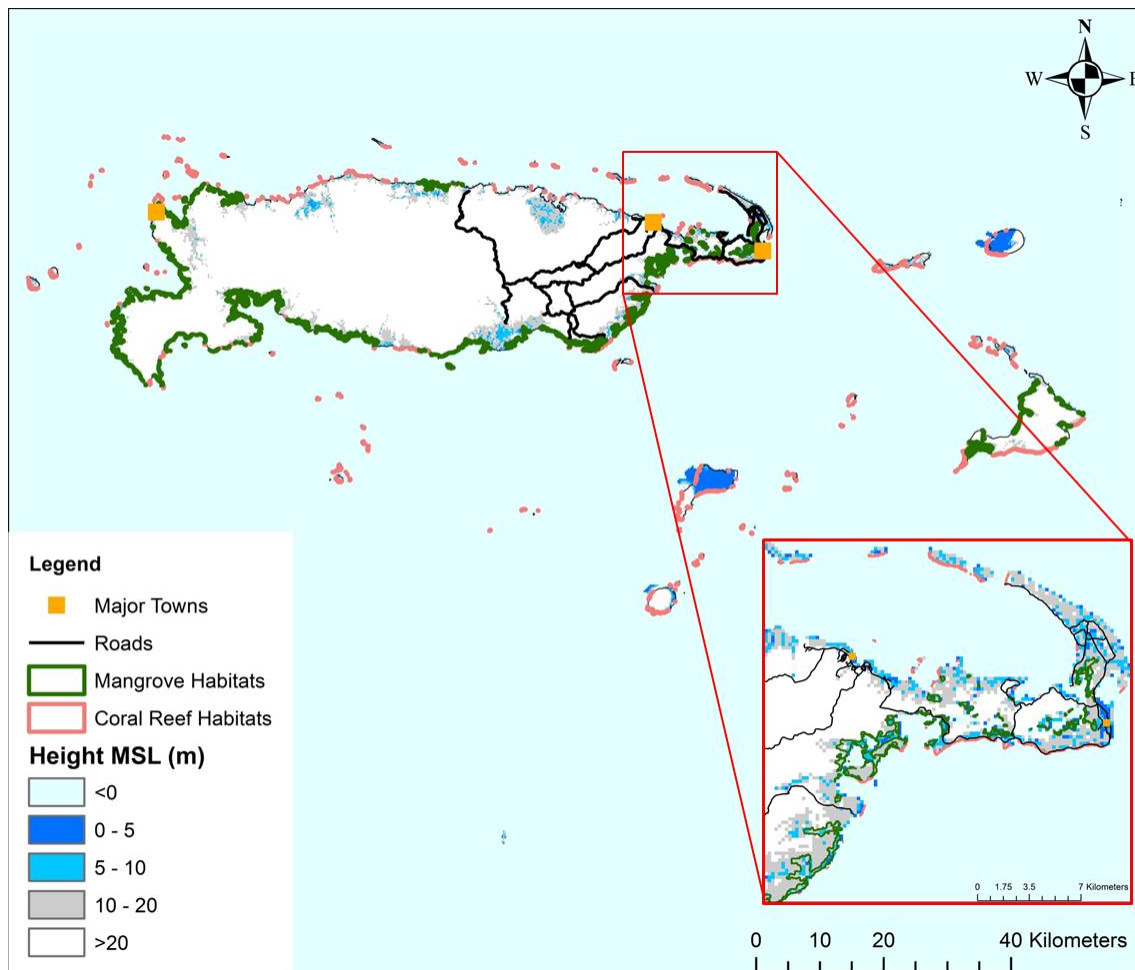


Figure 3 Overview of coastal habitats, towns and elevation above Mean Sea Level (MSL) around Manus Island and nearby islands in Manus Province (map does not show the outlying Ninigo Island group). Inset shows detail of east Manus Island with Momote Airport and Lorengau Urban LLG (UNEP-WCMC, 2010, UPNG/GEFC, 2014)

2.2. CHARACTERIZATION OF COASTAL HAZARDS AND ASSETS

The dominant coastal hazard in Manus Province is erosion. Several locations around the province are experiencing rapid loss of land (~ a few metres a year) from coastal erosion. The low-lying outer islands and atoll islands are the most vulnerable to this coastal hazard. The main causes of erosion are strong currents and high waves. Sea-level rise is another immediate concern, especially in the low-lying outer islands. Sea level data from 1994 measured at Lombrum in Manus Province shows an average rise of 10 mm/year at current rates which translates to a 0.5 m increase in sea-levels – and almost complete inundation of some low-lying islands (see Figure 5 in Box 1) – by 2065 (Commonwealth of Australia Bureau of Meteorology, 2015). The region is also susceptible to tsunamis and extreme tide surges, such as the 2008 King Tide, an extreme surge event that inundated entire islands along the northern coast of the province.

Coastal communities in Manus invariably live right on the shoreline and typically build stilt houses close to and in some cases within inter-tidal zones. Important cultural assets such as the village cemetery, church or traditional community buildings are often located at the shoreline. In many places, homes and village toilets are threatened by erosion and rising sea-levels.

Rising sea-levels are also causing salinity intrusion into food gardens and drinking water sources. Underwater springs at the shoreline that are the only drinking water source in some locations are flooded for longer durations. The outer atoll islands are witnessing frequent inland flooding due to high tides, a hazard that will increase as sea-levels continue to rise. High coastal water levels also result in ground-water flooding on coastal roads such as the road which links the province's main airport at Momote to the provincial capital at LorFigure 4: Coastal erosion on Momote-Lorengau road, Manus Province.



Figure 4 Coastal erosion on the Momote-Lorengau road, Manus Province. Photo by EN

Box 1: In addition to the Participatory Risk Assessments for climate change, WCS are mapping coastal zone elevations at locations in Manus and New Ireland Provinces to identify exposed communities and coastal risk hotspots. This information, together with information on inundation extents from historical extreme events, like the 2008 King Tide, will be extremely useful in predicting coastal risk hotspots as a result of sea-level rise or future extreme events. Extending this exercise to other coastal areas in the two provinces will provide an overview of areas most at risk within these provinces.



2.3. CURRENT AND FUTURE OPTIONS FOR COASTAL PROTECTION

Coastal protection measures in Manus are primarily aimed at reducing erosion and vary from mangrove planting to dry stone seawalls depending on the local context and environment. Coral reefs are known to reduce wave energy significantly (Ferrario et al., 2014). Several coastal communities in Manus are located behind coral reef habitats and consequently enjoy a high degree of protection from waves. Similarly, mangroves provide a number of services, such as coastal protection, timber and enhanced fisheries (Brander et al., 2012), and communities situated near mangrove forests benefit directly from these services. Communities where mangroves were cleared for agriculture or house-building reported observing increases in local erosion rates. Participants in the coastal protection workshop showed a high degree of awareness of the coastal protection benefits of coastal habitats, and the adverse consequences if these are lost. All participants stressed the need for coastal solutions that do not harm the marine environment.

Box 2: WCS and other NGOs have been engaged in community training exercises for mangrove conservation and planting to reduce coastal erosion and provide other benefits from mangrove areas. A useful addition to this would be to help local communities consider and evaluate the impacts of losing existing coastal habitats. In this regard, the monitoring and comparison of coastal erosion rates in areas with and without mangrove forests and reefs can help to better understand the extent and variation of the protection benefits from these habitats. For instance, workshop participants mentioned increased erosion along coastlines where mangrove forests had been cleared for development. Measuring erosion at a location involves measuring the rate of change of shoreline position at that location over a period of time. One simple way to do this is to measure the distance of a fixed object behind the beach from the high water mark. Since the shorelines of Manus and New Ireland province are highly dynamic, bi-weekly or monthly recordings of shoreline position for at least a year will be needed to define an envelope of shoreline variability. Comparing rates of change thus measured, between adjacent shorelines with and without coastal protection (seawalls, mangroves or reefs); or before and after a coastal protection project will provide insights into the effectiveness of the project.



Seawalls are a widely used coastal protection measure in Manus Province. The majority of these walls are small scale structures built using local materials such as mangrove timber and dry stone. These walls are usually built to protect assets such as cemeteries, churches, etc. that are immediately threatened by erosion and where space is a constraint. However, there is limited awareness of proper design techniques leading to ineffective structures, such as with the gabion basket seawall for the Momote Lorengau road that did not reduce erosion and was washed away within a decade. In many locations, seawalls built without an adequate foundation experience damage and eventual failure due to scour.

The proper design and construction of concrete seawalls can be prohibitively expensive especially if designed for high levels of protection. For example, a seawall for erosion control in Thailand was reported to cost 60 million Baht (US\$ 1.78 million) per kilometer (Thai Financial Post, 2013). In comparison, seawalls made from local materials and mangrove reforestation are easier and cost less to implement though the levels of risk reduction they provide will be lower and will vary from measure to measure. Also, awareness of the potential adverse effects of hard barrier structures such as concrete seawalls on adjacent coastlines is limited. The Manus Provincial Development Plan for 2006-2016 identifies 62 seawalls in the province – three maintained by the national government, three by the provincial government and 56 by lower government levels (LLGs) (Manus Provincial Administration, 2005). As of 2008, several seawall construction and maintenance projects have been funded by the provincial and local level governments for amounts ranging from 5,000 Kina to 10,000 K (1,800 to 3,600 US\$) for erosion control (Manus Provincial Administration, 2004).

Long-term coastal CCA options for the low-lying outer islands are limited and will potentially involve having to relocate populations to other islands or the mainland. Relocation is however a complicated and time-consuming measure. High exposure to wave energy on these coastlines makes them unsuitable for mangrove habitats. Temporary coastal defense measures for these islands could include preservation of existing reef habitats and/or construction of artificial reefs and seawalls to protect key assets.

2.4. SOCIAL AND CULTURAL CONSIDERATIONS

Coastal communities in Manus Province traditionally live very close to the shoreline and often within the inter-tidal zone. These communities have a degree of need-based and cultural adaptation built into their practices such as building on stilts. However, the capacity to identify specific issues that require targeted management, such as increased intensity and/or frequency of inundation and erosion, is absent. Given their dependence on coastal habitats (coral reefs, seagrass beds and mangrove forests) the awareness among local communities of the need to protect these habitats is high. However in many instances – particularly for mangrove habitats – this comes into conflict with the motivation to convert natural habitat to commercial plantations (coconut, oil palm, etc.).

The workshop discussions in Manus indicated that when there is awareness of other ‘hard’ coastal engineering options, these are often perceived as attractive with regard to their reliability and long life. However there is limited awareness of the potential financial cost and negative impacts of conventional engineering structures like seawalls, and in parallel, limited awareness of the potential coastal protection benefits offered by reef and mangrove habitats. Also, the participants stressed the lack of capacity to design and construct effective coastal engineering structures. Projects that included training and awareness components were therefore felt to be much more valuable compared to those that only implemented solutions.

Box 3: WCS have organized community training exercises for constructing dry stone stack seawalls in two villages in Manus Province to protect important residential and community assets. Monitoring of the effectiveness and health of these seawalls and of any negative consequences on nearby coastlines will inform further coastal protection actions and help improve coastal management practices. Also, training local communities to integrate these with other traditional methods such as reefing (see Section 6.3), or building seawalls from local materials will help make these solutions more comprehensive. The image below shows a dry stone stack jetty in Korijih village, Manus Province constructed using local materials as part of a WCS training programme.



2.5. COASTAL MANAGEMENT, CCA AND DRR POLICIES

Interviews with officials from the Provincial Government indicated an absence of any national or provincial level coastal zone management plans and/or legislations. Development along the coast, including construction and coastal protection works is largely unregulated. The development and maintenance of national infrastructure such as roads, bridges and airstrips, though regulated for criteria such as environmental impact assessments, quality and standards, are not subject to any coastal regulations or zoning. For instance, an upcoming project to upgrade the 28 km coastal road from Momote Airport to Lorengau – a road currently susceptible to groundwater and coastal flooding – is mainly limited to surface maintenance with no proactive coastal protection strategy. Officials are aware of the fact that mangroves between the road and the ocean protect it from erosion (but not from groundwater or tidal flooding) along some stretches. However, there has been no explicit consideration of this service when planning road construction or maintenance.

The Organic Law in Papua New Guinea, which allows LLGs to develop their own laws, provides them autonomy with regard to coastal regulations. However, examples of LLG level laws dealing with the coastal zone are few in number and largely driven by individuals championing specific local issues such as mangrove deforestation or coastal erosion with critical assistance from local NGOs and CBOs (see Figure 13 in Box 5 on “Problem to Action Pathway”).

The national Disaster Mitigation Act at present focuses on recovery and restoration of communities affected by disasters, rather than mitigation per se. Also, the absence of an effective early warning system (or prediction system for regular tidal flooding) hinders preparation for floods from high tides, storm surges or more extreme coastal events. There are plans at the national level driven by the Office of Climate Change and Development (OCCD) to expand the scope of Provincial Disaster Relief Offices to include coastal DRR and CCA planning (see Appendix 6.4, Interview with Michael Lamusan, Disaster Relief Officer for New Ireland).

2.6. ROLE OF GOVERNMENT, NGOS AND CBOS IN COASTAL PROTECTION

The interviews and workshop discussions identified the Provincial Government as the key source of funding, expertise and capacity with regard to identifying and solving coastal problems. LLG and lower level governments are in turn the primary mechanism to whom communities propose projects pertinent to their wards and villages. The focus of the Provincial Government in Manus Province is in ensuring that these local level projects are aligned with national policies, especially around new policies regarding CCA and DRR. International NGOs and local Community Based Organisations (CBOs) play a key role in this regard by building awareness around coastal issues and providing training in sustainable coastal management particularly with regard to managing and restoring coastal habitats. The WCS mangrove restoration training project and coral reef farming projects were cited as examples of effective engagement with NGOs to help solve local issues.

3. FIELD REPORT – NEW IRELAND PROVINCE

3.1. SITE DESCRIPTION

The coastlines of New Ireland Province are characterised by a mixture of sandy beaches, mangrove forests and offshore coral reefs. The largest island in the province, New Ireland, has a mixture of limestone cliffs and sandy beaches along its eastern coastline, and mangrove forests and beaches along its western coastline. The island has a central mountainous spine and several rivers. Smaller islands like the Tigak Island group are relatively flat throughout with elevations generally below 10 m. Public infrastructure, including roads, bridges and airports, is concentrated on New Ireland. The island has the provincial capital Kavieng, a city of around 17,000 people, as well the main airport for the province. The other main city on the island is Namatanai on the central eastern coast. Communities on the eastern coastline between Kavieng and Namatanai are served by the Boluminski Highway with a few road links to the western coastline. Public schools and aid posts are distributed throughout the province. Regions where private logging, mining or agriculture are present have roads, coastal seawalls and jetties built for cargo handling and transportation. On New Ireland and New Hanover islands many communities supplement their income with food gardens and cash crops or with income from mining. There is some tourism in the province with the main tourist activity located in and around Kavieng and some nearby islands, as well as a few locations along Boluminski Highway in New Ireland. Coastal communities on the smaller islands rely primarily on fishing in the reefs and mangroves for their food and income.

3.1. CHARACTERIZATION OF COASTAL HAZARDS AND ASSETS

Erosion and frequent tidal inundation were identified as the dominant coastal hazards in New Ireland Province. The main causes of coastal erosion in New Ireland Province are high waves along the exposed eastern shorelines and strong tidal currents in the inner islands. Erosion on the bigger islands is exacerbated by the clearing of natural coastal vegetation for oil palm, coconut and other commercial crops. As with Manus Province, sea-level rise is a serious and immediate concern for coastal communities especially in the low-lying atolls. Sea level data from the only measuring station for PNG at Lombrum in Manus Province shows an average rise of 10 mm/year at current rates (Commonwealth of Australia Bureau of Meteorology, 2015), which translates to a 0.5 m increase in sea-levels by around 2065. Several workshop participants and interviewees also mentioned the 2008 King Tide as having caused extensive changes to coastlines. The event destroyed or submerged more than 140 homes along the northern coastline (see Appendix 6.7) and caused large-scale destruction of coral reefs as well as significant changes to nearshore coastal morphology and tidal current patterns, the adverse effects of which are still being felt by local coastal communities.

New Ireland Province has seen considerable logging and commercial plantation activity relative to Manus. Upstream logging has caused extensive sedimentation along the south-eastern coastline of New Ireland Island resulting in much wider beaches than before and, in some cases, even destruction of shallow reef habitats. Dynamite fishing had destroyed coral reefs along some islands in the past though this practice has now largely stopped.

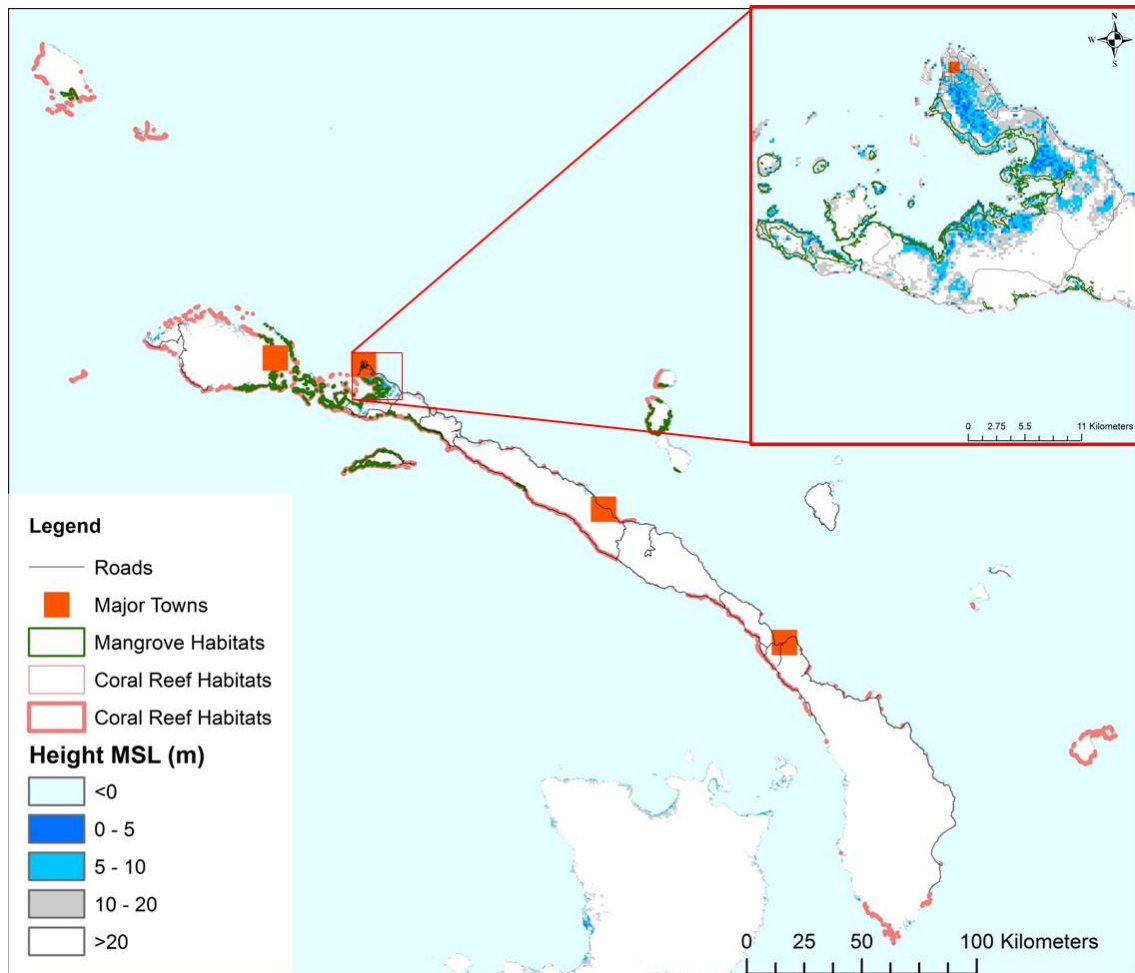


Figure 5 Overview of coastal habitats, towns and elevation above Mean Sea Level (MSL) around New Ireland Island and nearby islands in New Ireland Province. (Map does not show outlying Mussau Island group). Inset shows detail of Kavieng Urban LLG (UPNG/GEFC, 2014, UNEP-WCMC, 2010).

Like in Manus Province a large proportion of the population has close ties to the coast and the ocean. Most coastal villages are located very close to the high tide mark and as a consequence important assets are severely threatened by coastal erosion and/or flooding. Key assets at risk include houses, village cemeteries and road infrastructure. The erosion and washing away of coastal vegetation – which is an important source of timber – was mentioned as a particular concern by workshop participants. In some villages the main fresh water source is located on the beach. More frequent and longer periods of inundation therefore adversely affect the availability of fresh water. Construction on the bigger islands in New Ireland Province tend to be on the ground and at some distance from the shoreline due to practical considerations of soil stability and, in the case of some steel and concrete structures, exposure to salinity in the air (see Appendix 6.4, interview with Isaac Gunugu, Provincial Administration Technical Services, New Ireland).



Figure 6 Erosion threatens village cemetery at Sohun Village, New Ireland Province.

3.2. CURRENT AND FUTURE OPTIONS FOR COASTAL PROTECTION

Many of the coastal communities in New Ireland Province are situated directly behind or close to coral reefs and as such benefit from the protection (among other services) that these habitats provide. Like in Manus Province, solutions are mainly directed at reducing coastal erosion and range from planting of natural coastal vegetation – i.e. *Calophyllum* and mangrove trees – to gabion baskets, to seawalls built of local bush material and using traditional techniques.

Mangrove reforestation was identified by workshop participants as a low-cost solution that is easy to implement and can be quickly started as opposed to conventional engineering solutions that are often costly and require specific technical expertise. Some workshop participants and interviewees also mentioned a traditional method of constructing artificial wave breakers to protect and encourage development of shallow reef habitats (referred to locally as “reefing”). Gabion baskets were identified as a common though ineffective measure, the key obstacles being the lack of proper design and construction techniques.

Though information on the number of seawalls or other coastal protection structures was not available, awareness of coastal issues and solutions for adaptation and protection seemed to be generally higher among workshop participants compared to Manus Province. For instance, one village Bol, which was heavily affected by the 2008 surge event (including damage to its health centre) has implemented soft solutions such as building on higher ground and building on stilts in addition to the use of seawalls. Some villages also have plans in preparation or submitted to the provincial government for relocation of homes and infrastructure and even for dredging of offshore lagoons and subsequent nourishment of beaches.



Figure 7 Mangrove nursery as part of an afforestation exercise for coastal protection at Nonovaul Island, New Ireland Province.

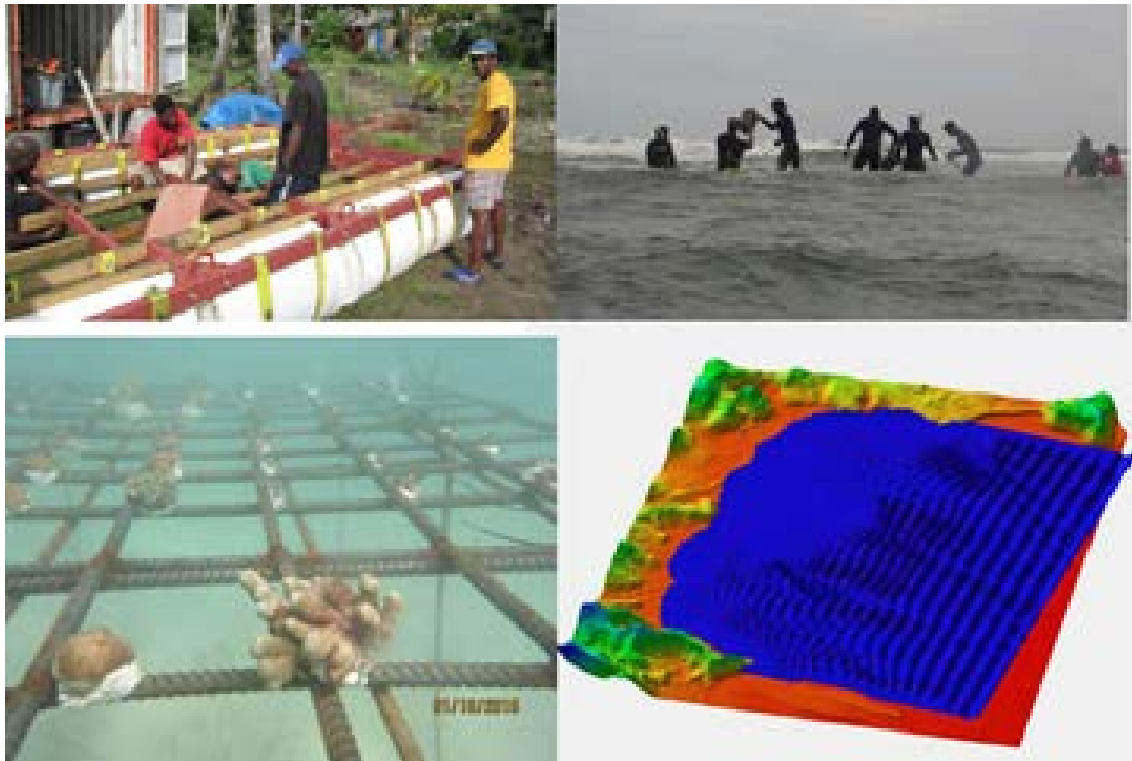
Similar to Manus Province, the key obstacles to implementing coastal protection solutions were the lack of awareness of the different options available, the lack of expertise to design and execute engineering solutions and the lack of financing for these solutions. Workshop participants also highlighted the need for demonstrative examples from other regions, to help provide an understanding of where and when a particular solution could be applied.

3.1. SOCIAL AND CULTURAL CONSIDERATIONS

New Ireland was similar to Manus Province in that most of the interviewees and workshop participants had close social and cultural ties to the coast and the ocean and exhibited a high degree of awareness of the past and current states of their coastal habitats, as well as the importance of preserving them. The workshop discussions indicated that awareness of the other services provided by these habitats (i.e. enhanced fisheries, timber and, in one instance, carbon sequestration) were higher than awareness of their coastal protection services.

Workshop participants, who were mostly Provincial, LLG and Ward level government officials, appreciated the opportunity for targeted cross-departmental discussions across different government levels, and with local NGO and CBO partners.

Box 4: Workshop participants in both provinces mentioned the usefulness of and need for case-study examples of coastal protection projects from other places. Habitat restoration and management projects for coastal protection could combine techniques from projects elsewhere with lessons from projects implemented in the region. For instance, the Building with Nature project in Indonesia (Borsje et al., 2011) use naturally restored mangrove habitats for coastal protection. Another example is reef restoration projects for coastal protection: in Andra Island, of Manus Province WCS have implemented a reef restoration project for coral farming that uses techniques similar to a project aimed at coastal protection and reef enhancement in Grenada in the Caribbean, though the Andra island project is at a much smaller scale (images from The Nature Conservancy, 2014).



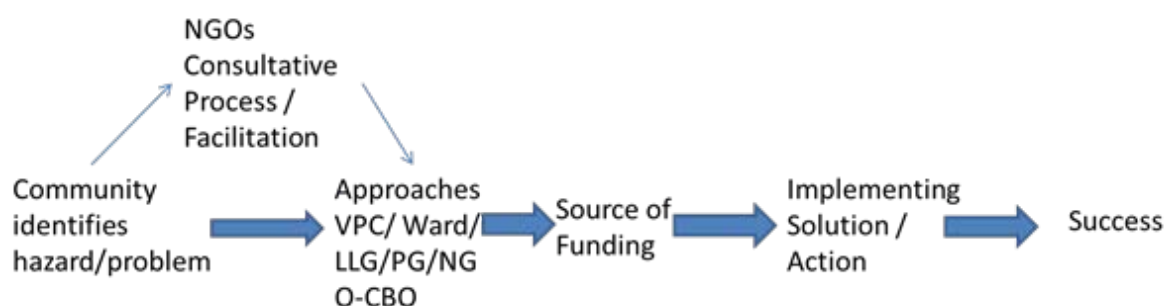
3.2. COASTAL MANAGEMENT, CCA AND DRR POLICIES

Similar to Manus Province, interviews with officials and workshop discussions indicated an absence of coastal regulations or management policies at the national and provincial levels. Since New Ireland was also heavily affected by the 2008 King Tide, there was some attention on coastal rehabilitation and disaster recovery after this event. At present, the emphasis is on damage assessments and post-disaster recovery. The Disaster Relief Office in New Ireland is actively engaged in interacting with other departments to develop an integrated disaster risk reduction and recovery planning policy for the province. This is in conjunction with national plans to expand the current Disaster Mitigation Act to include DRR and CCA components (see Appendix 6.4, interview with Michael Lamusan, Disaster Relief Officer, New Ireland).

3.3. ROLE OF GOVERNMENT, NGOS AND CBOS IN COASTAL PROTECTION

Like in Manus Province, the Provincial Government in New Ireland is primarily concerned with aligning local level projects with national level policies. The Provincial Government acts principally in deciding the allocation of funds and helps develop appropriate project proposals. Officials from the Provincial Planning Division who oversee proposals from districts and lower levels of government said they had not seen any proposals to date that dealt specifically with coastal issues or climate change. Workshop discussions indicated that the success of coastal protection or habitat restoration projects was often due to help provided by NGOs in developing proposals for funding from LLG and higher levels of government.

Box 5: The provincial and local level governments play a key role in formulating policies and facilitating sustainable coastal development. While current policies do not cover coastal zone management or disaster risk reduction and hence do not recognize the coastal protection value of coastal habitats there are opportunities to start integrating coastal CCA and DRR practices into existing policies. An example is PNG's Organic Law, which can be used to introduce legislation at the local level for the protection of coastal habitats. Other opportunities include national level plans by the OCCD to integrate CCA and DRR into existing policies for land-use planning. Individuals at community meetings identified that NGOs and CBOs like WCS or Ailan Awareness play a key role in awareness building, capacity building and training for project execution and proposal development and in some cases as a source of funding opportunities for local projects. By continuing to provide training in these areas NGOs and CBOs can play a critical role in influencing the success of sustainable, medium-to long- term projects for coastal CCA and DRR at the scale of villages and wards.



The figure above, a “Problem to Action Pathway” for a coastal hazard problem, was drawn by participants at the coastal hazards workshop in New Ireland and identifies the role of government, NGOs and CBOs in the process.

4. RELEVANT FINDINGS FROM SNAP DATABASES AND ANALYSES

This report has drawn upon and contributed to ongoing analyses within the Science for Nature and People (SNAP) Coastal Defenses Working Group (www.snap.is/coastal-defenses). SNAP Coastal Defenses is a multidisciplinary team of experts in ecology, engineering, policy and economics who are investigating where, when and to what extent coastal habitats may play a role in coastal protection and hence in CCA and DRR. Coastal communities in Manus and New Ireland provinces currently benefit from the coastal protection – among other services – that ecosystems such as mangroves and coral reefs provide. Awareness of the extent of this protection and where and when it is provided is generally low. Initial results from syntheses of global field evidence suggest that coral reefs and mangroves are both highly effective in reducing incoming wave energy (by over 40% and up to 74%), with reefs being relatively more effective than mangroves, as well as more suitable for highly exposed environments. Over large extents (~ few kilometres) mangrove wetlands can also significantly reduce storm surge levels (Narayan et al., 2015). Since they reduce wave heights it is likely that these habitats also reduce coastal erosion rates (e.g. Shepard et al., 2011) though this effect will vary from place to place depending on site conditions.

Workshop participants and interviewees stressed the lack of awareness of the coastal protection values of specific coastal habitats and the need for case-study examples from similar regions to enhance consideration of these options. To facilitate easy access to information from nature-based coastal protection projects and case-studies around the world an online database of natural defenses is being developed within the SNAP group.

This database¹ is an interactive interface that allows users to map and examine projects based on criteria such as habitat type, coastal setting and engineering and cost effectiveness and directs them to more information on each project. A number of projects in this database involve a combination of hard engineering structures and natural habitats designed to complement one another in providing coastal protection. These projects also give some insights into planning and designing coastal protection projects that involve coastal habitats. In addition there are a growing number of guidance documents such as the Engineering with Nature guidelines of the United States Army Corps of Engineers (USACE) and the Building with Nature (BwN) guidelines that outline the steps to be followed in designing nature-based coastal protection measures. Integrating this information with existing guidelines on best practices for mangrove restoration (e.g. Maniwavie et al., 2013) will greatly help enhance the effectiveness of similar coastal CCA projects.

The interviews conducted with government officials in Manus and New Ireland were designed to obtain insights into the constraints, incentives and barriers that affect the consideration and use of coastal habitats in risk reduction and/or coastal protection policies. On-going analyses within SNAP in Melanesia and elsewhere suggest that there is a lack of policies to do with coastal zone management, conservation and disaster risk reduction in several developing countries. Other obstacles include a lack of awareness of feasible options and a lack of technical capacity for designing and executing solutions. PNG's Organic Law which provides legislative power to

¹ Accessible at <http://maps.coastalresilience.org/global/> - click on "Natural Defense Project"

LLGs is a potential opportunity to help integrate local-level coastal management plans within wider conservation, CCA and DRR policies. Using information gained from this exercise in PNG and similar exercises elsewhere, SNAP is working on identifying relevant policy triggers and constraints that can help foster implementation of nature based protection where appropriate.

5. CONCLUSIONS AND RECOMMENDATIONS

Coastal communities in Manus and New Ireland Provinces are severely exposed and vulnerable to erosion, frequent tidal flooding and, less frequently, to extensive flooding and coastal changes by extreme events such as the 2008 King Tide. Sea-level rise rates for PNG are ~ 10 mm / year, which will mean almost complete inundation of low-lying islands such as Andra Island in Manus Province by AD 2050 (see Figure 5 in Box 1, section 2.2). In general, the northern and eastern shorelines in the two provinces experience higher waves and surges and hence greater flooding and erosion compared to other shorelines. However, strong currents and complex geomorphologies mean that coastal erosion is a common problem everywhere. People in coastal communities live very close to and sometimes below the high-tide mark and rely on nearby reef and mangrove habitats for sustenance and livelihood. Most of these communities live directly behind reefs and benefit from the coastal protection – among other services – that these habitats provide. Habitat degradation, though not as extensive as in some other part of the country, is having adverse consequences on local livelihoods. Coral reefs have been, and are being, damaged by sedimentation from upstream logging, natural extreme events, and also by past instances of dynamite fishing - now an abolished practice. In some places habitat degradation is increasing coastal hazards. Some coastlines where mangrove forests have been cleared have seen an increase in erosion rates (see Box 2, Section 2.2).

At present, adaptation to coastal hazards is generally reactive in nature and there is little or no proactive coastal management. General awareness of the different coastal protection options and their benefits and drawbacks is low. The majority of coastal protection measures in both provinces are targeted at erosion control. A range of erosion control measures are used including seawalls, gabion baskets and mangrove reforestation. The high costs of conventional engineering structures and the lack of capacity to design and construct them properly are the key obstacles to their widespread implementation. Softer options, such as mangrove afforestation and adaptation measures such as building higher or retreating are widely seen as cheaper, easier to implement and as having less of an impact on the coastal environment although there is limited understanding of the effectiveness of these options. However, many communities in these provinces have successfully implemented mangrove afforestation and conservation projects with observable coastal protection benefits. The conservation of offshore reefs is critical to coastal protection especially since most coastal communities are situated directly behind coral reefs though awareness of their value in this regard is low. Harder options such as seawalls and gabion baskets are seen as the only option in situations where there is an immediate and severe threat to assets. Wire mesh gabion baskets have been tried in the past to protect highways and important facilities in the major towns from erosion. However, improper construction techniques have resulted in these baskets failing to provide erosion reduction and being washed away. In

communities where locals have been trained in seawall construction these techniques have been adopted successfully. Most of these seawalls are built using local stone and mangrove timber and have to be maintained or replaced periodically.

There are currently no coastal protection measures against flooding from high tides, surges or waves. Communities that experience frequent flooding show a degree of adaptation by building on stilts and, in some cases, retreating to higher ground. Relocation to higher ground, or in more severe cases to a different island, is the only viable long-term solution for communities on some of the outer atolls. This is a complex issue that will take time to execute and will require consideration of multiple social, cultural, political and economic aspects. In such situations a combination of measures such as adaptation to low-intensity flood events (i.e. building on stilts), artificial reefs or submerged breakwaters for erosion control and seawalls to protect important assets against high-intensity flood events may be necessary in the short to medium term. This will require developing local awareness of coastal issues and building their capacity to adapt and implement suitable coastal protection measures.

Coastal protection in the context of CCA and DRR is complex, often involving multiple government institutions. There are currently no national or provincial legislations governing development in, or management of, the coastal zone. Disaster mitigation and environmental policies do not include a risk reduction component though efforts are underway to expand these policies to include DRR and CCA within their scope. Like with any coastline, protection measures in Manus and New Ireland provinces will have to: a) methodically identify and prioritise issues that need tackling; b) assimilate multiple structural and non-structural solutions; and c) consider related issues such as the health of adjacent coastlines and ecosystems and the impacts to local practices and livelihoods. From the field visits, interviews and workshop discussions a few general recommendations are made in this regard:

1. Integrate on-going training exercises with awareness building on coastal management, CCA and DRR. Also, include training and awareness of coastal engineering options and coastal protection services of habitats (for example, through the use of factsheets and briefing notes).
2. Where possible use and incorporate lessons from case-studies and examples of sustainable coastal protection projects implemented elsewhere (for example, SNAP, Building with Nature, etc.).
3. Help and train local people to identify and map coastal issues (flood extents, erosion rates, changes in habitat) at village/ward scales.
4. Help build capacity for developing proposals to obtain funding from Provincial Governments, and for streamlining proposals with national and provincial policies.
5. Help and train locals to monitor and maintain records of the effectiveness and impacts of any implemented coastal protection measure using simple observation and mapping techniques (i.e. shoreline extent, flood frequency and extent, health of mangrove forest and/or seawall, etc.).

In addition a number of site-specific recommendations are made throughout this report. Based on findings from the field visits and discussions with local and provincial government officials, these recommendations identify opportunities for WCS and other NGOs and CBOs to increase

the effectiveness and impact of their coastal protection, CCA and DRR activities in these provinces. The main recommendations are summarized below:

1. Extending on-going coastal elevation and inundation extent mapping activities to other locations in the two provinces (see Box 1 in Section 2.2).
2. Incorporating training on measuring/evaluating the costs of lost habitats by monitoring shoreline changes and other effects along with ongoing habitat conservation and restoration training activities (see Box 2 in Section 2.3).
3. Including training on monitoring effectiveness and impacts of built coastal structures such as dry stone stack seawalls and integrating these with the use of traditional coastal protection/habitat restoration methods such as reefing (see Box 3 in Section 2.3).
4. Investigating the feasibility of habitat management specifically designed for coastal protection (for example, artificial reef restoration, and mangrove restoration using permeable fences) using techniques similar to projects implemented in the region (see Box 4 in Section 3.3).
5. Helping develop local awareness of coastal issues and the capacity to enforce legislation on sustainable coastal zone management, CCA and DRR using the opportunities provided by PNG's Organic Law. This will also help streamline local actions with national and provincial policies (see Box 5 in Section 3.6)
6. Developing local capacity for writing project and funding proposals that identify coastal issues and propose sustainable, cost-effective solutions. (see Box 5 in Section 3.6)

6. ACKNOWLEDGEMENTS

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ANNEX 1

Sample Workshop Agenda and Workshop Participant Lists

Manus Workshop on Coastal Hazards

Date: February 26th 2015

Location: Education Department Conference Room

Goals

The goals of this workshop are to discuss coastal hazards for coastal communities in Manus province with government and administrative officials from all levels, and to identify possible solutions, key knowledge gaps, barriers and opportunities.

Agenda

9.00 am – 9.15am: Welcome by Ezra and Sid

9.15 am – 9.30 am: Round-table introduction by participants

9.30 am – 9.45 am: Background presentation by Sid

9.45 am – 10.15 am: Breakout session 1 on “Solutions for Coastal Hazards today in Manus: What solutions do we have and do they work?”

10.15 am – 11.00 am: Open discussion on coastal hazard issues in Manus Province. Aim at end of session is to identify and characterize type and location of different coastal hazards and start thinking about solutions.

11.00 – 11.15 am: Presentation on coastal solutions and case-studies by Sid

11.15 am – 12.00 noon: Breakout session 2 on “Future Solutions to Coastal Hazards in Manus: Exploring Possibilities.”

12.00 noon – 12.30 pm: Wrap-up by SN, EN

12.30 pm: Lunch

ANNEX 2

Participant List for Manus Workshop on Coastal Hazards

Number	Participant Name	Department / Office	Role
1	Luke Sihamou	Bisasopia LLG	President
2	Simon Pondrelei	Manus PG	Public Servant
3	T. Mundri	Self Employed	
4	S. Moleatar	Rapatona LLG	Executive Officer Acting Executive Manager
5	Kanawi Sindol	MPA, Law and Justice	Provincial Forest Officer
6	Pius Pokris	Forestry Unit	Councillor Mbuke
7	Selarn Keluwin	Councillor Enviro/Climate Change Unit	Scientific Officer
8	Luke Ndrasal	Disaster Unit	Assistant Relief Officer
9	Ricky Baur	Enviro/Climate Change Unit	Conservation Officer
10	Sharon Koitut	Papindo	Supervisor
11	Philip Maran	Education	SPA - BE
12	Peter Nalan	Andra Ward Councillor	Councillor
13	Tom Kalolo	Ward 1 Ponam	WDC
14	Moses Ndrau		Provincial Works Manager
15	Geneveve Kalenda	DOW	CBO Coordinator
16	Mildred K.	MECCN	Executive Manager
17	Obert Otto	Planning Manus Admin	

ANNEX 3

Participant list for New Ireland Workshop on Coastal Hazards

Number	Participant Name	Department / Office	Role
1	Ahimsa Kibikibi	NBC Niu Ailan National Courts, Province	Content Maker
2	Sagal Boski	Office Nonovaul LMMA,	Court Officer WI Recorder/Local
3	Jonah Oliven	Tikana LLG	Conservationist
4	Jordan Bulo	Climate Change NIPA	Coordinator
5	Job Opi	WCS Manus	Marine Biologist
6	Harold Papaol	Kavieng Urban LLG	Town Manager
7	Fidelis Losman	KULLG	CHO
8	Jonathan Mesulam	WCDF	Coordinator
9	John Igua	Ailan Awareness	Field Officer
10	Patrick Topital	Live & Learn	Team Leader
11	Max Kuduk	WCS New Ireland	Team Leader
12	Edward Kibikibi	Kavieng Urban LLG	SO/Liaison
13	Francis Sabade	Newcrest Mining Limited	Coordinator/Govt. Liaison
14	Will Humphries	WCS New Ireland	Climate Change Consultant

ANNEX 4

Factsheet for workshop breakout session 2 on coastal protection options

SOLUTION	FOR HAZARD	ADVANTAGES	LIMITATIONS
Gabion basket/Boulders	Erosion, Flood	<ul style="list-style-type: none"> • Easy to build • Low costs 	<ul style="list-style-type: none"> • Short life • High maintenance • Not very effective
Seawalls	Erosion, Flood	<ul style="list-style-type: none"> • Effective, esp in highly exposed areas • Can be built quickly 	<ul style="list-style-type: none"> • Can be costly (depends on material) • Severe impacts on coastal envt • Requires training
Mangroves	Erosion, Flood	<ul style="list-style-type: none"> • Easy to design • Cheaper than seawall or levee • Other ecosystem benefits 	<ul style="list-style-type: none"> • Needs space and time • Effective only in specific locations • Requires training
Breakwaters (sea breakers)	Erosion	<ul style="list-style-type: none"> • Very good at wave and erosion reduction 	<ul style="list-style-type: none"> • Expensive • Requires technical expertise
Reefs	Erosion	<ul style="list-style-type: none"> • Very good at wave, erosion reduction • Cheaper than breakwater • Other ecosystem benefits 	<ul style="list-style-type: none"> • Effective only in specific locations • Requires technical expertise
Groynes	Erosion	<ul style="list-style-type: none"> • Effective in beach building • Low costs (if use local timber, rock) 	<ul style="list-style-type: none"> • Needs sediment supply along coast • Can cause erosion elsewhere
Beach Nourishment	Erosion	<ul style="list-style-type: none"> • Good at beach building • Can be eco-friendly if done properly 	<ul style="list-style-type: none"> • Severe impacts on coastal envt if not done properly • Expensive, needs repetition • Requires technical expertise
Levees	Flood	<ul style="list-style-type: none"> • Effective in flood control • Can be combined with natural options (mangroves) 	<ul style="list-style-type: none"> • Needs space • Can be costly (depends on material)

ANNEX 5

Manus Province Interview Summaries – Part I: Link to DRR and Priority of coastal protection (continued on next page)

Organisation	Name	Position	Mandate	Link to DRR	Priority of DRM/ coastal protection
Provincial Planning Office	Obert Otto	Provincial Planner	Planning, coordinating and overseeing activities by other departments within the province	Helps coordinate activities of Disaster Office and Department of Environment and Conservation (DEC) within Manus Province	Recognised as a problem but low priority in terms of policy
Provincial Administration	Paso Pohe	Deputy Provincial Administrator	The PA monitors the standard and quality of activities of other departments. PA Technical Services focus on provincial roads, buildings, etc. PA Economic Services focus on agriculture, fisheries, etc. They also provide assistance to Local Level Governments (LLGs) in plan and project development activities	No direct link, but can indirectly help enforce town planning and national zonation laws and can assist LLGs in development of plans and projects for DRR and/or coastal protection	Low to non-existent. Last known coastal protection work in Manus province was gabion basket walls in the 1980s that got washed away in 10 years or so
Lands and Environment	Kanawi Sindol	Acting Executive Manager, Law and Justice Dept (formerly MPA with Lands and Environment)	NA	Lands and Environment were involved in setting up, maintaining and collecting data from the Lombrum Sea Level Rise (SLR) Monitoring station as part of the Australian Bureau of Meteorology Pacific SLR Monitoring Programme (data collection has now been automated)	Low, linked to specific projects such as the SLR monitoring programme
LLG Executive Manager's Office	Robert Siewert	Executive Manager	The Executive Manager's office is responsible for coordinating the activity plans and implementation of these plans for all LLGs in the province	The Exec. Manager has a secondary role in the Deputy Provincial Office which created a new environmental unit (DEC) that deals with disasters, mainly post-disaster surveys	There is currently no provincial coastal protection or management plan. LLG activity plans could implicitly include coastal protection/CCA plans, though Robert has so far not seen an LLG activity plan that includes these issues.
Works Department, Provincial Office	Geneveve Kalanda	Provincial Manager	The Provincial Works Office in its current reduced capacity is responsible for all national roads and bridges in the province. They also assist PA Technical Services in implementing provincial infrastructure projects	Only link to DRR is with post-disaster maintenance/reconstruction of national roads and bridges	Low, limited to post-disaster maintenance/reconstruction

Manus Province Interview Summaries – Part II: Policies, Barriers, Opportunities and Recommendations (continued on next page)

Organisation	Name	Position	Relevant policies	Barriers	Opportunities	Recommendations
Provincial Planning Office	Obert Otto	Provincial Planner	Organic Law (and hence LLG laws and policies); There are currently no known regulations or policies to deal with coastal management/coastal hazards at the provincial level	Main barrier in addressing coastal issues is a lack of technical and engineering expertise, resulting in ineffective and/or unsustainable solutions; Other barriers include a lack of budget and manpower within the PP office to plan and administer coastal solutions	Opportunities for better, more long-term, more holistic coastal protection and planning include the organic and deregulated nature of decision-making (PNG Organic Law); Relatively high concern and awareness among local populations of coastal issues and hazards can also be tapped	Increase awareness among locals of the need for coastal planning and management, and improve capacity and expertise for implementation of basic plans and solutions
Provincial Administration	Paso Pohe	Deputy Provincial Administrator	Local (town) zonation and planning laws exist that may include coastal areas, but these are often not enforced. National environmental laws exist that include coastal areas, but these are weak, top-down and not enforced	Lack of regulations, and enforcement of existing laws are a key barrier in improving coastal management; Lack of engineering and technical expertise is the main barrier in implementing coastal protection solutions.	Learning from coastal protection/management examples elsewhere in PNG, assisting wards and LLGs in plan development, and obtaining funding from international donors	Need better regulations and enforcement of existing laws
Lands and Environment	Kanawi Sindol	Acting Executive Manager, Law and Justice Dept (formerly MPA with Lands and Environment)	There are currently no known regulations or policies to deal with coastal management/coastal hazards at the provincial level	Lack of importance given to coastal and climate change issues	Disasters - coastal and climate change issues in the province were discussed with national leaders after the 2008 King Tide event, but there has been no follow-up action since. Climate change awareness building plans have been on the drawing board for a while.	Increase awareness of coastal and climate change issues among LLG and higher level government officials, using information and data from projects such as the Lombrum station project
LLG Executive Manager's Office	Robert Siewert	Executive Manager	Organic Law (and hence LLG laws and policies); There are currently no known regulations or policies to deal with coastal management/coastal hazards at the provincial level	Main difficulties for LLGs are in documenting a problem and commitment of the officers to develop a plan and apply for funding. One reason for this could be the lack of technical expertise	Funding is available for LLGs if they develop a plan and apply for it. Funding to the tune of 10 M Kina a year is distributed among all LLGs of the Province via the Open Member's office (Open Member is the elected representative at the national govt)	Assist LLGs with documenting a problem and developing a plan, to apply for funding; Where help is available, the organic law structure can be used to incorporate coastal issues into local laws. For instance Penabunali LLG have local environment protection laws developed with the help of an external NGO (TNC)
Works Department, Provincial Office	Geneveve Kalanda	Provincial Manager	No known coastal CCA/DRR or environmental policies that apply to infrastructure works	Lack of awareness and planning on coastal issues. Disaster work is entirely post-disaster. There is little disaster planning in place, except for planning for the distribution of drinking water supplies (tanks).	Proactive maintenance/construction of roads. Officials are aware that mangroves protect the main road from Momote Airport to Lorengau though this was unintentional. The 28 km road is due for maintenance in March 2015, by a private Australian contractor. The road is currently low-lying and threatened by coastal flooding, and the Works Office had suggested raising it by backfilling. However this was vetoed and the maintenance work will be limited to surface maintenance with backfilling along a limited stretch of 1.5 km.	NA

Manus Province Interview Summaries – Part III: Funding, Partners, Summary

Organisation	Name	Position	Funding	Partners	Summary/ Take home message
Provincial Planning Office	Obert Otto	Provincial Planner	Government funding	DEC; Disaster Office; Works Department; Forestry; Fisheries	Provincial Planning Office does not have a mandate for coastal management, however their role as coordinating body gives them scope to oversee, and possibly influence and direct coastal activities implemented via other departments.
Provincial Administration	Paso Pohe	Deputy Provincial Administrator	Government funding	Works Department; LLGs	The PA's office only has an indirect link to coastal protection. In the almost complete absence of any coastal management plan or regulation, the best they can do is provide assistance to wards and LLGs in developing their own coastal management projects.
Lands and Environment	Kanawi Sindol	Acting Executive Manager, Law and Justice Dept (formerly MPA with Lands and Environment)	Government funding	NA	Lands and Environment deal with coastal issues only when they are involved in a project that is tied to these issues, such as the sea-level rise monitoring station. Otherwise their mandate for coastal management/coastal protection/climate change adaptation is limited. Opportunities include using their connection to the Lombum station project to increase awareness within government on these issues
LLG Executive Manager's Office	Robert Siewert	Executive Manager	Government funding	LLGs	The Executive Manager's office is directly responsible for LLG plans and projects. Given that the Organic Law which recognises laws developed by LLGs, assisting this level of government in developing coastal management/protection/CCA offers the greatest opportunity.
Works Department, Provincial Office	Geneveve Kalanda	Provincial Manager	Government funding	Provincial Administration	The Works Department used to be responsible for all infrastructure (including coastal) in the province, but this has now been delegated to various departments, mainly PA Technical Services. Works are now responsible mainly for national roads and bridges, and as such have little say in coastal management or protection plans and works.

ANNEX 6

New Ireland Province Interview Summaries – Part I: Link to DRR and Priority of coastal protection (continued on next page)

Organisation	Name	Position	Mandate	Link to DRR	Priority of DRM/ coastal protection
Provincial Planning Division	Eric Cook	Provincial Planner	Assisting Wards and LLGs in project development; providing and collecting statistics; assist lower govt levels in developing proposals and aligning these to national plans	No direct link to DRR; Helps coordinate LLG plans and activities which may be linked to DRR	Recognised as a problem but low priority in terms of policy; Has so far not seen any funding requests for projects dealing with coastal or climate change issues
Provincial Administration, Technical Services	Isaac Gunugu	PA Technical Services Manager (Temporary Charge)	PA Technical Services is mainly responsible for building infrastructure - i.e. schools, health centres, etc. Other infrastructure works are outsourced to Works Department	Only link to DRR is with post-disaster rehabilitation of damaged schools, health centres. The Bol health centre was rebuilt by the PA-TS. However the river training works in front of the health centre and the bridge were Works Department projects	Low, limited to post-disaster maintenance/reconstruction
Department of Environment and Conservation (DEC)	Esau Kabin, Jordan Bulu	Executive Manager, Asst Executive Manager	The DEC was established in 2007-08 by the Provincial Government with an initial mandate to create awareness among communities of climate change issues. The scope has now been expanded to include addressing climate change issues and assisting communities with adaptation wherever possible.	No direct link to DRR. The DEC has drawn up some CCA plans for local communities though they lack the funding to execute these plans. Also, until recently there were no links between the CCA and the DGs and LLGs.	Coastal issues are a priority task, in terms of assessing hazards and identifying hotspots. The DEC have been engaging with coastal communities talking about adaptation options such as building on stilts, and are planning to do a province-wide survey to identify coastal risk hotspots.
Disaster Relief	Michael Lamusan	Disaster Relief Officer	The Disaster Relief Office is the provincial division of the National Disaster Office. Its main mandate is implementing legislations and management plans in the province, in line with national DRR directives (e.g. Disaster Mitigation Act. It is also responsible for improving awareness, communications and response capacities, empowerment of communities, etc.	Direct link to disaster response, though no mitigation or DRR activities yet. Activities mainly include awareness building, and communication and response capacities for all disasters, from King Tides and landslides, to boat mishaps	Limited to scope of disaster relief activities
Fisheries Department	Simeon Agaar, Emmanuel Tamba	NA	The Fisheries Dept. is directly responsible for fisheries in the atolls, and supervises the LLG level fisheries at every LLG of the province.	None	No link to DRR; Fish catch is regulated within mangrove areas as per National Fisheries Administration regulations
West Coast Development Foundation	Jonathan Mesulam	CEO	The West Coast Development Organisation is a Community Based Organisation (CBO) working on climate change adaptation along the west coast regions of NIP. They work in building awareness of CC issues and adaptation options with local communities along the west coast.	WCDF work includes building awareness of coastal issues and adaptation options with local communities, and providing training for mangrove planting for erosion control	WCDF have been engaged in mangrove replanting, rehabilitation and conservation for erosion control in Danu, including training the local community in mangrove management and hope to expand this work to other west coast communities.

New Ireland Province Interview Summaries – Part II: Policies, Barriers, Opportunities and Recommendations (continued on next page)

Organisation	Name	Position	Relevant policies	Barriers	Opportunities	Recommendations
Provincial Planning Division	Eric Cook	Provincial Planner	Organic Law (and hence LLG laws and policies); There are currently no known regulations or policies to deal with coastal management/coastal hazards at the provincial level	Main barrier is difficulties for LLGs in documenting a problem and applying for funding	There are plans by the Provincial Government (Lands??) to buy run down oil palm plantations and use the land to relocate some island communities	Improve capacity and expertise among lower govt. levels for development of plans and funding applications
Provincial Administration, Technical Services	Isaac Gunugu	PA Technical Services Manager (Temporary Charge)	There are currently no coastal zoning (or any zoning) regulations, or any other acts that determines where to build. However structures are generally built away from the shoreline, due to issues of soil stability, atmospheric salinity (which causes rusting), etc.	Poor construction practices - many jetties built by logging companies are acting as groynes, experiencing heavy siltation on one side and heavy erosion on the other	NA	Provide regulations on where to build and construction guidelines
Department of Environment and Conservation (DEC)	Esau Kabin, Jordan Bulu	Executive Manager, Asst Executive Manager	There are currently no known regulations or policies to deal with coastal management/coastal hazards at the provincial level	Lack of importance given to coastal and climate change issues, lack of awareness on coastal issues and hotspots	Community engagement to build awareness and identify/map coastal hazards and other coastal management/CCA issues	Province-wide survey of coastal hazards to identify hotspots and prioritise coastal management/protection/CCA activities
Disaster Relief	Michael Lamusan	Disaster Relief Officer	There is currently no disaster management plan in place for the province though the office plans to have one in place by mid-2015. There are currently no known regulations or policies to deal with coastal management/coastal hazards at the provincial level	Lack of a national disaster act to help enforce policies for zoning, etc. (the current Disaster Mitigation Act only applies to emergency response)	Coordinating activities with various departments and soliciting their cooperation with regard to developing a comprehensive disaster mitigation and response plan for the province	To increase coverage of RR capacity building activities, which are currently being done by 'partner's' i.e. NGOs and CBOs at the community level
Fisheries Department	Simeon Agaar, Emmanuel Tamba	NA	National Fisheries Administration regulations regarding fish catch in mangrove areas	NA	NA	NA
West Coast Development Foundation	Jonathan Mesulam	CEO	NA	Lack of awareness and technical expertise	Improve and build community awareness and capacity for implementing long-term, sustainable coastal solutions	Increase community awareness and build capacity to implement solutions (training for mangrove planting, seawall construction), and to develop coastal management plans

New Ireland Province Interview Summaries – Part III: Funding, Partners, Summary

Organisation	Name	Position	Funding	Partners	Summary/ Take home message
Provincial Planning Division	Eric Cook	Provincial Planner	Government funding (see funding flowchart in Notes)	LLGs	Provincial Planning Office does not have a mandate for coastal management, however their role as coordinating body for LLG activities gives them scope to oversee, and assist LLGs in developing coastal management/protection/CCA plans
Provincial Administration, Technical Services	Isaac Gunugu	PA Technical Services Manager (Temporary Charge)	Government funding	Works Department; LLGs	The PA Technical Services office only has an indirect link to coastal protection. Their scope in this regard is limited to the post-disaster rehabilitation of damaged structures. There are no laws or regulations governing where to build, though practical construction choices are made that often result in the provision of some sort of coastal setback
Department of Environment and Conservation (DEC)	Esau Kabin, Jordan Bulu	Executive Manager, Asst Executive Manager	Government funding; NGO funding	Partner organisations (CBOs, NGOs, donor orgs)	The DEC have a broad scope with regard to CCA, and a relatively limited scope with regard to DRR. There are currently no coastal regulations/laws in place but the DEC have initiated a province-wide survey of coastal issues to build community awareness and help lower govt. levels develop coastal management/protection/CCA plans
Disaster Relief	Michael Lamusan	Disaster Relief Officer	Government funding	All organisations working in disaster prone regions - DEC; Lands and Environment; Works; Planning Offices; Fisheries; Agriculture; LLGs; Partner Organisations	The Disaster Relief Office is a new office, charged with building community awareness and response capacities for disasters. There is currently no mitigation or DRR plan in place though the office is working towards starting the development of a provincial DRR plan by mid 2015 with the cooperation of all concerned provincial and lower level departments
Fisheries Department	Simeon Agaar, Emmanuel Tamba	NA	Government Funding	NA	The only link between the Fisheries Department and coastal protection/management/CCA issues is the regulation of fish catch within mangrove areas. There was also anecdotal mention of some communities practising coral farming activities, possibly in areas affected by previous dynamite fishing. These activities could have an effect on coastal protection.
West Coast Development Foundation	Jonathan Mesulam	CEO	NGOs, International Donor Organisations	NA	Jonathan's CBO represents a key aspect of coastal protection/management/CCA activities in the province. In light of the absence of any regulations and/or little government support, much of the work actually implemented on the ground in this regard is due to the activities of these CBOs and similar NGOs.

ANNEX 7

Manus Breakout Summary – Part I: Identifying Coastal Hazards (continued on next page)

Breakout I	Group	Community / Location	Hazards / Severity	Assets Affected	Solution at Present	Main Concern
Hazards	1	Ponam	High tide, waves, erosion, strong currents, strong winds, dry spells, over population	Sandy beach, roads, buildings, food gardens, well water, decrease in land area, reefs destroyed	Seawalls (dry stone stack), mangroves, water tank, water pumps, coral farming, clam-shell farming	Decrease in land area, marine life (reef and shoreline destruction altering fish behaviour, movement patterns)
		Souh	High tide, waves, erosion, strong currents, strong winds, dry spells, over population	Sandy beach, roads, food gardens, well water, decrease in land area, creeks	Seawalls, water tank, water supply, move road inland	Water supply
		Kari	Erosion, floods	Roads, rivers, food gardens, forest, building	Water tank, water supply, road maintenance	Fresh water, forest, food gardens
	2	Tilienu Island	Erosion, sea level rise, soil infertility	Land reduction, houses not protected, garden foods	sea walls, breakers (suggested), farming system	Resettlements
		Kali Island	Sea level rise, erosion, flooding (rain)	House not protected, land reduction, water / food	Seawall, rain water tanks, piped water	Resettlements
		Pere	Erosion, sea level rise, Public health (toilets)	Infrastructure damage, land reduction, People (health)	None (mangroves are being managed but not directly for coastal protection), Relocation of toilets	Move to higher ground, early warning system
	3	NBC Beach (Ward 7 - Ward 1) Lorengau Town water front, (Lorengau Urban LLG)	High waves, sea currents, wind	Road, buildings, beach, settlements	sea wall, war time buffer (boulder revetment)	Road, Beach
		Mbuke Island (Pobuma LLG)	High waves, sea currents, wind	Road, water wells, crops, settlements, social service, marine environment	Seawall, mangrove, coral cultivation, re-settlement	Settlements, food, water
		Lohie Village (Tetidu LLG)	High waves, sea current, river system, salt water intrusion	Roads, crops, creeks, settlements, beach, marine environment	Nil (Needs immediate attention)	Settlements, food, water, beach

Manus Breakout Summary – Part II: Assessing Coastal Solution

Breakout II	Group	Community / Location	Possible Solutions	Role of Provincial Government	Opportunities	Barriers
Solutions	1	Ponam	Reclaim land by ?, Build shoreline, sea breaker	Technical assistance, awareness	Opportunities for safe homes	Shortage of land, shortage of man power
		Souh	Mangrove planting, move inland	Technical assistance, awareness	better (more healthy) marine and coastal environments	Lifestyle / cultural change
		Salien	Relocation, backfill	Technical assistance, awareness	Opportunities for safe homes	Shortage of land, shortage of man power
	2	Tilienu Island	Resettlement	Resettlement policy, identify lands, source funding	land on higher ground is safer, resettlement can be an opportunity	no policy in place, land owner issues
		Kali Island	Sea walls, sea breakers, mangroves	Policy / funding, Design and technical expertise	Development of skills and manpower, employment generation	Ecosystems may be affected by solutions, funding
		Pere	Sea walls, sea breakers, mangroves	Policy / funding, Design and technical expertise	Development of skills and manpower, employment generation	Ecosystems may be affected by solutions, funding
	3	NBC Beach (Ward 7 - Ward 1) Lorengau Town water front, (Lorengau Urban LLG)	Sea walls, Boulders, land reclamation	Policy, plans, funding, partnership	Opportunity for long-term solutions	Land ownership, high costs, funding, culture change, political uncertainty, knowledge and expertise gap
		Mbuke Island (Pobuma LLG)	Seawalls, mangrove planting, re-settlement, natural diversion of sediment	Policy, plans, funding, partnership	Opportunity for long-term solutions	Land ownership, high costs, funding, culture change, political uncertainty, knowledge and expertise gap
		Lohie Village (Tetidu LLG)	Seawalls, mangrove planting, re-settlement, break waters	Policy, plans, funding, partnership	Opportunity for long-term solutions	Land ownership, high costs, funding, culture change, political uncertainty, knowledge and expertise gap

ANNEX 8

New Ireland Breakout Summary – Part I: Identifying Coastal Hazards (continued on next page)

Breakout I	Group	Community / Location	Hazards / Severity	Assets Affected	Solution at Present	Main Concern
Hazards	1	Panachais Village	Coastal erosion, sea-level rise, water source covered by sand, erosion of coastal vegetation	Roads, Villages, Houses, cash crops (coconut, cocoa), coastal timber (vegetation)	Gabion basket, stone lining seawalls, relocation (planned)	Erosion in coastal villages
		Maragon Village	Sea level rise, bridge washed away (by 2008 tsunami), beach erosion, coastal vegetation washed away, road infrastructure	Bridges, roads, culverts, waterlogged airstrip, coastal timber washed away, sediment build up on reefs	Nil (relocation planned)	Sea level rise effects on coastal villages
		Lamusong Village	Sea level rise, vegetation washed away, cemetery washed away, water spring covered, erosion	Cemetery, coconut and cocoa, coastal timber washed away	Stone lining (traditional)	Sea level rise, effects on cash crops and houses
	2	Nae Village (Ward 1, Murat LLG)	Frequent flooding by high tide, erosion, salinity intrusion	Houses, shoreline vegetation (coconut, other trees), loss of marine life due to sedimentation	Seawall using local bush material, establish wind and sea breakers, awareness programmes	Severity of natural disasters increasing, food security
		Weitin Valley (Ward 8, Konoagil LLG)	Coastal erosion, sediment build-up on reefs (due to upstream logging), earthquake	Loss of reefs and marine life, ports not accessible, shoreline has advanced by 60 m	None yet	Sediment build-up on reefs, associated with mass logging
		KVG Town Waterfront (KVG Urban LLG)	Continuous pollution, defecation	degradation of marine life and coastal environment	None yet	Pollution
	3	Sohun Village< East Coast, Namatanai	Erosion, frequent flooding by high tide, refeding coastline, sedimentation build up in dam upstream (needs study)	Cemetery, houses	Planting trees along beachfront (like Calophyllum) with help of WCS	Erosion of cemetery, houses
		Bol Village, East Coast, Karanalik Area, Kavieng	Flooding during high tide, erosion, more waves, receding coastline	Cemetery, market, houses, health centre, church, road and bridge	Building on stilts, and re-building	Relocate most of the assets to higher ground
		Mongol Village (Urban), Kavieng	Erosion, overcrowding posing hygiene problems, dumping of wastes from various sources	Houses, beachfront to hospital, market, dist., administration, etc.	Consultation done with VPC and KVG LLG (Town Office)	No control/dumping measures, no policies, no population control, health risks posed by problem
	4	Nonovaul Village, Tikana LLG	Erosion, mangrove degradation	Houses, cemetery, coastal vegetation	Planting mangroves (MARSH project), planned dredging and seawall projects	Erosion, relocation, water problem, population
		Namasalang, Tikana LLG	Erosion, bush clearing for oil palm	Shortage of land, road system, houses	Replanting of trees, relocation of road (planned)	Social disharmony, land disputes, water problem
		Danu, Sentral Niu Ailan LLG	Mangrove degradation, erosion, salinity intrusion	Road, houses, water source, cemetery	Mangrove rehabilitation (UNDP, WCS), road relocation (planned), seawall (planned)	Road, houses, water source, cemetery

New Ireland Breakout Summary – Part II: Assessing Coastal Solutions

Breakout II	Group	Community / Location	Possible Solutions	Role of Provincial Government	Barriers	Opportunities
Solutions	1	Panachais Village	Mangroves, groynes, replanting of shoreline vegetation	Sourcing expertise, provide funding, building capacity	Funding, expertise, no priority given to coastal management	Develop capacity (donor submissions)
		Maragon Village	gabion baskets, seawall, replanting of shoreline vegetation	improve engineering infrastructure, fund stakeholder engagements	Funding, expertise, no priority given to coastal management	Identification and use of local materials, ID local tree species for suitable planting
		Lamusong Village	traditional sea breakers (stones lined offshore for wave breaking and habitat development - reefing ?), mangroves	build awareness	Funding, expertise, no priority given to coastal management	Use adaptable plants, develop nurseries, new agenda for Monday workshops (council day) for improving awareness building and knowledge awareness
	2	Nae Village (Ward 1, Murat LLG)	Groynes (too exposed for mangroves)	Provincial Government, District Development Authorities, LLG, NGOs all play a role	Lack of expert advice, lengthy process to secure funding resources from the government, lack of govt policies and planning, important partners don't cooperate	To open dialogue with stakeholders/partners, locals to identify and implement locally based solutions (resources, knowledge)
		Weitin Valley (Ward 8, Konoagil LLG)	Dredging (will need detailed assessments), logging ban, reforestation along river banks and forests	Provincial Government, District Development Authorities, LLG, NGOs all play a role	Same as Nae Village + Weak acts (Forest Acts, etc.)	Review acts policies, ownership by locals, funds through Forest Levee I
		KVG Town Waterfront (KVG Urban LLG)	Better waste management, improve awareness, ownership of problem, toilets	Provincial Government, District Development Authorities, LLG, NGOs all play a role	Same as Nae Village + Lack of resources	Establish pollution acts at KV LLG Level
	3	Sohun Village< East Coast, Namatanai	Mangrove planting (can be started immediately), stone walls (need time to obtain funding, expertise), Groynes (need time obtain funding, expertise)	Consultation, technical assistance, funding assistance, policies	Lack of awareness, ownership issue, attitude	Education on issues, community involvement, replication to neighbouring communities
		Bol Village, East Coast, Karanalik Area, Kavieng	Mangrove planting, reef rehabilitation, onstruction of groynes, traditional methods of wall, sea breaker construction	Consultation with Village Planning Committee (VPC), technical assistance, funding assistance, policies	Overuse of mangroves for wood, lack of information, lack of technical assistance	Education on issues, community involvement, replication to neighbouring communities
		Mongol Village (Urban), Kavieng	Introduce waste management solution system, involve KV LLG for waste collection, enforce hygiene control	Consultation, introduce litter policy, funding from Provincial govt. + LV LLG for plans from VPC	Lack of coordination, Lack of funding, Lack of awareness	Hygiene, sanitation practices, Increase community awareness and stakeholder involvement
	4	Nonovaul Village, Tikana LLG	Mangroves (eastern side), gabion baskets (southern side)	Technical advice, funding, building community support	Lack of expertise, lack of funding, lack of community support, lack of awareness	e.g. mangroves - high and long term protection for beach front and marine ecosystem, gabion basket quick solution but will have good impact, should use network approach
		Namasalang, Tikana LLG	Access carbon trading process, improve VPC planning on water and sanitation, create more buffer zones	Technical support from responsible organisations, funding	lack of expertise, political parties' egnagement, lack of awareness on subject matters, lack of monitoring	carbon trade to be taken up in the community/wards, improve culture and traditional values
		Danu, Sentral Niu Ailan LLG	Mangroves	Technical, funding	lack of expertise, political parties' egnagement, lack of awareness on subject matters, lack of monitoring	Funding and technical support from NGOs, Donor Organisations, Provincial Governments

ANNEX 9

New Ireland Province 2008 King Tide Disaster Assessment Report

SITE	TIME INSPECTED	STATE OF SITUATION					
		<i>ENVIRONMENTAL DAMAGE</i>	<i>PHYSICAL STATE OF PEOPLE</i>	<i>No. OF HOMES AFFECTED</i>	<i>BEHAVIOUR OF WAVES</i>	<i>NEEDS</i>	<i>ACTIONS TAKEN</i>
PUTPUT	11:17 AM	Sea water high enough to reach houses and damage a few of them. Road intact	Stable, no injuries or complications.	3 houses damaged	Rough	Clean Water Shelter	All have moved to higher grounds inland
LOSUK	12:19 HRS	Sea water level has risen and damaged 3 houses initially but later 20 homes were destroyed. Road has partially been destroyed. Trees have been uprooted and floating in sea water.	Stable, no injury incurred or no loss of life.	20 homes destroyed	Very Rough	Water Shelter Food	All have moved to higher grounds inland
MANGAI	12:31 hrs	All houses have been destroyed Road intact Water contaminated	All alive and well	16 homes	Very Rough	Water \ Shelter food	All have moved to higher grounds inland
NGAVALUS		Effect more seen by the sea shore.		5 houses destroyed			All have moved to higher grounds inland
LAUVAN	12:38hrs	Rising sea level flooding houses Road intact No major environmental damage	All alive and well	All houses by the sea	Very rough	Water Shelter	Moved to higher land
PARUAI	1240hrs--		People well .	7 houses destroyed			All have moved to higher grounds inland
NONOPAI	1249hrs	People homeless, houses submerged in sea.	People well	15 houses destroyed			All have moved to higher grounds inland
LEMAKOT	1258hrs		People well	Houses were submerged in sea			All have moved to higher grounds inland
FANGALAVA	1313hrs	Wqter flooding road.	One male adult drift out at sea, not rescued.	3 houses destroyed with several submerged			All have moved to higher grounds inland
LABURUA	1336hrs		People well.	5 houses destroyed			All have moved to higher

2008 King Tide Disaster Assessment Report for north coast of New Ireland (Part I of III) (Source: Kavieng Hospital Emergency Team, 2008)

						grounds inland
MUNAWAI	1350hrs	Destruction similar to above observed.		3 houses destroyed with several submerged in water		All have moved to higher grounds inland
LARABINA	1357hrs	Destruction similar to above observed.		4 destroyed, 26 submerged in water.		All have moved to higher grounds inland
LUGAGUN	1405hrs	Destruction similar to above observed.		Houses submerged, 3 houses destroyed		All have moved to higher grounds inland
MADINA	1411hrs	Destruction similar to above observed.		All houses submerged, and several damaged		All have moved to higher grounds inland
LUVAUPUL	1418hrs	Destruction similar to above observed.		Several destroyed and the rest submerged in water		All have moved to higher grounds inland
TUVABI	1423hrs	Destruction similar to above observed.		Several houses damaged and others submerged in water		All have moved to higher grounds inland
FISSOA	1425hrs	Destruction similar to above observed. Damage more eminent.	All people homeless.	All houses destroyed and submerged in sea.	Larger waves splashing onto road and bridge.	All have moved to higher grounds inland
KAFKAF	1442hrs	Site seen to be as above but more by the seashore.		7 houses destroyed, others submerged in water		All have moved to higher grounds inland
BOL	1452hrs	Debris over road, river flooded	People homeless	Health Centre destroyed All houses submerged in water	Waves were larger and very destructive.	All have moved to higher grounds inland
TANDIS	1528hrs	Effect more by evident along seashore		Several houses destroyed.		
KONOS	1550hrs	Intact		No destruction		
SOMANIM	1554hrs	Intact		No destruction		
KIMADAN	1616hrs	Intact		No destruction		
KADAN	1627hrs	Some debris over road		No destruction		

2008 King Tide Disaster Assessment Report for north coast of New Ireland (Part II of III)

PAM	1632hrs	Debris over road, houses destroyed, company containers & equipments in a mess.		Whole camp by the sea destroyed			All have moved to higher grounds inland
KANABU	1651hrs	Road heavily covered with debris.		Houses destroyed, and several houses submerged in water.			All have moved to higher grounds inland
KATANGAN	1707 hrs	Road heavily covered with debris.		Whole camp destroyed.			All have moved to higher grounds inland
DABONOT	17:19 hrs	One drowned case seen. People anxious. One old person shifted to higher grounds.		9 houses destroyed completely.			All have moved to higher grounds inland
SILOM	18:07 hrs			Whole camp 7 houses destroyed completely.			All have moved to higher grounds inland
BULU - LOKON	20:09 hrs	Graves unearthed, water holes contaminated, one drowned case. Several wounded lightly, others children sick.		7 homes destroyed in all camps.			All have moved to higher grounds inland

2008 King Tide Disaster Assessment Report for north coast of New Ireland (Part III of III)