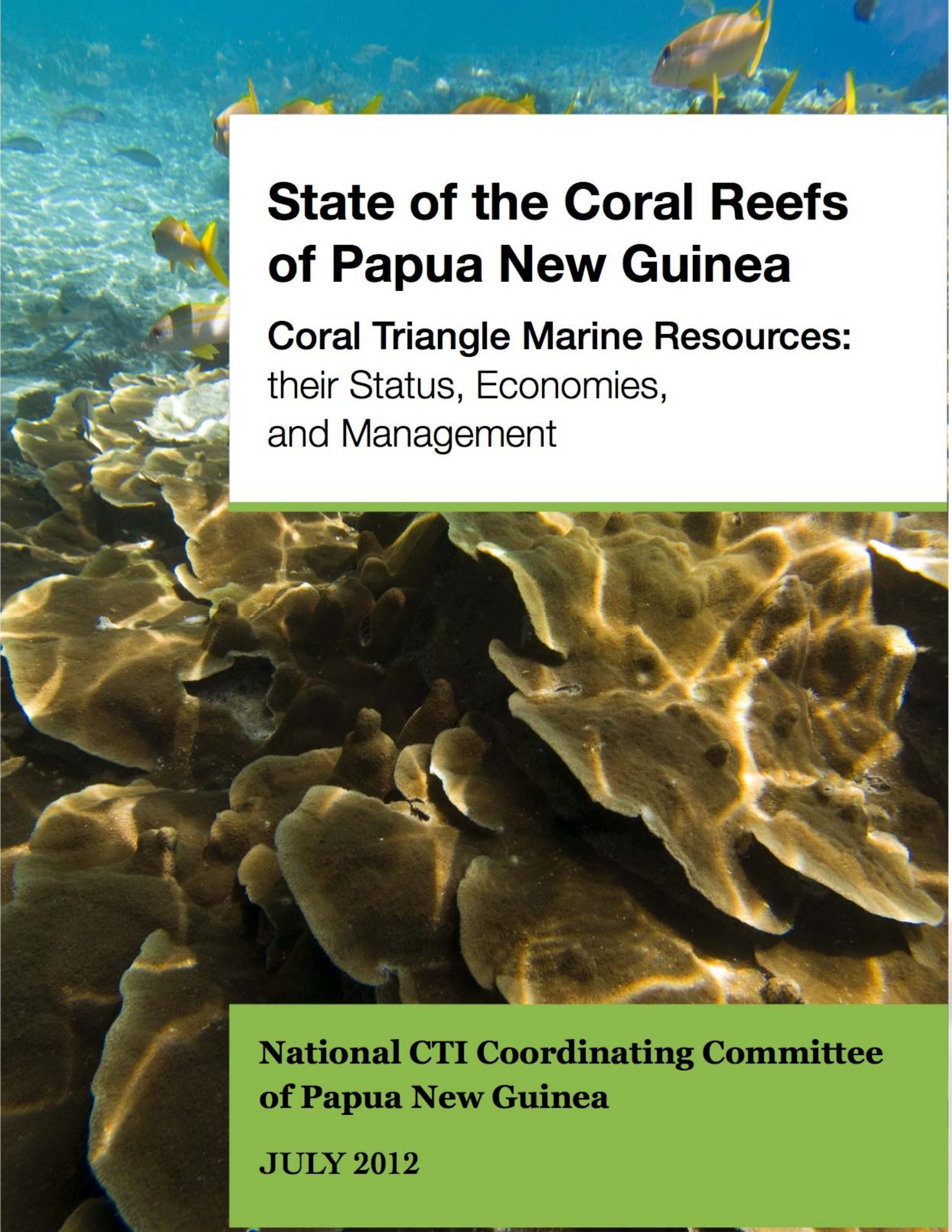

State of the Coral Reefs of Papua New Guinea

Coral Triangle Marine Resources: their Status, Economies, and Management

National CTI Coordinating Committee of Papua New Guinea

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I. Introduction

Papua New Guinea (PNG) is the largest Pacific Island country in total land area (some 460,000 square kilometers (sq km) and second in respect to ocean area (some 3 million sq km within its Exclusive Economic Zone (EEZ). PNG's population of over some 6 million people is sparsely distributed: population density strands at about 9 people per sq km which is the lowest in the south pacific region.

Principle marine and coastal ecosystems in PNG include coral reefs, seagrass beds , mangrove swamp forests and pelagic seas. Features of the marine and coastal zones are describe in table 1 below,

Table 1. Features of PNG's marine and coastal zone

length of coastline	20,197 km
% population living within 100 km of coast	61%
claimed Exclusive Economic Zone (EEZ)	1,673,759 sq km
territorial sea (up to12 nautical miles from shore)	752,256 sq km
area of coral reefs	40,000 sq km
area of coral reefs under protection	--
area of mangrove forests	4,586 sq km
area of mangrove forests under protection	23%
area of seagrass beds	--

Source: EarthTrends 2003. *Coastal and Marine Ecosystems. Coiuntry Profile-Papua New Guinea.* World Resource Institute. accessible at http://earthtrends.wri.org; other sources; --= not known.

Papua New Guinea has many coastal reefs and offshore patch reefs with high biodiversity; Information on PNG reefs is limited, with little research, monitoring and management capacity. Some monitoring data are available from independent sources. Many areas are remote, isolated and difficult to access and manage. However, this isolation has reduced the impact of human activities on reefs. Pressures include terrestrial sedimentation from poor land management, over-fishing (particularly of invertebrates such as sea cucumbers), loss of top level predators in some areas, destructive fishing, crown of thorns starfish (COTS) outbreaks and coral bleaching. PNG reefs are likely to be affected by global climate change, thus local stresses should be addressed to maintain reef resilience against climate change threats

The coral reefs in PNG are mostly located to the north and east coast of the country and lie within the 'coral triangle' that includes eastern Indonesia, the Philippines, eastern Malaysia, Timor Leste and the Solomon Islands. The coral triangle is a global centre of marine biodiversity and has very high conservation value.

Many reefs in PNG are close to shore and sensitive to terrestrial influences. Research and monitoring capacity in PNG is relatively low with most programs run by NGOs, such that there are few long term datasets for PNG reefs. There are also few MPAs in PNG and awareness and support for marine resource management is mostly limited to areas where NGOs have active programs, such as in Kimbe Bay, Kavieng, Manus and Madang.

A system of customary tenure ('tambu') for fringing reefs and inshore fishing resources exists in many coastal communities. Temporary closing of a reef is a historical practice that is now declining. Most reefs in PNG are in relatively good condition, although some reefs are under pressure from: sedimentation arising from poor management of mining, land clearing, oil-palm plantations and logging; over-fishing, including top predators such as

sharks and invertebrates such as sea cucumbers (bêche-de-mer); the live fish trade; COTS outbreaks; and coral bleaching.

PNG's marine and coastal ecosystems play a very important role both in supporting rural livelihoods for many island and coastal people and in supporting a fishing industry which provides significant revenue to the Government of PNG (GoPNG). Population growth in coastal areas is increasing. New forms of coastal development are also emerging in PNG including deep sea mining and a potential expansion of marine tailings disposal from mining operations. Predicted climate change impacts will also likely degrade ecosystem services through sea level rise, the deterioration of coral reef ecosystems and associated fish populations; subsequently causing economic disruption and social flow-on effects. Many island and coastal communities are disadvantaged by geography and distance, poor access to services, low-cash income and limited options for alternative economic opportunities.

Fisheries resources are associated with coastal, pelagic (open ocean) and freshwater habitats. The resources are somewhat rich and create a huge opportunity, but also present an enormous challenge for monitoring and control. The total market value for PNG's fisheries by catch is estimated at 350 Million – 400 Million Kina annually on average. Despite the richness of PNG fisheries resources, and the substantial value of fisheries production in absolute terms the contribution to national GDP is smallest as compared to other Pacific island countries. There is a significant potential to increase the economic value and returns to PNG in the sector through better management and development programs.

II. BIO-PHYSICAL GEOGRAPHY

Papua New Guinea has a very diverse Natural Environment. The country is characterized by steep and variable topography and high rainfall (annual average over 2,500mm). High biodiversity of animals, plants and fungi make up an estimated 4 million species. A treasury of marine resources, include coral reefs (which harbor more than 500 species of scleractinians), plus over 198 species of marine and fresh water decapod crustaceans and over 3,000 species of fish.

PNG has many undeveloped Areas. The country is thinly populated (9 persons/km2) and undeveloped.

The natural environment is relatively little affected by development. The rugged terrain of the country makes it extremely difficult to establish transportation and communication links. This also makes it difficult for infrastructure developments.

A. Land Area

Total Area land of PNG 460,000 km2 .The land is geologically classified into:

- **Southern Region:** Hot and humid and rainfall is usually low. Distinct rain and dry seasons. A few dormant volcanoes are found in this region
- **Islands Region**: Hot and humid. Made up of islands off the mainland. Some of these islands have active volcanoes. The significant features of these islands are the coral reefs, beaches and rich volcanic soil and marine resources.
- **Momase Region**: Ranges from open beaches to coastal swamps with dry savannah. Rainfall ranges from 3,000mm to 3,500mm. There are few active volcanoes in this region.
- **Highlands Region**: Has several large open valleys. The region is quite cold at night although the days are warm. Experiences cloud cover and fogs, and afternoon rain is common Rainfalls are usually between 3,000mm to 4,000mm.

B. Meteorological Features

Three major climatic systems control regional weather patterns that also influence the systems in PNG. The Inter Tropical Convergence Zone (ITCZ) passes over the region twice a year with its main influence from January to April. Cyclones often bring heavy rain and high winds at this time. Trade winds dominate from May to August.

The Climate of PNG is Tropical Monsoon. The northwest monsoon usually occurs in December to March while the southeast monsoon, from May to October. There are slight seasonal temperature variations.

There is basically a Dry Season and a Wet Season. Dry season occurs from May to October and the rainy from December to March.

With regard to temperature, the Average Temperature is 23 ~ 32 ºC: Highland 11 ~ 25 ºC, Rabaul 23 ºC, Lae 22.9, Port Moresby 23ºC.

Annual Rainfall is over 2,500-3,000 mm (Some districts have annual rainfall of more than 9,000 mm. Port Moresby: less than 1,000mm, Lae has over 4,500mm and Highlands 4,000mm)

Winds are changeable. May to August – Trade Winds, January to April – Northwesterly Winds

Climate Area: Highlands-cooler; Coastal areas humid and hot

C. Ecological Features

PNG's bio-geographical classification fall into 6 major areas.

- Coastal and oceanic areas
- Deltaic plains
- Lowland forest areas
- Lower mountain forest areas
- Upper mountain forest areas
- Grasslands

PNG's known species include 20,000 species of vascular plants, 3,000 species and more of fish , 197 species of Amphibians (frogs), 300 species and more of Reptiles , 762 species of Birds , Mammals (Marsupials 71species)

Characteristics of fauna and flora species : 3,000 orchid species, over 35 mangrove species, corals (greater than 700 species of stony and soft corals), over 500 reef building species, over 198 species of marine and fresh water decapods crustaceans

Other features: Extensive mineral deposits and hydrocarbons, abundant water and mixed tropical woods

D. Hydrological Features

Main Rivers systems in PNG include the Fly (1, 200km), Purari (233km), Markham (170km), Leron (76km), and the Sepik (500km)

PNG Lakes all together add up to about 5383 (22 lakes with surface area more than 1,000 ha). The Main Lakes (surface area): Murray (64,700ha), Chambri (21,600ha), Wisdom (8,590ha), Dakataua (?)

E. Ocean currents

Due to the location of the PNG waters in the Western Equatorial Warm Pool there has been much international interest in studying the air-sea interactions given the global effects of ENSO. In the 1980s The Western Equatorial Pacific Ocean Study (Lindstrom et al, 1987) described the major ocean currents and upper ocean structure. This was followed by the Coupled Ocean-Atmosphere Response Experiment (COARE) Godfrey et al, 1998

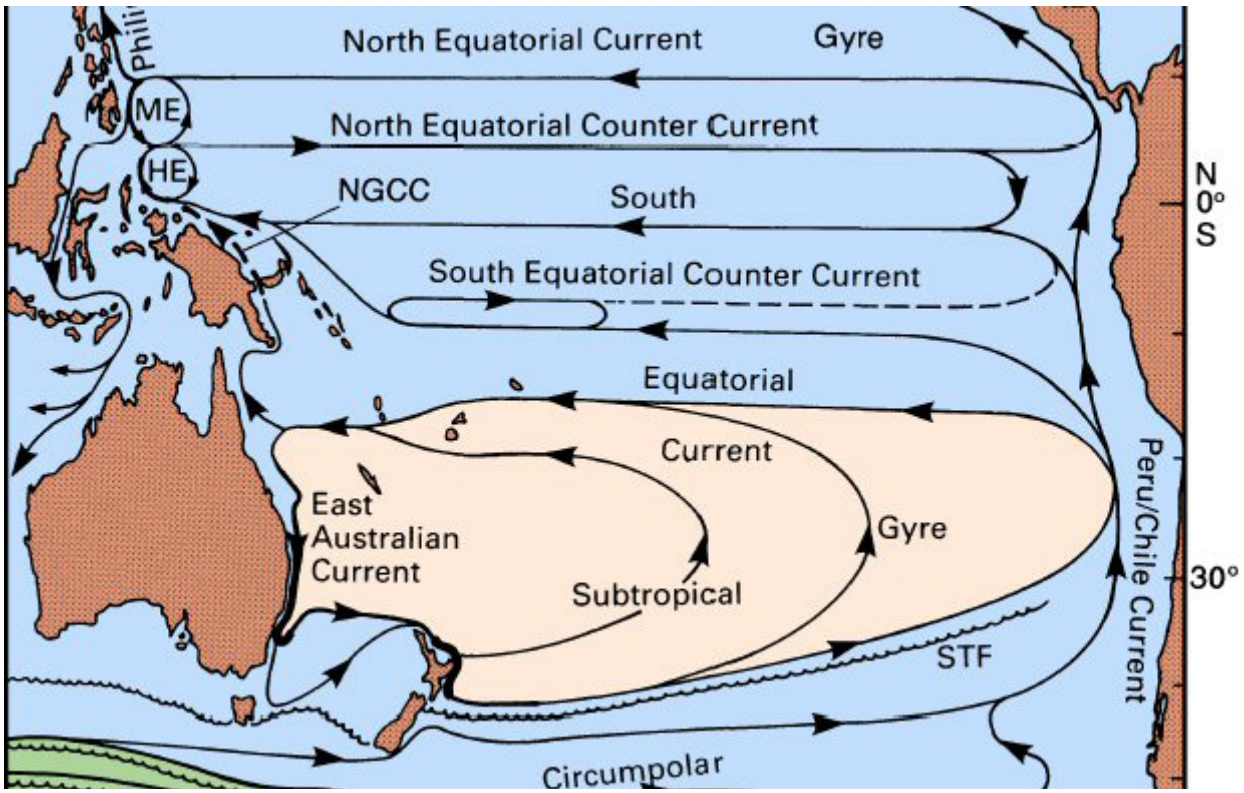

Figure 1. *Surface currents of the Pacific Ocean, adapted from Figure 8.6 Tomczak and Godfrey, 1994*

Figure 1. shows the major surface current systems of the Pacific Ocean during the SE monsoon (April to November). The broad westward flow of water on the northern arm of the South Pacific Gyre is called the Southern Equatorial Current (SEC). SEC water that traverses the Coral Sea can form a northern branch when it meets northeastern Australia and forms the New Guinea Coastal Current (NGCC). This flows around and through the Louisiade Archipelago to the southwest of Papua New Guinea and resumes its flow toward the Bismarck Sea through Vitiaz Strait. The more northern SEC tends to flow past the Solomons and can either enter the Bismarck Sea through St Georges Channel or Ysabel Channel from the North.

During the NW monsoon the NGCC and northern arm of the East Australian Current can reverse and flow southeast through Vitiaz Strait along the northern coast of Papua New Guinea. The above studies focused on the major regional circulation systems and pathways. However, the circulation within the Bismarck Sea still remains relatively poorly known. The navigational chart (AUS 4622) mentions an anti-clockwise eddy may form. Discerning circulation features through remote sensing has been limited in part due to the region being very cloudy and high in humidity. The Bismarck Archipelago acts as a barrier to the main SEC flow and so any circulation outside the major current pathways is likely to be characterized by complex flows and re-circulations in the lee of the island arcs, especially during the prevailing southeast trades.

F. Coastal and Marine Features

Papua New Guinea is surrounded by three seas and a major gulf, the Bismarck Sea to the north, the Solomon Sea to the north and east, the Coral Sea to the south and east, and the Gulf of Papua to the south, lying between Papua New Guinea and Australia. Papua New Guinea has a total sea area (EEZ) of 3,120,000 square kilometres and 17,110

kilometres of coastline (Sowei et al 2002). This huge area encompasses a diverse array of marine environments, ranging from tidal wetlands and estuaries to deep ocean basins. The country is renowned for the diversity and pristine quality of its coral reefs and coastal environments, but its waters extend beyond the coastal shelves to include deep ocean basins that are practically unexplored.

The principal marine environments in Papua New Guinea are as follows.

- Reefs (fringing, patch and barrier reefs).
- Seagrass beds.
- Mangroves.
- Sand and mud shorelines and intertidal flats.
- Barrier dunes and their associated coastal lagoons.
- Deltaic floodplains and estuaries.
- Rocky shorelines.
- Reef walls and drop-off areas of the continental slope.
- Sea mounts.

(Sekran and Miller 1994: - based on Agardy and Pernetta, 1993).

Except for the sea-mounts and continental slope environments, all the others listed are coastal environments or are environments located on the continental shelf (such as barrier reefs).

Coral Reefs

Most of the coral reefs around Papua New Guinea are of the fringing or patch type, and extensive barrier reefs are only found along the south coast (e.g. the Motuan coastline), the Louisiade Archipelago and around to East Cape on the eastern coast. The northern coast (e.g. Madang) and the New Guinea Islands are dominated by fringing and patch reefs. Corals are susceptible to any freshwater dilution of the sea-water, salinities of less than 35% suppress coral growth. This, together with their susceptibility to turbid waters, influences their distribution around the coasts of Papua New Guinea, where despite their widespread occurrence, they are noticeably absent from the coastal areas around the mouths of the major rivers.

Several recent studies have confirmed anecdotal evidence that coral diversity is typically very high in Papua New Guinea's reefs and this is globally significant.

A Rapid Ecological Assessment of the coral reefs of Kimbe Bay, in West New Britain Province, was conducted in 1994 by a team of scientists from Papua New Guinea, Australia and Hawaii on behalf of The Nature Conservancy - Asia/Pacific Program (Holthus 1994). A total of 78 sites were surveyed, and detailed information on coral species abundance and distribution were collected from 39 sites (Maragos 1994). A total of 345 species of coral were reported from these 39 sites. This number compares favourably to that of other detailed surveys conducted in Australia, Japan, Indonesia, the Philippines and elsewhere in Papua New Guinea, and at the time was amongst the highest ever reported from such a small area (Maragos 1994). Two thirds of the coral reefs surveyed had high levels of live reef cover (greater than 50 %), and many individual sites had extensive areas of very high coral cover (greater than 75 %) (Holthus and Maragos 1994), indicating the near pristine state of the coral reefs at those locations.

A report on the Madang Locally Managed Marine Network prepared by Wetlands International (Jenkins 2002), assessed the diversity of coral reef fishes as an indication of the biodiversity of the coral reefs in Madang's Marine

Area Network. This report noted that the biodiversity of reef fish fauna within the network is of global, national and local importance.

A marine Conservation Needs Assessment Report of Milne Bay Province prepared on behalf of Conservation International reported that over 429 species of coral fauna, including 10 new species, were recorded during Rapid Assessment Program surveys carried out by Conservation International during 1998 (Seeto 2000). This is believed to be the highest coral diversity recorded so far in Papua New Guinea. This number of species is more than is found on the entire Great Barrier Reef, and is equal in diversity to the coral faunas of the Philippines and Indonesia, which were previously believed to be the most species rich in the world.

These reports clearly indicate the global significance of Papua New Guinea's coral reefs, but these reefs are also vitally important to the local people as a primary resource supporting their traditional culture and sustainable livelihoods.

Coral reef fisheries are a vital source of food and income for many coastal communities. They are important feeding and nursery habitats for many marine species. They provide a physical barrier to ocean swells and storm surges, protecting the shoreline against erosion. Behind the reefs, the sheltered reef lagoons provide habitats for a variety of important coastal species, notably seagrass beds and mangrove stands, which further stabilise the shoreline by anchoring the sediments (see below).

Seagrass Beds

Seagrass beds are a common community in the reef flats and coastal lagoons of Papua New Guinea, particularly where these are situated close to small river estuaries that maintain a steady, but low level, supply of fine silt and mud sediments to the lagoon floor. However, if the concentration of suspended sediments is too high, seagrass growth is likely to be inhibited by the turbidity of the water in the lagoon.

There are many different species of seagrass occurring in Papua New Guinea coastal lagoons. The most commonly encountered species include turtlegrass (*Thalassia hemprichii*), *Enhalus acoroides* and species of the genus *Halophila*.

The seagrass beds are an important habitat for many species of marine invertebrates and juvenile fish.

Their root network helps anchor the fine silts in which they grow, providing a stable substrate for many species of marine worms, which themselves are the basis for a complex food web that extends throughout the seagrass community. Of particular note is the importance of seagrass beds to the survival of the dugong, a large herbivorous mammal that inhabits Papua New Guinea waters and feeds almost exclusively on seagrass.

The dugong is a highly endangered species and is on the IUCN Red List as a vulnerable species. Formerly widespread in the tropical waters of southeast Asia, it is now close to extinction, probably due primarily to habitat loss, although indiscriminate hunting in the first half of the last century resulted in massive depletion of its numbers. The Papua New Guinea population of dugong, which is mainly centered on the Papuan Lagoon in the southwest of the country, is of global significance and conservation value as it is likely to be the world's largest population still remaining today.

Mangroves

Mangroves are widespread around the coastal regions of Papua New Guinea, with particularly extensive stands in and around the deltas of many of the major rivers, particularly those along the southern coast. These extensive stands of mangroves, with their close-knit lattice of aerial roots, stabilise the mud and silt sediments they inhabit by holding them in place and providing a sheltered environment in which deposition predominates. On a wider scale, these tough, securely-anchored root lattices provide physical protection against storms and surf, so that just a few metres inside the outer edge of a mangrove stand, the water is significantly less turbulent. At greater distances inside the mangrove stand (which may extend for 100's of metres back), still water conditions prevail, more or less regardless of the coastal sea conditions.

Mangroves provide an important shoreline protection function by anchoring shoreline sediments and providing a firm and resilient barrier to storm surges and their erosive effects. Substantial damage or loss of mangroves can result in significant changes to the erosion - deposition regime along coastlines, which can have profound effects on the coastal ecosystem, the use of its natural resources, and the stability and use of coastal infrastructure. The protected still waters inside the mangrove stands are richly provided with habitat opportunities amongst the root lattice and its epiphytic communities. The organic matter and nutrients in the river mud and silts amongst the lattice, which are replenished daily by the ebb and flow of tidal currents, provide rich and productive habitats for numerous invertebrate species. This makes these waters ideally suited as nursery habitats for many marine and estuarine species, and several commercially important PNG fisheries have juvenile stages that are dependent on these rich and sheltered mangrove waters.

Mangroves are susceptible to changes in the coastal flow regimes, particularly as these affect the amount and composition of the local sedimentation. If rates of sedimentation increase, the roots of many mangroves can be effectively suffocated by the greater sediment load, leading to a cessation of growth and ultimately, death of the trees. A marked decline in sedimentation rates can result in insufficient sediment and organic matter entering the system to replace and replenish the natural loss of sediment and organic matter which occurs naturally as a result of sediment flushing, attrition and natural decomposition. In this case, growth of the mangroves can be limited by falling sediment nutrient concentrations. In its worse case, the loss of sediment can expose the roots themselves, which are then susceptible to damage and disease, and ultimately the risk of structural failure as their anchorage in a thinner soil becomes less secure. This can result in widespread loss of the mangroves and exposure of the coastline to the erosive effects of storms and wave action.

Sand and mud shorelines, and inter-tidal flats

The organisms occurring in these habitats are adapted to the extremes of submergence and exposure that characterise much of these in-shore habitats, and specifically the inter-tidal flats. Many species adopt strategies of hiding in the sediments (which retain water) to escape desiccation between the tides, whilst others move with the tidal flow to remain in the aquatic environment. These depositional environments also exhibit wide variations in oxygen content and in deeper sediments, anoxic conditions are not uncommon. In the permanently submerged lower reaches of sand and mud shorelines, seagrass beds are common, but are unable to survive in the fluctuating tidal environments of the inter-tidal mudflats and above the low water tidal level. In these habitats, organic production is dominated by decomposition processes and frequently supports an extensive community of aquatic, inter-tidal and terrestrial communities (members of which are transient inhabitants of this transitional zone, such as waders and other birds and many species of insects). The importance of these rich and productive habitats to the

coastal food webs extends well beyond their immediate area. Thus changes to these habitats as a result of changes in the hydrology and depositional regime can have significant consequences on the wider coastal ecosystem and the biological resources it contains.

Barrier dunes and their associated coastal lagoons

Barrier dunes are sand bars formed by coastal deposition processes which may cut off an inlet or bay to form a lagoon, or their formation may divert and extend the natural outfall of a small river or stream, to form a closed lagoon or an open or semi-closed lagoon respectively.

These coastal lagoons may be saline or brackish (partially saline, mixed with freshwater) waters. They are frequently highly productive, particularly where the euphotic zone extends to the bed of the lagoon promoting primary production throughout the water column. The higher level of productivity supports a variety of aquatic and semi-aquatic communities, including many juvenile stages, and are important feeding areas and habitats for many coastal communities. They are also frequently important from an anthropogenic perspective as valuable artisanal fisheries for both bony fish and shellfish such as prawns.

Deltaic floodplains and estuaries

These exhibit many of the features discussed in the “sand and mud shorelines and inter-tidal flats” section presented earlier. Both floodplains and estuaries are typical transition environments, with a wide range of habitats reflecting the transition from aquatic to terrestrial and from freshwater to seawater respectively. Superimposed on this spatial variation is the temporal variation of diurnal fluctuations in water levels and salinity reflecting the daily tidal cycle, and longer-term variations reflecting seasonal and meteorological (storms etc.) changes in river flows and the monthly “spring-neap” tide cycle.

Deltaic floodplains typically contain a wide range of habitat types. These include inter-tidal flats and wetlands, which are subject to diurnal fluctuations in the degree of submergence, water levels and salinity values as governed by the daily tidal rhythms. The more elevated floodplain levees above the mean high water mark, which are only occasionally submerged when extra high “spring” tides coincide with periods of high river flow, contain different species assemblages adapted to a drier, more terrestrial type environment.

In most coastal areas of Papua New Guinea, these deltaic floodplains are populated by mangrove communities, grading back to swamp vegetation communities on higher ground of the floodplain levees that are located above the saline influence of the tidal reaches.

With regard to estuaries, the habitats and conditions along the estuary margins, and outside of the main water channels within the deltas, have already been described above. The environmental conditions and habitats within the estuary waters are dominated by the diurnal fluctuations in salinity concentrations that characterise all river-mouths. These daily tidal fluctuations vary according to the monthly tidal cycle and the river flows, resulting in complex and highly variable water current patterns within an estuary. These water currents are generally carrying high sediment loads (from terrestrial runoff loads in the river and from suspended silts and mud in the saline waters). The sediment deposition and re-suspension regimes exhibit complex and highly variable patterns, particularly over the longer-term as areas of net daily deposition become areas of net daily re-suspension, and vice versa.

Despite the highly variable nature of estuarine environments, many organisms have adapted to, and thrive in, this "difficult" environment, which is rich in nutrients and organic matter. Estuarine waters are typically turbid and do not support high levels of primary production, the principal organic production is through detrital feeding and the decomposition food chain.

Rocky shorelines

These are typically exposed shorelines characterized by turbulent waters and strong water currents, often with considerable erosive potential, and are sometimes referred to as high energy environments alluding to the energy of the turbulent water. Other characteristics include high dissolved oxygen saturations, moderately high levels of suspended material, and little if any sediments, except in sheltered pools and backwaters in the lee of the rocks. These habitats have their own characteristic faunal and floral (seaweeds) communities, and add an important dimension to the country's coastal habitats and the diversity of species they contain.

Reef walls, continental slopes

Reef wall and continental slope habitats occur at the sea-ward edge of reefs and the continental shelf, respectively. They constitute transition zone habitats. Reef walls link the reef habitat and its community with the pelagic community of the open, and deeper, sea. For many pelagic community dwellers, the reef walls provide important feeding and reproduction / nursery habitats. Continental slope habitats offer similar opportunities for the oceanic (bathyal and abyssal) communities.

III. Governance

A. Environmental Policy and Legislation

Policy

Environmental sustainability is enshrined within the constitution of PNG which states in the Preamble to the Constitution:

"we declare …PNG's natural resources and environment to be conserved and used for the collective benefit of …all, and to be replenished for the benefit of future generations. (Goal Four)

As such there is a constitutional basis for the legislative framework that has developed in PNG to manage the nation's natural resources.

Legislation

Environmental Management

The primary piece of legislation pertaining to the management of natural resources is the Environment Act 2000 (as amended 2002) which became fully operative in 2004. This legislation was developed using Australian legislation as a starting point and replaced three pieces of earlier legislation, namely:

- Environment Planning Act;
- Environmental Contaminant Act; and
- Water Resource Management Act.

The new legislation aims to streamline the process of environmental management and improves the process of obtaining and monitoring permits for development activities. Key to the Environment Act is the establishment of three levels of development activity (Section 42). The Act and the Environment (Prescribed Activities) Regulation 2002 defines the specific requirements for environmental impact assessment that need to be complied with, in order for permits and licenses to be issued for activities of each level. EIA's are required for level 3 developments and may, in specific cases, also be required for level 2 developments.

Under the Organic Law, Provincial and Local Governments may, within limits, make Local Environment Policy. There is no requirement in the Act for Strategic Environmental Impact Assessments (SEA), nor does it appear that such assessments have been ever been undertaken, though such an approach has many benefits for managing environmental impacts.

In addition the requirements and penalties for exceeding the conditions attached to permits are detailed within the Act. Stakeholders within the mining, forestry and agriculture sectors indicated that the Environment Act was considerably more stringent than the previous legislation and the penalties for transgressions were more severe.

The Act is comprehensive but during the course of this mission a number of stakeholders including the DEC, commented that the focus was on large scale projects and no provision was made for managing the effects of the large numbers of small scale activities that occur in PNG.

Conservation

Conservation is not included in the remit of the Environment Act and as such is managed under five existing pieces of legislation:

- Fauna Protection and Control Act (1974, 1982);
- The Conservation Areas Act (1980, 1992);
- The National Parks Act (1982);
- International Trade (Fauna and Flora) Act (1993); and
- Crocodile Trade (Protection) Act (1982).

Other Legislation

The **Fisheries Act** gives broad powers to the Minister of Fisheries and Marine Resources to regulate fishing activity, mainly through prohibition (ban on using explosives) and licensing restrictions. Other pieces of legislation pertaining to fisheries include the Continental Shelf (Living Resources) Act, 1978, the Fisheries (Torres Strait Protected Zone) Act, 1978; the Export (Fish) Regulation Act. The Forestry Act (1991) represents the main legislation covering the management and conservation of forest resources. Environmental safeguards, especially pertaining to logging on steep slopes or in proximity to rivers, are provided for by agreements between government and the permit holder. Landowners who cut less than 500 cubic meters per year do not have to obtain a permit.

The Mining Act is currently under review and an amended Act was expected in 2006. Mine owners and developers are expected to conform to the requirements of the Mining Act which does not currently directly address environmental issues but there is a requirement for the mines themselves to liaise with DEC and to ensure all the requirements of the Environment Act are met prior to mining or exploration permits being issued.

The National Agriculture and Quarantine Inspection Authority (NAQIA) is responsible for how the agriculture and quarantine sectors are managed. As part of this, there are provisions to safeguard the environment from agriculture where it is not covered in the Environment Act; this includes requirements for the safe disposal of agrichemicals.

Other environmental legislation instrumental in managing PNG's natural resources includes the National Seas Act; the Prevention of Pollution of the Sea Act, 1981; the Dumping of Wastes at Sea Act, 1981; and the Lands Act.

B. Land Tenure Issues

The land tenure and land utilisation system in Papua New Guinea (PNG) is based on customary land ownership. Ninety-seven percent of the land is owned by traditional landowners who have the right to decide what does and does not happen on their land. Only 3%, known as alienated land, is controlled by the State. This system supports the largely subsistence non-cash economy that supports 85% of Papua New Guineans.

C. International Treaties, Conventions and Agreements

PNG is a signatory to a number of international and regional environmental conventions (Appendix 3). While the treaties and conventions may be officially ratified, there is a delay in the associated, national legislation and a clear lack of knowledge of how to implement the status or the contents of the conventions locally.

D. Environmental Institutional Framework

Legislative Institutions

To date the National Government agencies have had the main responsibility for implementing, monitoring and enforcing the country's legislation. With the passing of the Organic Law on Provincial Governments and Local-level Governments (1995), most of the operational functions could be devolved to the Provincial and/or local governments. However, devolution has been slow to be implemented.

Local Government Level

Under the Organic Law, provinces and local level governments have the authority to make their own laws for "transferred powers" and to pass their own by-laws (e.g. prohibition of plastic bags in Milne Bay Province) as well as to take on the responsibility for implementing the various pieces of National Government Legislation. To date, the devolution appears to be mostly theoretical and as a result, in the environmental field, DEC is still accountable for implementing virtually all environmental regulatory, monitoring, and management functions across 19 provinces and NCD nationwide.

Limitations in capacity and budget are greater constraints at local than at national level and as a result provincial governments and local level government require assistance if they are to take on their legally mandated powers to undertake monitoring and management functions and pass appropriate by-laws.

While awareness of the importance of the environment is growing at National Level, this is not as advanced at provincial, community level.

Department of Environment and Conservation

The Department of Environment and Conservation (DEC) is the principal national government agency responsible for management of the country's environment and environmental legislation. DEC coordinates with other national-level departments and authorities (i.e. National Planning and Rural Development, Land and Physical Planning, Agriculture and Livestock, Works, Mining, Petroleum and Energy, Health, Forest Authority, National Fisheries Authority, etc.). DEC also relies on these bodies to undertake some of its duties in addition to their own specific environmental management responsibilities, and to provide logistic support for monitoring visits.

The main operational divisions within DEC are the:

• *Environmental Management and Protection Division* whose main responsibility is enforcement and compliance, assessment and monitoring - that is overseeing the application of the EPA (2000); and

• *Conservation Management and Development Division* which is primarily responsible for five conservation legislations (Section 3.1.2).

The DEC is severely constrained in its operations by extremely limited funding and, in some areas, capable staff. Much greater budget appropriations will be required to support the DEC's mandate (impact assessments, compliance monitoring, etc.) effectively, without depending on clients for support, and to equip it with facilities and capabilities in data and geographic management systems and similar technologies.

While environmental monitoring, regulation, and management are a function of the national government, implementation of the majority of these functions occurs at the provincial, district, local level, and

community/village level government. Under the Organic Law, provinces and local level governments have the authority to make their own laws for “transferred powers.” Currently, however, very few environment-related functions have been decentralized. Furthermore, limitations in capacity and budget are greater constraints at local level than in DEC itself. At best the results is a haphazard application of the requirements of the Environment Act and at worst no application of its provisions.

IV. SOCIO-ECONOMICS CHARACTERISTICS

A. Demography

From the last National Census Report (2000), PNG had a population of 5.1 million with an average growth rate of 2.43 % (2001 est.) Currently the population is estimated to be over 6 million with an urban population of 16%. Life expectancy is 63.1 years with females being 65.3 years and male 61.1 years.

The major ethnic groups are Papua and Melanesia tribes falling under Melanesia. The major religion is predominately Christianity and traditional religions.

Socio-economic indicators are outlined in the table below.

Table: 2. Socio-economic indicators

Indicators	Data	Year of data	Ref.
Population	5.1 million (Average annual growth rate : 2.43 % in (2001 est.)	2000	2)
Ethnic Groups	Papua and Melanesia tribes falling under Melanesia		26)
Religion	Christianity is predominant, as and traditional religions		26)
Literacy	Total Pop. 72.2 %; adult female: 62.7 %; adult male: 81 %		26)
Urban Population	16 %	2000	2)
Life Expectancy	63.1• years; females: 65.3 years; males: 61.1 years	2000	28)
Child Mortality	58.21 (Mortality of children under five years old against 1,000 birth)	2001 est.	26)
GNP	4.1 billion US$ (US$ 890 per capita)	1998	3)
GDP	12.2 billion US$ (US$2,500 per capita)	2001 est.	26)
GDP Composition	Agriculture:25% Industry: 35% Services: 40 %	1999 est.	28)
Industry	Food processing, timber, plywood production, wood chip production, mining of gold, silver and cooper, oil palm processing, crude oil production, construction, tourism, copra crushing	2000	28)
Natural Resources	Gold, copper, silver, petroleum, timber, coffee, cocoa, copra, raw rubber, tuna, palm oil, marine resources	2000	28)
Access to the Safe Water *1	Urban areas: 84 % Rural areas: 17 %	1980-1995	
Access to the Sanitation *2	Urban areas: 95 % Rural areas: 12 %	1980-1995	
Human Development Indicators• HDI• •	0.542 (133rd in the world, GNP was 108th in the same year)	1998	3)

Note: *1: Access to Safe Water is the percentage of the population with reasonable access to an adequate amount of safe water including treated surface water and untreated but uncontaminated water, such as from springs, sanitary wells and protected boreholes.

*2: Access to Sanitation is the percentage of the population with reasonable access the pit latrine, flush toilet with sewage, septic tanks and other suitable facilities to dispose and prevent human from contact with excreta.

B. Traditional Knowledge Management

For 50,000 years of inhabiting New Guinea, man has survived harmoniously with the environment through the knowledge and practices that he developed for survival. Traditional terrestrial and marine knowledge have evolved to over the years to respond to changing weather patterns, population, land acquisition, agriculture, hunting and harvesting primarily for food and the ultimate survival of the clan.

This knowledge is passed down from generation to generation verbally emphasised with practical living. Tradition knowledge of clans includes the following aspects; authority, protocol, survival skills, hunting/harvesting seasons, demarcation of roles between males and females, clan ownership, provision of security, feasts etc.

The different aspects of traditional knowledge are very complex in Papua New Guinea because of the diversity within PNG. Traditional knowledge including legends and myths has been passed verbally over hundreds of generations either through song, dance or passed on at initiations.

Traditional knowledge has been intentionally or accidently evolving over the years due to peoples changing circumstances. The evolving of this knowledge enabled people to adapt to their changing livelihood status. As emphasised by the Social Resilience Literature, 'Local people inherently accumulate a knowledge base of how to relate and respond to environmental changes in their area. This traditional ecological knowledge is complex and represents decades of societal and institutional learning about species, environments, and their interactions accrued and passed down over multiple generations' (Drew 2005).

This section of the report is based on the traditional knowledge pertaining to marine conservation and resource management.

Many coastal communities in PNG have traditional knowledge that dictates/guides;

1. Ownership of certain sections/zones of the sea
2. Authority that permits or forbids harvesting
3. Timeframe/duration of closure and open seasons
4. Methods of harvesting different marine animals (fishing gear use)
5. Individuals that harvest (certain clan members, females, newly initiated men etc.)

However, some of the above are eroding at different rates in coastal communities around PNG. This loss of traditional knowledge is caused by; loss of traditional authority, loss of traditional values, population increase and the introduction of a cash economy.

Benefits of traditional knowledge in marine conservation

Traditional knowledge can also be known as local ecological knowledge. It has been used to facilitate scientific research and protection of marine areas by communities. Traditional knowledge is important to;

a) Present historical information pertaining to marine biological and ecological information. It helps scientist and conservation practitioners to understand the history of a particular marine area. The SPC Traditional Marine Resource Management and Knowledge Information Bulletin # 22 – December 2007, further supports this stating, 'Fishers local knowledge can also be critical in providing a perspective on the historical state of reef fish communities. In the Indo-Pacific area, coastal fisheries quantitative baseline studies are rarely available to marine biologists, but rich bodies of local ecological knowledge frequently exist, and if accessed correctly, can provide detailed insights into past abundances, size structure and spatial distribution of a particular fish stock' (Johannes and Yeeting 2001; Hamilton 2003b; Dulvy and Polunin 2004).

b) Additionally, traditional knowledge can be considered a baseline for science to understand where it was, establish current status and enabling other conservation experts develop actions to preserve

these areas. 'Local ecological knowledge contains baseline information on local ecologies, including information on the components of local ecosystems, and their temporal and spatial patterning. Fishers can provide critical information on inter-annual, seasonal, lunar, diel, tide- and habitat-related differences in behaviour and abundance of target species, and how these dictate fishing strategies (Johannes et al. 2000). These data are particularly relevant to marine biologists working in the Indo-Pacific region, where sources of more orthodox ecological information are normally unavailable. Fishers often know much more than biologists about the location of critical habitats such as spawning grounds (Johannes 1989), spawning behaviour (Hamilton 2005), nursery areas (Johannes and Ogburn 1999), and seabird aggregation sites (Nakashima 1993). Local fishers are also often the only people who know that during particular seasons certain otherwise unremarkable islets or coral sites become critical habitats, such as nesting beaches for sea turtles (e.g. Johannes 1981), rookeries for seabirds (e.g. Nakashima 1993) and egg releasing beaches for land crabs (e.g. Foale 1999).

c) In coastal communities where there is traditional knowledge loss to a lesser degree, they have used the knowledge to conserve certain section of the marine environment that is owned by them. Currently communities either use their traditional methods of marine conservation or decide to use ones that are derived from foreign countries introduced by conservation practitioners in PNG.

d) Promote the protection of marine areas, thus protecting marine stocks and providing sustainable food and income for communities. It controls the use of marine resources by the community.

e) Traditional knowledge facilitates the work of organisations such as the PNG Community Locally Managed Areas (PNGCLMA) that is mandated to assist communities to manage areas within their communities in a culturally appropriate way

f) Traditional knowledge can be incorporated into marine laws at all levels (Local, provincial and national) so that it enables communities to be robust in conserving and managing their marine environments

Impacts of lost traditional knowledge

The impacts are the following:

a) Ignorance and unsustainable fishing practices;

The bulk of PNG population are subsistence farmers and fisherman that rely heavily of the land and sea within the vicinity of their communities. In many of the coastal communities there is little to no alternative economic activities to sustain livelihood. There is an increased risk of people depleting marine stocks carelessly and rapidly outside the confines of traditional knowledge and practices.

It is also worthy to note that not all communities have access to other conventional methods of conservation. Some of these communities may have lost their traditional knowledge and practice over the years. The lack of information on conventional methods of conservation and traditional knowledge and practices, will potentially result in an ignorant population. The consequences will be devastating to the marine environment with long term negative impacts on livelihood.

b) Absence of baseline information for scientific research

As stated earlier traditional knowledge facilitates scientific research for greater understanding and development of sustainable action by all stakeholders. Loosing traditional knowledge may have an impact on research.

The lack of baseline information is likely to have an impact on scientific research. Conducting research may take longer than usual leading to high cost of doing research. This can be a cause for organisations refusing to do research or providing poor results that will give the populace insufficient knowledge and awareness of marine information

c) Communities can often become overwhelmed by the introduction of modern scientific methods of marine management that can result in conflicts between community elders with status and lack of scientific knowledge and the younger people who have acquired some science knowledge through formal education.

Preservation of traditional knowledge

In this day and age, handing down of traditional knowledge verbally is at a greater risk of being lost. As such this knowledge must be documented and archived in the national library and archives to assist in the conservation efforts in the years to come.

There are some documentation of traditional knowledge and practices by researchers and other experts such as teachers and writers with interest in the subject. There is brief information, on one or two aspects of traditional knowledge from some coastal communities in Manus, West New Britain Province, New Ireland Province, Bougainville and Milne Bay Province. A book titled "Aquatic Knowledge & Fishing Practices in Melanesia" containing essays compiled by a number of individuals on the subject includes stories from some areas within the 3 coastal regions of PNG – New Guinea Islands, Momase and Papua. There is also a minute documentation of fishing in the highlands of PNG especially communities around rivers and lakes.

There is not much comprehensive documentation sighted. There are also a couple of examples of information documented as TV documentaries. Other than that there is limited information

Incorporating traditional knowledge in national policies

The Convention on Biological Diversity (CBD) encourages coastal countries to develop appropriate mechanisms to address traditional knowledge of local communities to enable them to manage biological diversity within their respective areas. In PNG, customary rights to locally manage areas are vested in communal clan or families. Therefore any relevant governance structure must reflect this.

As noted in the governance section of this report the government has to integrate needs such as promoting conservation practices, using traditional knowledge of coastal communities into overall government planning. We further note that both legal and policy gaps do exist in government policies and legislations for coastal community issues. Therefore the promotion of traditional knowledge could be developed further within existing precedents such as the Bialla Local Level Government (LLG) law on conservation of marine environments.

In the overall planning, many coastal areas are of critical significance such as spawning habitats that must be protected. Therefore, the government needs to take that into account when planning for conservation areas based on traditional knowledge that is balanced with formal government control.

Management of Traditional Knowledge

Documented traditional knowledge in relation to the marine environment must be;

a) Managed by a designated organisation to manage all documentation in any shape or form. In PNG under the CTI, the Learning and Training Network (LTN) can be the hub that manages this database and give access to organisations to facilitate marine research and conservation in PNG.

b) Furnished with copies to the hub (LTN) whether it is produced overseas or within PNG.

c) The hub is responsible to work in collaboration with office of library and archives and or other relevant organisations to store these documents for future references

d) Documented and utilised in ways that are endorsed by the custodians of this information (Hamilton and Potuku 2007). In this context the custodians are the owners of the traditional knowledge and not the designated hub.

e) The hub (LTN) as part of management creates a database of all documentations.

C. Gender Issues

Men and women in the Pacific including PNG consider the importance of their environment surrounding according to their gender roles in their community or country.

The following have been classified by UNIFEM (cited Seniloli M et all, 2002) as the gender roles:

- Reproductive roles
- Family care roles
- Production roles
- Community roles
- Decision making

Reproductive roles are responsibilities concerning the production and socialisation of human beings within the family setting. Family Care roles involve raising children as well as caring for the elderly members of the family. Production roles are income generating activities such as paid work, harvesting and selling food including marine products at the market to earn an income.

Community roles involve the social roles of men and women in the community such as church activities, traditional obligations, women groups etc.

Decision making and political roles involve men and women who are seen in the leadership capacity as decision makers.

Personal Experiences in working with communities in PNG show that resource mapping exercises expose the difference between what men value compared to what women value in their environment. This was clearly captured in a study done in a community in Fiji (Seniloli M et all, 2002).

Across the world studies show that women have contributed in many ways in production, processing, marketing and management of fish and other marine resources. In PNG studies have shown that women's fishing supplies an estimated 20 to 50 per cent of catches annually in some areas (Kinch, 2003:32).

Influence of the cash economy, women's position is being usurped through changing values and a breakdown of traditional social structures. Although there is a division of labour by gender MacIntyre (1983) noted that this is more pronounced in ideology than in actual practice. E.g., women are also marine exploiters.

With concern over depletion of inshore marine resources due to habitat loss and overharvesting, fisheries departments in the Pacific according to Kinch (2003) are encouraging offshore fisheries for example by providing gear and training. Unfortunately, experience show women receive little or none of the benefits from such programs.

Many donor and government funded programs aim for 'increased participation by women, both as beneficiaries and agents in the development process, and improvement in the quality of life' (Kinch, 2003).

Women are very much involved in harvesting, processing and marketing but poorly represented at management levels or at meetings or planning processes. Because women do contribute significantly to the overall marine resources harvested, any attempt to develop any fishery or coastal resource management program will need participation of women as equal partners with men.

It is interesting to note what men and women spend their income on. Experience show women are more likely than men to spend their wages on children while men tend to spent on tobacco and alcohol. These often contribute to health and social problems. In PNG it is common for women to eat after men, and to eat less.

Women becoming wage earners is not always ideal because they are often expected to maintain their traditional gender roles within the home and community. But in order for effective resource management, be it in fishery, equal participation in development is necessary. Women need to have access to opportunities such as training, employment, education, and the like. Ultimately, this will contribute to improvement in health or wellbeing of the family and the community as a whole.

Men are seen as the leaders and continue to dominate most of the decision making roles in the families, communities and society.

In the area of use and management of natural resources, this has been predominantly done by men who have the power over the women.

An example of this can be seen in the Talasea area of West New Britain province, whereby men are the decision makers of the marine resources within the Locally Managed Marine Area (LMMA). (Helen Rei - PNGCLMA)

Women do not have much say, even as participants in sharing views and ideas at the training programs and workshops.

Over the years with the introduction of education, exposure to information including legal rights (E.g. – Convention on the Elimination of All Forms of Discrimination Against Women – CEDAW) and missionary influence by the churches, this trend is slowly changing with equal opportunities and shared responsibilities in the homes, community and society.

Matrilineal and patrilineal system governs the way Papua New Guinean societies live in terms of resources use, benefit sharing and decision making.

In PNG we have matrilineal and patrilineal systems of ownership, access and use of natural resources.

Traditionally, women have enjoyed a relatively high status in matrilineal societies whereby they are central to land ownership and food production. The land, sea and the resources are owned by the women, for example, in the Autonomous Region of Bougainville, East New Britain, New Ireland and Milne Bay. The rest of PNG societies use the patrilineal society. (Barbara Masike – TNC)

Although the changes in roles and responsibilities seem to bring about positive results on both men and women, the use and benefit from these resources show otherwise.

For example in Lihir, women own the natural resources, but the decisions on these resources are usually made by men in the 'Hausboi' (Sacred meeting place for men only). (Junne Cosmas – 2009)\

Benefit Sharing/ Decision-making Leadership

When a major stakeholder or group is excluded from decision making on the use of coastal and marine resources, the other parties are dissatisfied which may lead to incomplete planning processes. (MPA News Nov, 2002)

Experiences have shown that men often dominate decision-making process and have access to the benefits more than the women and children.

In terms of resources management and marine conservation, men still continue to dominate the decisions over the use of these resources even in matrilineal societies.

For instance, in the Milne Bay province where they practice the matrilineal system in which women own the land and resources, their men folk especially brothers would have access to the benefits more than the women themselves and the children. When these decisions are made, women are often not consulted which could potentially result in disputes and conflicts amongst family members. (Junne Cosmas- DEC Marine – ADB TA, Helen Rei – PNGCLMA)

This is a grey area that needs to be addressed, especially the rights and access to resource use and ownership in these communities. And government agencies, donors, NGOs or civil Society Organisations would have to be aware of this for future plans to engage with these communities.

Leadership

In PNG society, men are often seen as the head or leader of family and clan while women were seen as the subordinates. Traditionally this is still being practiced for example in New Ireland Province, the Maimai (traditional leader) has the authority over his community and usually his decision is final. (Helen Rei – PNGCLMA). However, with the modern influence and education and legal rights, this is slowly changing. Women are now equal partners in leadership responsibilities.

Since independence, the role of women in PNG has dramatically changed to the extent that women are now like their menfolk in the developing world. They now manage their homes as well as professional jobs in government, tertiary institutions, the private and the NGO sector.

And there are many examples out there in PNG today in the likes of former politician Nahau Rooney, Ambassadors Lucy Bogari and Winnie Kiap; in the NGO sector, Dr Jane Mogina, Executive Director of Mama Graun CTF and Maxine Anjiga, Executive Director of PNG Centre for Locally Managed Areas Inc. and many more. (Barbara Masike – TNC)

The overriding aim for previous policies on women in PNG has been the increased participation by women, both as beneficiaries and agents in the development process, and improvement in the quality of life for all.

Conclusion

- Gender roles need to be acknowledged and respected
- Planning process should be inclusive of all parties or stakeholders

- Recognise the difference between what men and women value as significance
- Traditional leadership and kingship system have a part to play in resource management
- Gender issues do play a role in how effective a program of resources is developed and managed.
- Equal opportunities and shared responsibilities due to exposure to information and missionary influence

D. Payment for Ecosystem Services

As human beings we depend upon the services ecosystems provide for our very survival. In spite of their importance to our way of life, ecosystems throughout the world continue to experience unprecedented degradation. Papua New Guinea is no exception. Even though the regions' marine ecosystems are relatively intact, the rapid development, growing population and climate change have combined to pose a serious threat to the health of Papua New Guinea's ecosystems.

The Millennium Ecosystem Assessment identified four types of ecosystem services; provisioning services, regulating services, supporting services and cultural services. Table 1 provides an overview of the services provided by the four categories of ecosystem services, in relation to marine ecosystems.

Table 1: Types of Marine Ecosystem Services

	Coastal Ocean	**Open Ocean**
Provisioning Services (produce tangible goods)	• Fisheries and aquaculture • Fuel wood • Alternative energy • Natural products • Genetic and Pharmaceutical • Space for ports/transportation	• Fisheries and aquaculture • Alternative energy • Strategic and other minerals • Natural products • Genetic and Pharmaceutical • Space for ports/transportation
Regulating Services (help maintain a stable environment)	• Weather regulation • Carbon sequestration • Shoreline stabilization • Natural hazard protection • Nutrient regulation • Waste disposal	• Weather regulation • Carbon sequestration • Nutrient regulation • Waste disposal
Supporting Service	• Soil formation • Photosynthesis • Nutrient cycling	• Nutrient cycling • Primary production
Cultural Services (intangible benefits)	• Tourism • Recreation • Spiritual values • Education • Aesthetics	• Tourism • Recreation • Spiritual values • Education • Aesthetics

Source: Adopted from Millennium Ecosystem Assessment *Ecosystems and Human Well Being (2003)*

Payment for Ecosystem Services (PES) is a new concept developed in recent years to address the undervaluation and degradation of ecosystems. As ecosystems provide off-site benefits to individuals and industries other than the

owner/s of the ecosystem, the beneficiaries voluntarily provide incentives for the owner/s of the ecosystem to achieve and maintain the desired ecosystem quality. One of the most cited and successful application of PES can be found in the payment for watershed services. Under this PES scheme, water consumers pay an additional fee (in their water bill) which is specifically dedicated to paying upstream landowners for "watershed conservation". These payments increase the monetary value of this land use.

E. Capture fisheries (commercial and sustenance)

Commercial fisheries

The main commercial fishing species are tuna and prawns. The Papua New Guinea (PNG) tuna fishery is made up of both the purse-seine and longline sectors with a small, but important handline sector. The longline and handline sector is a citizen- only activity and all vessels fish exclusively in the waters under PNG national jurisdiction. The purse-seine sector is a mix of both domestic and foreign access vessels. The domestic sector comprises the PNG flag vessels and PNG chartered vessels which support processing facilities onshore in PNG. While the PNG flagged vessels fish primarily in PNG waters, but occasionally in the adjacent high seas, the chartered vessels fish both in PNG waters and waters outside of PNG. Foreign vessels under access arrangements fish in PNG EEZ waters (but not territorial or archipelagic waters) whenever there is fish to catch.

Total catch in 2010 within PNG waters was 702,969 mt, a 55 % increase from the 2009 catch of 453,129 mt. The increase in total catch is attributed to the increase in total fishing effort relative to the increase in number of fishing vessels, mainly purse seiners. The catch contribution was 78.7% by foreign vessels that fish under access arrangements, 16.7% from PNG chartered vessels (locally based foreign (LBF)) and 4.1% from the PNG flag vessels. Small amount ≈0.5% (3120 mt) is from the longline sector. Almost all the catch from PNG Flag vessels was caught inside PNG waters as result of closure of the neighboring high sea pockets. The catch by PNG chartered vessels outside of PNG waters was 63,397 mt and was taken mainly in the waters of the other PNA member countries.

A total of 256 vessels was active in the PNG waters in 2010. Thirty-two (32) were longline and handline vessels and 224 were purse-seine vessels. Nine (9) of the 224 vessels were PNG flagged, 39 were PNG chartered and 176 were foreign vessels fishing under access arrangements. The total purse-seine effort in 2010 by foreign vessels was 15,796 days fishing and searching inside national waters, an 18% increase from 13,348 days in 2009. Longline effort also increased from 36, 574 hundreds of hooks in 2009 to 62,605 hundred hooks in 2010. Catch by purse-seine vessels in PNG were mainly on free schools which accounted for about 72% of the total catch. The remaining 28% was associated with FADs (drifting = 11.9%, anchored = 8.2%), logs (7.8%) and mammals (0.5%). About 82% of the free school catch was by foreign vessels and the other 28% by PNG flagged and PNG chartered vessels.

Information on the amount of by-catch is not available, and the lack of such important information could lead to overexploitation of vulnerable species. Given that Papua New Guinea cannot afford rigorous monitoring and inspection of foreign vessels fishing within the EEZ, this important information is unlikely to become available in the near future, unless more innovative means of collecting the information can be found.

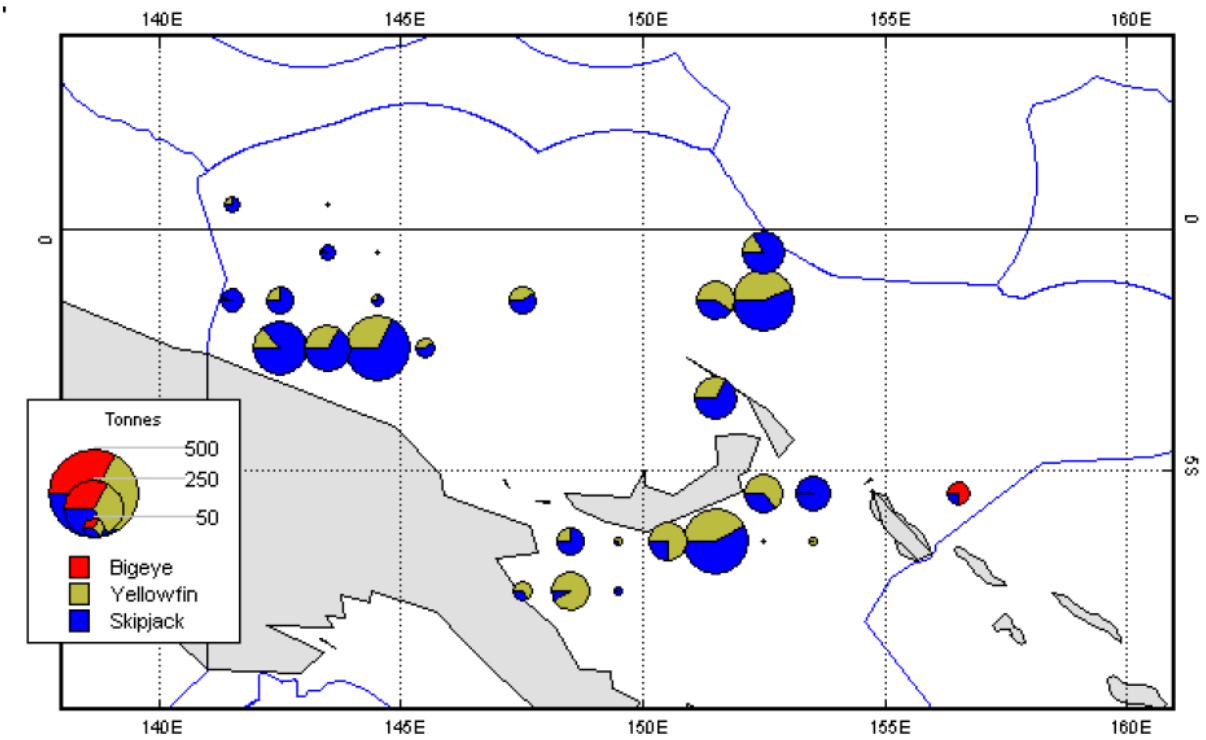

Figure: Catch distribution of primary species caught by flagged vessels in 2010. (Source SPC)

Another component of the fisheries industry that can give rise to environmental impacts is the fish processing and canning industry. Under the government's policy of promoting added-value exports, the fish processing industry has grown during the last few years and appears set to continue its growth, with another new processing plant soon to be constructed at Wewak. Fish processing, like other food processing of animal commodities, produces a concentrated organic effluent that usually has the consistency of a loose slurry and is composed mixture of water, fish tissue, fluids and macerated body parts such as fish heads, bones, fins, scales and soft tissues such as the gut and liver. This mixture is usually skimmed and screened to remove the larger floating and suspended solids before being discharged through a marine outfall. The potential impacts associated with the discharge will primarily depend on the location of the discharge and the rate of dispersion and dilution at the point of discharge. The discharge effluent has a high biological oxygen demand, primarily from the dissolved organic fraction, and contains a high concentration of particulate matter that is likely to have near neutral buoyancy.

Whilst such direct environmental threats are a locally significant concern in areas that may be affected, the principal environmental threat currently facing the commercial fisheries industry is the lack of detailed and accurate data on fish numbers, diversity, catch rates for target species and non-target species and the range of factors and environmental conditions that affect population recruitment and population growth rates. In the absence of this information, it is difficult to accurately estimate sustainable harvest yields (catch rates) and a cautious approach to the development of fish stocks' management plans has to be taken in order to effectively protect the fish populations from over-exploitation.

Subsistence and artisanal fisheries

Although the commercial sector is the major fishery in terms of catch weight, subsistence and artisanal fisheries are arguably more important in socio-economic terms. Fish is the major source of protein for the coastal populations throughout the Papua New Guinea mainland and islands, and is a part of the staple diet in these areas.

Fish are also one of the main sources of cash income for coastal communities, many of whom will take their catch 100 kilometres or more to reach a market where they can be sold for cash. In many communities, fish that are not consumed immediately and those that will be taken to market, are smoked to extend their "shelf-life", as fresh fish deteriorate rapidly in the tropical climate. The subsistence and artisanal sector provide most of the fish for the domestic market, and for export, including niche markets such as shellfish and *beche-de-mer*. The *beche-de-mer* fishery is reported to be the most valuable coastal fishery in Papua New Guinea (Australian Marine Science and Technology, 1997, reported in Mitchell et al 2001).

The subsistence and artisanal fisheries are concentrated in coastal and near-shore waters (generally within the 3-mile limit), and use a variety of methods, depending on the target catch. Although these fisheries have supported the coastal populations of Papua New Guinea for centuries, the rapid growth in coastal populations and the increasing demand for cash income has in recent years led to an increase in subsistence and artisanal fishing activity, raising serious concerns over the sustainability of coastal fish stocks.

This is particularly so for those species that have a high export value, such as *beche-de-mer* and some shellfish such as *trochus* and the giant clam, which attract high overseas earnings and are therefore particularly at risk of over-harvesting in a cash-poor economy (Mitchell et al 2001). Rural island households in Milne Bay Province have responded to their loss of purchasing power (the effects of inflation and decreasing commodity prices such as copra) and the increasing demand for sedentary fish products by increasing their harvesting levels of commercially valuable species.

Although anecdotal evidence increasingly suggests that some of these coastal stocks are declining, there appears to be a lack of reliable and accurate information on either coastal fish stocks or fish catches, so that accurate estimates of sustainable yield cannot be calculated, or indeed how serious the risk of overexploitation is at the current levels of fishing. In these circumstances, a precautionary approach should be adopted. However, subsistence and artisanal fisheries are, by their nature, difficult to manage and regulate by government agencies. Experience to date (see Section 5.2.6) suggests that sustainable management of these fisheries is best achieved through a combination of agency regulation and community based awareness programs and local skills' development programs for the local fishing communities. These should be designed to engage and then empower the local fishing communities to monitor and manage their own local fisheries resources in a more sustainable manner.

There is considerable concern, at both local and national levels, over recently introduced destructive fishing methods such as poisoning with derris powder and dynamite fishing. These methods are nonselective in impact and destroy large numbers of individuals of all species, and in the case of dynamite fishing, physically destroy the habitat as well.

F. Aquaculture

Aquaculture a significant component of fisheries activities in other countries is not so widely practiced in PNG. However there is great potential for future development. A number of small-scale pilot project and commercial projects have been implemented. Bismarck Barramundi (a project included in a proposal investment portfolio under the ADB Nucleus Agro-Enterprise Project), is one such small-scale venture in Madang. The project is now closed.

Another project has been initiated in Daru by the PNG Sustainable Development Project is operating currently. The project basically involves breeding and rearing of Barramundi fingerlings to a stage where they are big enough to be introduced into the wild. These and other aquaculture products, if developed successfully, could contribute significantly both to revenue generation and to meeting the food security needs of the country while relieving pressure on natural fish stocks.

Other aquaculture activities in PNG include Pearl Farming in the Miline Bay Province, Prawn Farming in the East New Britain Province and Seaweed Farming in the Milne Bay Province.

G. Coastal Tourism

The tourism industry is one of the fastest growing industries worldwide, with over 808 million tourists travelling in 2005 and a global value in excess of US$500 billion. In the South Pacific region, tourism accounted for US$1.52 billion of expenditure in 2004.

The PNG's Government's Medium Term Development Strategy (MTDS) 2005-2010 identified the importance and economic potential of the Tourism Industry in generating foreign reserves, and contributing to the creation of employment opportunities and other related spin-offs across other sectors of the economy. The Government for the first time in 2004 increased its tourism budget allocation three-fold to K6 million and in 2006 provided close to K13million to the Tourism Promotion Authority ("TPA").

Despite this, the industry in PNG as a whole remains largely fragmented. This is despite the level of support and strategic direction provided by industry bodies, representative associations and government through the Tourism Promotion Authority. The Commission is seeking views on the cohesiveness of the current approach towards fostering a sustainable tourism industry. The tourism industry in PNG has traditionally been developed by private sector initiatives with minimal government support. The key drivers within the industry include the airlines, hotel and hospitality, tour operators and niche industries diving, trekking, surfing, kayaking, and historical/cultural sectors.

In 2005, PNG received close to 70,000 overseas visitors of which 26 per cent (approximately 18,000) were holiday travellers and the remainder comprising of the business traveller segment. This is an increase of over 17 per cent on the previous year, generating estimated revenue of K488.5 million.

There is great, unrealized potential for predominantly nature and cultural based tourism in PNG. The only tourism sector that is any way developed at this time is the diving sector, which accommodates approximately 68% of the tourists visiting PNG (Tourism Promotion Authority, 2001 visitor survey). There are, however, a large number of other activities that if properly managed, could provide considerable revenue to the resource owners and to the national treasury.

Currently the impact of tourism on the environment is negligible as the levels of tourists are so low (during 2004 the total number of tourist visiting PNG amounted to fewer than 17,000). Given the potential range of activities available to tourists there is scope for greatly increasing this number. There is potential for the development of tourist ventures in most outdoor activities including climbing, trekking, rafting, canoeing and marine recreation. In addition bird watching, cultural tours and village based tourism have the potential to broaden their market. However, the current model of *ad hoc* tourist developments will require closer management if an increase in tourist numbers is not to adversely affect the environment on which it will depend.

H. Minerals, Oil, and Gas

Papua New Guinea possesses rich mineral resources including gold, copper, silver, nickel, cobalt, petroleum and natural gas. The exploitation of these resources over the last 30 years has provided the country with substantial foreign earnings, infrastructure, training and employment. The mining and petroleum sector continues to be of major economic importance, contributing approximately 75 % (K. 1,064.5 million) of the total value of merchandise exports (K.1,410 million) in the September quarter of 2002 (Bank of Papua New Guinea, 2002). Mineral export receipts, excluding crude oil, made up 49 % of total merchandise exports in this quarter, whilst receipts from crude oil exports accounted for 26 % of the total merchandise exports during this period.

Environmental impacts can occur at all stages of the mining cycle depending on the mining methods used and degree of activity, commencing with exploration, construction, operation, closure and post-closure, when residual impacts can continue to occur long after mine closure and abandonment.

I. Transportation and Shipping

17 commercial ports, mostly very small, and innumerable small wharves, jetties and other beach landings provide the basic infrastructure for maritime services, but the majority of these are in poor condition and carry very little traffic. The ports serving Port Moresby, Lae, Madang, Kimbe, and Rabaul carry international and coastal traffic and have a reasonable level of infrastructure, but lesser ports, ranging from those at Wewak, Kavieng, Oro Bay and Alotau to mere timber jetties and beach landings, provide only a basic service for coastal traffic and are often unusable in bad weather. Many landings involve loading and offloading over the ship's side from/to small village "banana" boats and canoes

Madang, serving many small coastal vessels, and Kimbe, serving agricultural exports, are the most frequently visited ports, but Port Moresby, Lae and Rabaul handle the most cargo; most imports pass through Lae and Port Moresby. Lae is the main import/export point for the populous Highlands region, the goods being moved from/to the port by road. Annual throughput by the major ports has been growing at about the same rate as population growth with import/export tonnages (increasingly containerized, but also including a growing logging trade) accounting for about a third of the total and most of the growth. Passenger cruise visits have also been growing, albeit from a low base. Coastal passenger operations are significant between the larger 20 centers like Lae, Madang, Kimbe, Kavieng and Buka, but recent falls in traffic have led to some reductions in services. Community-based services also extend to many smaller coastal villages, often in small, open, over-loaded craft operating over stretches of open sea without safety facilities or navigation aids (navaids).

Institutional Arrangements

The 1980 Merchant Shipping Act and the 1976 PNG Harbours Board Act provide the legal framework for maritime sector management. The National Maritime Safety Authority (NMSA) is responsible for all maritime safety matters.

NMSA is responsible for maritime safety and safety-related infrastructure. Its functions include installation and maintenance of navaids; coordination of SAR services; prevention of oil spills and environmental disasters; registration and licensing of vessels over 10 m in length; PSC; small-boat safety; hydrographic surveys; and ensuring that PNG's maritime safety obligations under international conventions are met. MSB has a depot in Madang, where it also bases its vessels *Sepura* (recently disposed of) and *Kulasi*, an inventory of navaids spares and

maintenance equipment. For SAR operations, it has a small fleet of catamarans and for hydrographic surveys a 26 m purpose-built hydrographic survey vessel.

Maritime Safety and Environmental Protection

Standards of maritime safety are poor. NMSA fails to maintain adequately the system of navaids. Most of the NAVAIDSrest are in need of repair or replacement. There is virtually no maintenance. When failures occur, months often pass before faults are reported. No notification is given to ship operators, who no longer trust the system and resent the imposition of light dues intended to fund navaids maintenance and repair.

The lack of navaids affects both major shipping operations and community services. The former can sometimes overcome deficiencies with their own equipment, but often have to make expensive detours to reduce risk. Community services commonly make dangerous journeys in hazardous waters without help from markers or lights. These add to the costs of sea transport, affecting incomes and impacting on producers and consumers at all levels.

PNG has no effective capacity for marine surveying or charting, nor capacity to issue its own hydrographic charts, instructions to mariners or marine publications. Utilization of its specialized hydrographic survey vessel is minimal. PNG's sea area amounts to some 1.7 million sq km, only about a tenth of which has been properly surveyed.

V. Threats and Vulnerabilities

A. Current issues for the Marine Resources Management

Papua New Guinea has a total of 14 Maritime Provinces and, of which 9 provinces are all located on the mainland while 5 provinces are located on islands. These provinces have large sea boundaries which provide subsistence and artisanal benefits to their livelihoods. The localized coastal area that sustains these coastal people are mainly located from the shoreline, high water mark, inshore waters, sea grass beds, fringing coral reefs, barrier reefs and the deep seas which extends beyond the 12 nautical mile zone.

Fisheries degradation and food security

A significant loss of coastal fisheries is very evident along the coastline of PNG. Major populated provinces that have depended heavily on their marine resources to sustain their livelihoods have become under stress from fishing pressure and the methods of fishing while other factors including easy access to distant or protected fishing grounds by outboard powered engines and fiberglass boats. Many of the 14 Maritime Provinces have agro-forestry projects located inland. These projects have over the last 20 years have contributed immensely to the degradation of the marine resources and their habitats and the other major form of degradation is from natural seasons of heavy rainfall and long drought spell.

Food security has been a very serious problem mainly with coastal province which have major gold and copper mines located within their provinces. The Western Province located southernmost part of PNG bordering Indonesia has been recently impacted by recent flooding caused by heavy rains further up the Fly River. A total of 15 village located along the coast are inundated by flooding which has destroyed food gardens, smothered sea grass meadows, caused flooding to tributaries and has prompted most o the marine resources to become unsafe to eat. Comparison from the last 12 months have recorded over 15% of men, women and children that are experiencing symptoms of arthritis, serious skin diseases, allergies, complications of women in child birth, and unknown death related to eating of reef fishes.

Threatened species

PNG has a very large sea area which supports a very high marine mega diversity which is considered to be one of the last frontiers of the coral triangle region. This includes;

- 32 species of large and small whales
- 1 species of the freshwater dolphin
- 1 species of dugong
- 6 species of marine turtles
- 12 species of fresh water turtles
- Over 6oo species of corals

- 8 species of tuna

These species which exist within our 3.2 million km² are at present under serious stress from unsustainable fisheries activities and poor management strategies to protect these marine animals from becoming critically endangered.

The most vulnerable marine species which are seriously under threat are as follows;

- Freshwater dolphin
- Dugong
- 3 of the marine turtles
- 3 of the freshwater turtles
- All of the tuna species.

The main influential factors into creating such decline of these species includes effects of weather patterns, run offs from heavy rain fall, habitat degradation and loss of foraging and breeding areas through impacts associated illegal fishing practices and IUU. There are also the lack of research and monitoring of such animals and this has become evident now that there is a loss of large numbers of these marine animals that have declined in numbers over the many years.

The legal boundaries between Australia, and Indonesia have been a very big challenge for PNG to manage. Cross Borders issues have been long outstanding and, therefore, the unsustainable take of these endangered animals have become victims of Transboundary actions by bordering countries. Enforcement has been lacking from PNG to better control illegal activities and due to the vastness of the borders PNG has become a victim.

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VI. POA Initiatives and Future Plans

A. Monitoring and Evaluation Baselines with Indicators (and Management Issues)

Priority "seascapes"—improved governance & management within existing areas

Seascapes in PNG context are defined in planning and land/marine use contexts as a combination of adjacent coastal, nearshore and offshore within an area, defined by a mix of coastal-sea indivisibility character assessment with major marine areas forming divisional points between one seascape area and the next.

The Admiralty and Bismarck Archipelagos and the northern coasts of PNG mainland are part of the Bismarck Solomon Seas Ecoregion (BSSE) initiative and perhaps one of the last tropical marine ecosystems that remains relatively unaffected by human activities.

The BSSE is defined by biogeography, oceanographic, geophysical and climatic boundaries, and is geologically active, with physical diverse marine environments.

NGOs such as WWF, TNC, CI and WCS have programs currently on-going in these areas that include research and conservation (MPAs, LMMAs) which are contributing to priority seascape conservation initiatives in PNG.

Large scale marine areas as priority seascapes across Papua New Guinea territorial and archipelagic waters are designated to serve as geographical foci for major investment and development for PNG. Seascape Investment Plans for priority seascapes are completed, along with arrangements for sequencing investments in line with the PNG Vision 2050

Target # 1: "Priority Seascapes" designated, with investment plans completed and sequenced.

ACTIVITY	Key Performance Indicator (KPI)	STATUS
1 .1.1 Develop a legal reform roadmap for coastal and marine policy development and implementation and commence review of legislation and development of appropriate legislation to support Marine Program outcomes (also see 3.1.1)	• Roadmap developed • Legislative review completed • Legislative development program commenced • Legislative development program completed	***Not started***
1.1.2 Develop a marine policy to support integrated marine environmental management for environmental sustainability and economic growth through a coordinated 'whole of government' approach for integrated planning and development based on quality information, participation by key stakeholders and partnerships between industry, government	• Project proposal prepared and funded • ***Project commenced*** • Draft policy prepar***ed and circulated for comment*** • Final policy submitted for approval	***Discussion paper on Protected Areas in circulation. There are plans to develop a separate Marine Policy***

and community, in accordance with the ESEG		
1.1.3 Undertake capacity building enhancement project for national, provincial and local level organizations	• Capacity assessment of organizations undertaken and program developed • Annual review against program	***Not started***
1.14 Coordinate the collation and review of available scientific and socio-economic information on marine areas and develop a data and management information system (MIS) to support decision-making in the marine environment.	• Literature review completed • GIS in place • MIS in place	***Not started***
1.1.5 Oversee the identification, delineation and prioritization of large scale marine areas for systematic management in conjunction with activity 3.1.2.	• Process and program developed • Implementation commenced on completion of relevant policies	***Not started***
1.1.6 Facilitate the determination of customary ownership rights, customary user rights and other non-customary stakeholders.	• Project des***ign for facilitation completed*** • Project commenced	***Not started***
1.1.7 Develop investment plans for all identified priority seascapes, including any joint investment plans for those seascapes involving two or more countries.	• Investment plans for identified Priority Seascapes commenced • Annual review of progress • Investment plans for identified Priority Seascapes completed	***Not started***
1.1.8 Coordinate stakeholder awareness, consultation and engagement.	• Stakeholder consultation and awareness program designed and approved • Annual progress review	***Not started***

Target # 2: Marine and coastal resources within all "Priority Seascapes" are being sustainably managed.

ACTIVITY	**Key Performance Indicator (KPI)**	**STATUS**
1.2.1 Oversee SWOT and feasibility analysis on establishment of a managed seascape at an identified and selected location.	• SWOT analysis designed • SWOT analysis completed	
1.2.2 Coordinate development of management plans, including implementation schedules and budgets, for priority seascapes.	• Planning processes are developed for each priority seascape as they are identified and approved • Planning processes evaluated on	

	completion	
1.2.3 Mobilise financial resources necessary to support "priority seascape" programs (based on Seascape Investment Plans).	• Funding strategies developed for each priority seascape as they are identified and approved • Seascape Investment Plans implemented successfully and ongoing	
1.2.4 Strengthen governance mechanisms and financial sustainability of BSSE and other priority seascapes.	• Strategy or plan developed • Implementation commenced • Implementation successfully completed	
1.2.5 Undertake a review of the Torres Strait Treaty	• ***Agree Terms of Reference*** • Ongoing participation in accordance with Term***s of Reference*** • Treaty review completed successfully	***Not started***

B. Ecosystem-based Fisheries Management

Population increase and the transition from a traditional and subsistence economy to the formal cash economy are contributing to overfishing of coastal fisheries in PNG and other parts of the Pacific. Conventional fisheries management approach is failing to stop the trend of overfishing at local scales and across whole fisheries. Ecosystem Approach to Fisheries Management (EAFM) has the potential to reverse the trend of overfishing and contribute towards sustainable fishing practices.

To date PNG does not have specific policy and legislations that address and implement EAFM. However, there are draft Policies on Fish Aggregation Devices, Community -based Management and Protected Areas that complement and support EAFM. Government, NGO's and other stakeholders do implement elements of EAFM but they do not have the impact that they would have if it there were a clear EAFM policy and there was an ecosystem approach to fisheries management being implemented through management plans that focus on the ecosystem in addition to fish and marine organisms that are exploited.

There is no specific legal framework/law that addresses implementation of EAFM. However, there is adequate legal coverage to implement EAFM using the various pieces of legislations at both the national and local level. With some specific amendment and modification to the Fisheries Management Act, 1998 including in Section 28, PNG can fully implement EAFM. There is a suggestion to amend and modify Section 28(2) to now read:

''The Managing Director may, and where the Minister so requires shall, cause to be drawn up a Ecosystem and Fishery Management Plan in respect of any fishery resource in the fisheries waters''.

There is also a suggestion to insert a new sub subsection under Section 28, subsection 3 to possibly read:

''identify and describe the status of the ecosystem and its characteristics, including the use of the ecosystem by other users''

Progress in the right direction towards full implementation of EAFM is expected in the coming years Some progress made to date include The Nature Conservancy-led training of EAFM (and CEAFM) principles in Manus and Kimbe where about 200 community practitioners and fisheries officers have been trained. The formation of the EAFM sub-working group which reports to the PNG Marine Program Technical working group which in turn reports to the National Co-ordinating Committee (NCC) is a positive sign.

The key EAFM gaps identified to date include;

- The need for an EAFM policy that is formally endorsed by the National Fisheries Authority Board.
- No specific EAFM provisions in the current legislations at the National and Local Level Government. This needs to be addressed by inserting EAFM specific provisions in the Fisheries Management Act and formal incorporation of EAFM provisions in the Local Level Government Environment and Conservation Laws/Fisheries Laws.
- Fisheries Management Plans implement conventional management approaches. This can be improved by modifying the management plan provisions to allow for the management of fisheries and ecosystem. The management plans would be known as Fisheries and Ecosystem Management Plans.
- Fisheries Officers, NGO technical officers and community field practitioners lack knowledge and experience in EAFM to conduct awareness and be effective in the implementation of EAFM. This can/will be addressed through training on EAFM.

Table xx. EAFM Targets, Activities and their implementation status under Goal 2 of the Marine Program

Target # 1: Strong legislative, policy and regulatory frameworks in place for achieving an Ecosystem Approach to Fisheries Management (EAFM)

ACTIVITY	Key Performance Indicator (KPI)	STATUS
2.1.1 Conduct a stakeholder and SWOT analysis in relation to EAFM.	• Project proposal approved • Analysis commenced • Final results received	Not Started
2.1.2 Review and strengthen decentralization arrangements in relation to coastal fisheries management.	• Project proposal approved • Review commenced • Final report • Commence strengthening initiatives	Not started
2.1.3 Evaluate and strengthen linkages between national, provincial and local level government laws, in line with MTDS, LTDS & MDGs.	• Commence evaluation • Evaluation completed • Commence linkage strengthening initiatives	Not Started
2.1. 4 Critically assess the improvement of enforcement capacity at the provincial and local levels.	• Methodology and approach approved • Review commenced • Review completed	Not formally started but NGO's involved with LLG through LLG laws

2.1.5 In view of the above, revise and incorporate EAFM amendments to the Fisheries Management Act 1998.	• Proposed amendments drafted • Propose amendments implemented	Minor amendments proposed in this report.
2.1.6 Explore feasibility of re-investing a portion of tuna revenue to fund small grants and loans for local fishermen to fund activities in relation to EAFM.	• Discussion paper prepared • Discussion paper circulated • Analysis and presentation of comments and options	NFA provides grants for coastal fisheries development

Target # 2: Improved income, livelihoods and food security of an increasingly significant number of coastal communities across the region through a new sustainable coastal fisheries and poverty reduction initiative ("COASTFISH").

ACTIVITY	Key Performance Indicator (KPI)	STATUS
2.2.1 Implement Coastal Fisheries Management and Development Project (CFMDP) in Milne Bay, Morobe and New Ireland.	• Implementation commenced • Annual review of progress • Project completed	Project funded under ADB but has not been continued. NFA has not restarted this activity to date.
2.2.2 Implement community-based fisheries management (CBFM) models.	• Project and program design completed • Implemented commenced • CBFM models adopted by communities	Being implemented by NGO's
2.2.3 Mobilise significant new financial investments to support "Coastfish"	• Develop Coastfish Investment Plans • Commence implementation of Plans • Annual review of progress	Not started
2.2.4 Through National Fisheries Authority, channel funding to National Development Bank targeted towards promoting micro- and small-scale fisheries.	• Policy proposal developed • Proposal endorsed • Implementation commenced	Started
2.2.5 Upgrade Kavieng Fisheries College.	• Approval for upgrade • Upgrade commenced • Upgrade completed	Ongoing
2.2.6 Build Mariculture Research Station in Kavieng.	• Proposal developed and approved • Construction completed	Ongoing and almost complete
2.2.7 Improve marketing of marine products, including diversifying and expanding markets.	• Marketing strategy commenced • Marketing strategy completed	Ongoing

	• Strategy implementation commenced • Strategy in place	
2.2.8 Conduct quantitative assessment of by-catch (prawn, tuna, others).	• Project design completed • Commence assessment • Annual assessment of progress • Assessment completed	Ongoing

Target # 3: Effective measures in place to help ensure exploitation of shared tuna stocks is sustainable, with tuna spawning areas and juvenile growth stages adequately protected.

ACTIVITY	Key Performance Indicator (KPI)	STATUS
2.3.1 Build a sustainably managed tuna industry and maximize economic benefits.	• Tuna Fisheries Management Plan in place • Annual review of plan implementation • Annual assessment of economic performance	Ongoing
2.3.2 Conduct tuna stock assessments and research on the socio-economics of the tuna fishery.	• Project design completed • Stock assessments conducted • Annual reporting of assessment results	Ongoing
2.3.3 Implement Vessel Monitoring System (VMS) for tuna fisheries.	• VMS designed • VMS implementation commenced • Annual review of implementation • VMS system in force	Implemented and on going
2.3.4 Conduct diagnosis and analysis of current situation and opportunities.	• Survey designed • Diagnosis and analysis process commenced • Draft report • Final report	Not started
2.3.5 Create a learning network group to lead the analysis and clearly define partners' roles with greater civil society involvement (Church, development agencies etc.)	• Learning network designed • Learning network process commenced • Annual reporting on performance of network	Started
2.3.6 Build capacity for all local fishermen to understand tuna fishery including protection of juveniles.	• Program designed • Program commenced • Annual reporting of performance • Final report	Not Started
2.3.7 Promote and encourage protection of key spawning tuna fishery areas. (e.g.: Former	• Areas identified • Program for protecting sites developed	Ongoing

Mogardo square,)	• Program Implemented • Annual reporting of success • Final report	

Target # 4: A more effective management and more sustainable trade in live reef fish and reef-based ornamentals achieved.

ACTIVITY	Key Performance Indicator (KPI)	STATUS
2.4.1 Develop a national management plan for the ornamental fishery.	• Management plan prepared • Plan implementation commenced • Annual review of plan performance • Final evaluation	Draft plan available with the assistance of SPC
2.4.2 Update the national Live Reef Food Fish (LRFF) management plan.	• Review process commenced • Review completed • Management Plan updated	Not started
2.4.3 Conduct analysis of current situation and opportunities.	• Survey designed • Diagnosis and analysis process commenced • Draft report Final report	Completed but need updating
2.4.4 Create a learning network group to lead the analysis and define partners' roles with greater civil society involvement. (Church, development agencies etc.)	• Learning network designed • Learning network process commenced Annual reporting on performance of network	Started
2.4.5 Educate and train fishermen to understand LRFF trade and ornamental fish.	• Education program designed • Education Program implemented • Annual review of performance • Final report on evaluation of program	Not started
2.4.6 Promote and encourage protection of spawning areas for species target by ornamental and LRFF.	• Strategy developed • Strategy implemented • Annual review of strategy performance • Final evaluation of strategy performance	Started

C. Management of MPAs

At the moment there is no large scale MPA in existence in PNG. However, there is a large Wildlife Management Area in Western Province called Maza Wildlife Management Area.

Management of MPAs

The PNG Government released a Policy discussion paper on Protected Areas early in 2012. There was wide consultation on the policy discussion paper and as a result a draft Protected Area Policy has been drafted. The Government has plans to hold wide public consultation on the draft Protected Area Policy. The Protected Area Policy will provide the broad framework for establishing the protected area system in PNG. After the protected area policy is officially endorsed by the Government, specific policies will be drafted on Marine Protected Areas.

At the moment there is no large scale MPA in existence in PNG, as mentioned above. As concerns the Maza Wildlife Management Area, its implementation focuses on the protection of turtles and dugongs. Local Communities in partnership with the PNG Government and International partners are in collaboration on a number of projects to improve the effectiveness of The Maza Wildlife Management Area.

To improve marine biodiversity and resource management at Kimbe Bay, local communities and the West New Britain Provincial Government and The Nature Conservancy have been in partnership to design and implement an innovative MPA network called the Kimbe Bay Marine Management Area. The MPA was designed so that it could be resilient to the impacts of Climate Change. The Kimbe Bay Marine Management Area is a network of Locally Managed Marine Areas (LMMA) that are managed by the communities using LMMA Management Plans. There are 11 LMMAs that are formally part of the Kimbe Bay Marine Management Area (MPA Network).

Locally Managed Marine Areas have been established in other provinces in PNG at Milne Bay, New Ireland, Manus, Madang and Central Provinces. The LMMA's will be part of an MPA system once the MPA policy is formalized by the PNG Government.

Table xx. ***MPA Targets, Activities and their implementation status under Goal 4 of the Marine Program.***

Target # 1: National MPA System in place and fully functional.

ACTIVITY	Key Performance Indicator (KPI)	STATUS
3.1.1 Engage a legal consultant to review and propose amendments to legislation for MPAs.	• TOR for review prepared • Review undertaken • Report of review submitted	Not started
3.1.2 Seek parliamentary support and enactment of revised or new legislation on MPAs in accordance with 3.1.1.	• Legislation submitted to Parliament • Parliamentary approval of legislation	There is strong Environment and Conservation Minister Support

3.1.3 Seek stakeholder and NEC endorsement and compile revised legislation in accordance with 3.1.1.	• Submit legislation review report to NEC and stakeholders • Subject to review responses, commenced legislative revision	Not started
3.1.4 Develop a MPA policy as an outcome of the marine policy process and as a component of a broader Protected Area Policy to guide development of a system of MPAs	• Policy scoping paper prepared • Policy review commenced • Draft policy circulated for comment • Draft final policy • Submit to NEC for endorsement	To commence after Protected Area Policy is endorsed
3.1.5 Based on development of a MPA policy (see 3.1.2), establish a MPA program, which should include support for the Locally Managed Marine Ares (LMMAs) Network	• Review MPA program models • Draft proposed MPA program approach • MPA program approach approved and endorsed • Commence MPA program	To commence soon
3.1.6 Identify and mobilize sustainable financing for MPAs	• Develop Financial Plan • Commence implementation of Plan • Annual review of progress	Not started
3.1.7 Establish Working Group for engaging private sector e.g tourism industry in supporting the MPA program, including investigation of private sector financial and in-kind support for MPAs	• Develop terms of reference for Working Group • Working group established • Annual review of progress	Not Started
3.1.8 Coordinate awareness and engagement of stakeholders on the MPA system.	• Stakeholder consultation plan developed • Consultation commenced	Ongoing
3.1.9 Coordinate implementation of the MPA system with stakeholders addressing critical aspects such as capacity building, community engagement, funding and collaborative partnerships.	• MPA implementation strategy developed • Implementation strategy commenced and annually evaluated	Co-ordinated through NCC
3.1.10 Develop appropriate management plans in accordance with the adopted MPA policy and program, incorporating governance, institutional and financial components in collaboration with stakeholders.	• Format and style for management plans developed • Plans prepared as required • Consultation processes undertaken • Plans approved and implemented	Plans in place but to align with Policy once it is endorsed

3.1.11 Establish partnerships with provincial governments, local level governments, research institutions, management agencies, local communities and NGOs to effectively manage MPAs.	• Partnership arrangements for each MPA identified • MoA developed and agreed	Ongoing at Demonstration Sites and NGO Sites
3.1.12 Develop and implement an effective networking and coordination mechanism for MPAs.	• MPAs established in accordance with the MPA Policy and Strategy • MPA managers network established • MPA managers meet annually	PNG Learning and Training Network established

D. Adaptation to Climate Change

The Government is addressing climate change though a hazard based approach. It has developed and implemented some initiatives to respond to Climate Change. Initiatives developed to address climate change includes coastal flooding, setting up early warning systems, protection of coral reefs, vulnerability assessment, mangrove planting and provincial consultations. Vulnerability Assessments have been undertaken by the OCCD in the central province and also done by NGOs at their project sites. Mangrove planting has been undertaken by most organizations as a cost effective adaptation measure. Communities are setting up nurseries to enable them to plant mangroves. This initiative is effective in coastal protection for coastal communities. A coastal early warning system is being developed to facilitate and plan for climate change induced hazards. Dry stone walling has been piloted as a cost effective barrier method for coastal protection. Provincial consultations have been undertaken to educate people on climate change and issues relating to climate change.

The OCCD's "Millions of Mangroves" project aims to facilitate the planting of millions of mangrove trees, a significant leap in the scale and effectiveness of community mangrove planting initiatives in PNG, by bringing together the disparate stakeholders involved in mangrove rehabilitation. The rehabilitation of natural mangrove forest is to protect coastal communities from coastal flooding as they are known to reduce the impacts of large waves. OCCD has hosted the 1st Mangrove workshop 2011 at the Motupore Island Research Centre. All stakeholders involved in mangrove activities were invited to this workshop. As follow on from this workshop, OCCD has supported the multiplication of seed stock and distribution network of mangroves by supporting MIRC to rehabilitate their nursery. Other organizations like, WWF in Madang and Manus Province and Ailan Awareness in New Ireland province have gone on to carry out trainings and awareness on mangroves with the communities they are engaged with.

E. Financial Considerations (Status of Sustainable Financing)

Financial sustainability is an admirable goal of any conservation and development strategy, but one that is seldom achieved.

The objective of sustainable financing is to create a more predictable cash flow. This could be achieved in many different ways. However, the fundamental outcome of sustainable financing is to have a plan or strategy which is designed to have **diversified income streams**; **increased administrative efficiency**; **cost-effective linkage between the income and the activities** to address key management challenges, **good governance characteristics**, and

incentives for local institutions to manage activities and budgets in a more cash-sustainable manner. These characteristics are not mutually exclusive and deliver more sustainable results when combined.

Thus we understand sustainable financing as a portfolio of diverse and stable financial mechanisms that cover operational and other costs with a combined option of short and long-term revenues. For the purposes of this report, financial sustainability refers to the consistent supply of revenues over time sufficient to meet the costs of core operations of the PNG CTI objectives. Further, sustainable financing ensures basic costs are covered for the foreseeable future.

1. Costing the PNG marine program (i.e. ref. to the five goals of NPOA))

At the time of the writing of this report, estimating the cost of the five goals of PNGs Marine program is both unrealistic and impractical. No sustainable finance planning or strategy exists for public sector conservation in PNG. Further, no costs or budgets for existing marine protected areas are available to provide the basis for costing of the five objectives. This is further compounded by the lack of central coordination to mobilize all CTI stakeholders for them to compile realistic costings. In addition, not all the specific objectives under the 5 goals of PNG marine Plan are SMART (specific, measurable, attainable, realistic and timely) enough to allocate costings. The PNG marine Plan also lacks specific measurable targets, thus it is also unrealistic to develop a sustainable financial strategy with a future in mind. At this point in time it is advisable that the lead government agency for the CTI develop a financial architecture with the assistance from the CTI to develop a sustainable financial strategy for PNGs Marine Program.

2. Costing MPAs

The financial cost of an MPA includes the initial, typically **short-term investments in establishment** as well as the **recurrent costs of maintenance** (including administration, management and enforcement) incurred over the long-term. Balmford et al. (2004) developed a model to predict total running (i.e., maintenance) costs per unit area based on a survey of 83 MPAs worldwide. Their results showed that MPAs cost more to run where they are small, where they are close to inhabited land and where cost structures are high.

Since the PNG Marine program sets no targets for number of MPAs, size of MPAs or coverage of MPAs, exploring the cost of MPAs will remain theoretical estimates rather than realistic.

The ADB-RETA program has circulated costing templates for MPAs which provides some way forward.

3. Identify existing funding sources

According to the PNG Marine Plan of Action the Marine Program (PNGs National Plan of Action) will be drawing support from all its international and national donors and development partners including through bilateral arrangements. These arrangements are facilitated at the regional level rather than in-country level. Thus, PNG foresees it main donors and technical support such as the Global Environment Facility (GEF), United Nations Development Programme (UNDP), UNEP and Asian Development Bank (ADB) have also been part of the CTI since its inauguration in Bali in 2007. The GEF has allocated funds under RAF 4 to the biodiversity focal area for Papua New Guinea to implement projects. Some of these funds were further allocated to implement marine

biodiversity management programs. The ADB was selected as the Implementing Agency to assist in developing the marine project proposal for the GEF Secretariat to consider in 2009.

The CT6 countries have agreed to involve United State of America and Australia as its political partners through the implementation of its respective programs and be referred to as the CT6 + 2. Out of this understanding, the government of United State is providing funding support through an NGO consortium known as the Coral Triangle Support Program while Australia will be providing its support through the Department of Environment, Water, Heritage and the Arts (DEWHA).

The PNG Marine Program has direct links with the CTSP and the ADB Regional Environmental Technical Assistance Program (ADB-RETA) on CTI.

Other projects will be developed with GoPNG funding through DEC, NFA and OCCD. The PNG Marine Program will be implementing the existing programs therefore will be aligned with approved activities by identified implementing partners and would require endorsement by the National Coordinating Committee (NCC) on PNG CTI. The NCC will monitor progress of projects and the work of sub-committees and furnish reports periodically to the CTI secretariat and the Focal Point. The main aim during the implementation of the Marine Program is to maximize positive impacts with the available resources so that these effects can be replicated and sustained over the long term and to promote an integrated approach to marine resource management.

4. Coral Triangle Support Partnership

CSTP is a consortium made up of NGO's comprising World Wildlife Fund (WWF), The Nature Conservancy (TNC) and Conservation International (CI) with funding support from USAID. The CTSP has developed its work plan in close consultation with PNG's CTI implementing partners to be consistent with the RPoA and the PNG Marine Program. The CTSP will follow CTI guiding principles to develop actions on all goals but will focus work in PNG on Goal 4 in close collaboration with the NFA in implementing the Ecosystem Approach to Fisheries Management (EAFM) activities. The project will also incorporate aspects relating to marine protected area management and climate change adaptation and resilience within the framework of EAFM.

5. ADB RETA on CT Pacific PNG

The Regional Technical Assistance on CT Pacific phase is funded by the GEF under the GEF-RAF4 allocation. The ADB is the implementing agency to assist Solomon Islands, Timor Leste, PNG plus Fiji and Vanuatu. The project is titled: Coastal & Marine Resources Management in the Coral Triangle of the Pacific. It is expected that this RETA will provide a response to key issues on coastal and marine resources

Table xxx. Financing Plan.

Program	Donor	Amount	Duration	Fund Manager
ADB-RETA	GEF	6, 622,425	4	Contracted Firm
CTSP	USAID	1`400,000	4	
DEWHA	Australia	-	3	

Marine Program	Gov. of PNG	3,000,000	4	
Total				

6. Identifying Shortfall

Until exact costs of each of the objectives are established it is not practical to identify the short falls in funding.

One of the weaknesses of the PNG marine Plan is that it does not explore any new internal sources of funding. Further all the sources of funding are sinking funds which do not provide much sustainability. Table 3 below provides some options for funding. (to add)

Table 3: Potential Sources of Revenue

Possible Funding Source	Source of Revenue
Multi-lateral Funding	GEF, FAO, ACP
Bi-lateral Funding	AusAid, NZAid, Japan,
International NGOs	TNC, WWF, CI,WCS
International Foundations	Packard Foundation, Macarthur Foundation,
Payments for Environmental Services	Downstream users, water consumers
Park User Fees	Individuals, Tourists, Researchers
Privatization of Park Services	Tour operators, private sector
Debt for Nature Swap	Donors, Government, NGO's
Environmental Levies	Individuals
Government Contribution	Government
Hotel Occupancy Tax	Hotel clients
Cruise Ship Fees	Cruise ship passengers
Fines	Individuals, Corporations
Permits and Licenses	Fishers, Hunters, Researchers,
Biodiversity Prospecting	Pharmaceutical Companies
Carbon Sequestration Payments	Corporations, Government

Green Investments	Corporations
Fish Catch and Service Levies	Commercial Fishers

Having a sustainable finance plan or strategy helps conservation managers to meet the cash flow requirements of management operations. This takes into account the varying and diverse financial requirements of management activities to achieve specific objectives. The core elements of sustainable financing are the development of financial management skills, the on-going availability of funds; the diversity of funding sources; and the transparency and accountability in the management of the resources, both financial and natural.

In practice the concept of sustainable financing is being applied to correct the problem of lack of funding for the conservation and management of natural resources. In most countries, natural resources are a public good, which makes them susceptible to the free-rider problem.

The free-riding occurs when the conservation of a protected area generates costs which are not covered by the beneficiaries of the ecological services. In this sense, the government, the local communities and the international community are all beneficiaries of the goods from protected areas, but the costs are distributed in an unequal way (Emmerton 2003). This is especially true for Marine Protected Areas, where the control of the access and the collection of fees are more difficult and where the livelihoods of local communities depend on the use of the natural resources, especially fisheries. The concept for the payment for ecosystems service presents itself as one strategy that places responsibility of meeting the the cost of conservation of important resources to be net by all beneficiaries, creating a form of sustainable finance for conservation.

F. Public Awareness

Public education and awareness on any development issue in Papua New Guinea is very important. It is a key component of program planning, implementation and monitoring and evaluation in order to achieve program goals and objectives.

Public awareness plays a vital role in the mobilisation of all stakeholders so that they can have sufficient understanding on issues in order to take the necessary and required actions to work with others in a collaborative manner and address issues that affect them.

Many organisations create communications and marketing positions because they believe in communicating their programs for the benefit of their target groups and others who are affected by their programs.

Creating public awareness on any issue in PNG has its fair share of challenges and can have both positive and negative impacts depending on how the awareness is implemented. This section will try to highlight the different elements of Public Education and Awareness related to marine conservation and resource management in PNG, and the organisations that have conducted activities in this area. Most of the information in this section is derived from Public Education and Awareness programs, experiences, challenges and learnings on marine conservation and resource management by civil society organisations that have occurred in PNG in the last 15 years.

This report will provide an insight into the scope of public awareness in PNG which includes: what has been done, how it has been implemented and at what levels it has occurred. It will also provide the results achieved in various geographies. Additionally, the report will also identify constraints, lessons learnt and the way forward for future planned public awareness programs and activities in marine conservation and resource management.

1. Purpose and objectives

The main purpose of this Public education and awareness report is to ensure the State of the coral triangle report from Papua New Guinea provides readers a balanced report on what CTI programs have achieved so far. It will also provide to the CTI secretariat the status of Public education and Awareness relating to conservation and marine resource management in PNG. The following are objectives for this section.

- Ensure the SCTR has information documented on the degree and type of public education and awareness related to marine conservation and resource management has occurred in PNG;
- Share the lessons learnt and experiences of public education and awareness in PNG with other CTIO countries
- Inform the CTI Secretariat and Regional Plan of Action on what the gaps maybe in the region for effective public education and awareness of marine conservation and resource management.
- Assist the CTI Secretariat and the Regional Plan of Action in the development of relevant tools and processes for effective public education and awareness related to marine conservation and resource management.

2. Participating organisations

All of the information in this section has been taken from the program activities, experiences and learnings from civil society organisations that have been established to only conducted public awareness or have elements of Public Education and awareness programs, in PNG that is related to marine conservation and resource management.

The writers of this section are people who had been involved in one way or another in implementing communications strategies within their organisations and had some experience with public education and awareness programs.

Civil society organisations whose programs this section covers are; Ailan Awareness (AA), Mahonia Na Dari (MND), PNG Centre for Locally Managed Areas (PNGCLMA), Mas Kagin Tapani Association (MAKATA), The Nature Conservancy (TNC), and Seaweb. This section also provides to readers a map of PNG showing the various sites where public education and awareness taken place and short brief of the organisations

Ailan Awareness was formally established in 2005, however was conducting public awareness since 1993. It is an public awareness NGO working in the New Ireland province to campaign against unsustainable and destructive fisheries practices such as dynamite fishing, and the use of derris roots by local people. They also conduct awareness in community based resource management, marine ecosystems and climate change. Their awareness program involves visiting both schools and communities. The use of drama, song and dance are key methods to disseminate information to their target groups.

Ailan Awareness is also the focal point for the Learning and Training Network in New Ireland a recently developed activity under the Coral Triangle Initiative. Additionally, they assist interested communities to develop marine managed areas extensively in New Ireland.

Mahonia Na Dari (MND) means 'Guardian of the Sea' is a local conservation education NGO based in Kimbe, West New Britain province. MND has been in existence for the last 15 years. Its major program is the Marine Environment

Education Program, (MEEP) which it to selected primary and secondary school students mainly and teachers in West New Britain provinces. Other interested schools from outside participate through marine camps that are hosted at the centre. Another school program they have is the annual school visitation they conduct to all educational institutions in Kimbe Bay using puppetry, video shows and story boards.

MND also conducts education awareness to communities within Kimbe Bay, on marine ecosystems, sustainable fishing practices, and impacts of land use and benefits of marine protected areas.

It also has a research facility that provide support to marine biologist around the world who are interested in Kimbe Bay. They currently have a partnership with James Cook University (JCU). Researchers who use MND train staff on marine biology, ecosystems, marine species, impacts of climate change on marine life and ecosystems which increases the level of knowledge for the staff in disseminating information to schools and communities.

PNG Centre for Locally Managed Areas (PNGCLMA) is a national conservation NGO formally established in 2008. It is part of a regional LMMA network in the Pacific including Indonesia and the Philippines. It is primarily working to promote self reliance of communities through management of their resources. It is a membership NGO whereby its members are communities that are practicing some form of marine resource management. At present PNGCLMA has about five (5) members in West New Britain Province, one (1) in Madang Province and one (1) in Manus province. These members have management areas set aside.

Mas Kagin Tapani, (MAKATA) means 'Ocean Stewards and Guardians' is a community based organisation working in the coastal communities in Madang province. It was establish in 2009, initially focusing on the protection and management of leatherback turtles. However, MAKATA has expanded its awareness programs into other aspects of marine conservation and resource management that includes climate change for schools and communities. It is also worthy to note that MAKATA is extensively educating communities in other livelihood issues such as; Eco tourism, small business development, financial literacy etc.

The Nature Conservancy (TNC) is a US based conservation NGO working in many parts of the world including Papua New Guinea. Since 1993 TNC has been working in Kimbe bay to develop a MPA network that is resilient to the threats of climate change and is currently replicating its lessons from Kimbe Ridges to Reef Program in Manus Province. The public education and awareness for TNC marine programs have mainly been site based, and have mainly been for specific target audiences who have common interest in the program.

Seaweb is a communications/ media organisation focusing on marine conservation. It is a US based organisation with its PNG office in operation since 2003. The organisation aims to provide communications training to organisations and personnel involved in information dissemination to effectively educate communities and the general public on marine resource protection and management in order to compel community/public action. Its programs include; sea series program for journalist to help them understand critical marine issues and are able to report accurately in the media. It also conducts communications training for communications officers in conservation organisations. Their community engagement programs comprise marine education and communications training for community based organisations. These CBO's are tasked to conduct the awareness to schools and communities.

The organisations above were consulted in order to develop this report. Details of the public awareness programs conducted by these organisations will be provided in the next section which looks at programs implemented in PNG.

3. Conservation Awareness Programs in PNG

Programs

Marine conservation and resource management awareness organisations have developed a number of education programs that targets different groups with the geographical areas they work in. The programs include;

a) **School programs** - A number of marine conservation resource materials were developed for schools in PNG. The materials were posters and booklets were delivered to the Curriculum Development Division (CDD) of the National Department of Education as learning and teaching resource for students and teachers. This was relevant in the marine unit of making a living subject in primary schools under the outcome based education system.

b) Other structured marine education program for schools included; the Marine Environment Education Program conducted for grade 9, 10 and 12 students through an application process. This program was conducted over a period of 13 weeks. Additionally, formal in-service training for teachers is also provided to complement the curriculum in assisting them to teach the marine unit effectively.

c) School visitation in the areas they work in, is one of the core programs of many organisations involved in public awareness. The frequency of visits depends greatly on funding. Otherwise, most have indicated that this is an annual activity, due to the logistics and complications to access remote schools. In such circumstances, organisations maximise the school visits by extending the invitation to villagers to participate with students and teachers.

d) **Community programs** - Community awareness programs covers rural communities in educating them about the marine environment and sustainable fishing practices. One important component for this group is resource management which includes; benefits of resource management and the process involved for managing these resources.

e) An effective process many of these organisations have taken is training youths from communities to conduct community awareness in these communities using the local vernacular and in a culturally appropriate manner.

f) **Media development program** - Another medium of communication and dissemination of information is the use of the media. While journalists in mainstream media have the reporting skills, on the other hand they lack the content knowledge to confidently report on environmental issues. Consequently, they are given resource information by marine experts; this then is reported in print and electronic media to reach Papua New Guinea on a larger scale.

g) Communications officers from conservation organisations are given training to deliver message in a way that will compel communities to take action.

4. Target groups

The groups that the public awareness reaches include; schools, communities, journalists, communications personnel of conservation organisations, partner organisations, donors and the rest of PNG through the

media, school curriculum, internet, brochure and awareness visits conducted by public awareness organisations.

5. Geographical areas covered

Province	*Areas*	*Target groups*	*Other areas*	*Organisation*
Manus	North Coast	General Population		TNC, Seaweb, PNGCLMA
	South Coast	General population		
	Inland	General population		
New Ireland	Tikana LLG	General Population		Ailan Awareness, TNC,PNGCLMA
	Lovongai	General Population		
	Kavieng urban	General Population		
West New Britain	Kimbe Bay	General Population	School groups from Bougainville, Madang, Goroka, Tabubil, Port Moresby, Rabaul	MND, TNC, PNGCLMA
	Bialla	General Population		
Port Moresby	NCD	Journalist and other stakeholders		TNC, PNGCLMA, Seaweb
Madang	Rai Coast	General Population		MAKATA, TNC,PNGCLMA
	North coast	General Population		
	Bogia	General Population		
	Manam	General Population		
	Long Island	General Population		
	Karkar Island	General Population		

	Bagabag island	General Population		

Note: General Population covers men, women and children.

6. Topics covered

a) **Work of organisations** - Many people, especially from rural communities have a perception that organisations are there to tell them what to do with their resources and handout money. Therefore it is important that organisations inform communities of the work they do.

b) **Marine ecosystems** - This topic covers; all marine ecosystems that include; their importance, benefits to people, life it supports, threats and way of managing these ecosystems sustainably. This also covers discouraging of unsustainable fishing practices.

c) **Resource management**- Marine resource management educates communities on the benefits of managing their marine resource and

d) the process involved in setting up LMMA. LMMA approach involves sharing & learning among member communities.

e) **Marine Law & community rights** – This covers the law that governs the sea. Communities are taught their rights within the marine zone under their jurisdiction. It also helps them understand the zone under provincial and national government jurisdiction.

f) **Endangered marine species** – Supported by scientific data, the awareness highlights marine animals that are endangered.

g) **Climate change** (sea level rise/erosion, food security) – Currently the issue of discussion at the international level, climate change awareness is included in community awareness. It enables communities to identify and the impacts of climate change in their surroundings. Climate change mitigation and adaptation awareness is vital and is now becoming an awareness topic of discussion with target groups.

h) **Impacts of land based activities** – The resource boom in PNG is increasing and communities are educated about the impacts of these large scale developments. Additionally, they are educated on the impacts of prolonged small scale land use such as continuous cultivation of an area of land.

i) **Waste management** – Waste management is a growing problem in many communities. Under this category they are taught how to manage waste; such as food peeling can be put into the soil, holes dug to dispose other non-bio degradable waste. This typically educates them to reduce waste being dumped into the ocean. Other issues discussed are the waste generated by large scale developments and where their waste should be disposed.

j) **Live Reef Food Fish Trade (LRFFT)** – The LRFFT was banned in a couple of provinces because of the rapid loss of the grouper harvested to supply the Asian fish market. The concept encourages unsustainable harvesting of the grouper species and impacts it has on the coral reef ecosystem. This topic discourages communities to consider this concept because of the negative consequences.

k) **Coral Triangle Initiative** – This topic educates the public on this region and biodiversity it contains. They are taught the significance of PNGs geographical location in this region. It educates them on what action PNG is taking to protect its area in this region.

7. Frequency of awareness

The school programs for students, teachers and journalists are an annual event either through the curriculum or awareness conducted by these organisations. For communities it is a series of awareness education depending on funding or project life span and or request from communities' as continuous awareness will eventually result in LMMAs.

8. Number of people reached

While there are no definite statistics to indicate the exact number of people reached through awareness program conducted in the last 15 years, it is genuine to say that public awareness programs throughout the country would have reached at least 40% of the population.

This is based on proportion of PNG population spread in the 4 regions. The estimated 40% reached includes schools and communities in coastal provinces and mainly schools in the highlands, via the school curriculum, newspaper, radio, television, posters, brochures and awareness visits conducted education awareness organisations.

There is also no account of people reached as the awareness is also accessed via the internet on face book, organisation websites, twitter etc.

9. Methods of dissemination

Organisations face the challenge of packaging information in a way that will compel groups to take practical actions in managing their environment. The following have been developed by public awareness organisations to disseminate information through; Radio programs, Puppet shows, Posters, Billboards, Video documentaries, Pamphlets, Newspaper articles, Lectures, Drama, Informal gathering, Social networks on the internet, Peer discussions, Formal gathering and the School curriculum

10. Issues arising from audience during awareness

The awareness session provides a forum for groups to discuss other issues relating to conservation and resource management. Some of the issues raised were around;

a) **The use of small size fishing nets** – One of the unsustainable fishing practices is the use of half inch net that indiscriminately catches adults and juvenile. As a result there are no juvenile that will grow to maturity to reproduce more. The question was how we stop this altogether when people can easily buy them in shops.

b) **Misunderstanding of the work of PA organisations** - Communities do not trust organisations. The coordination among PA organisations have resulted in mixed feeling among communities about the work of PA organisations. There have been situations when 2 organisations conduct the same activities in the same areas. While communities appreciate the assistance of such organisations, there has to be awareness on the demarcations of roles of these organisations to reduce mistrust and false expectations in communities.

c) **Issues of alternative income generation and food source –** The sea is source of food and income for many communities. While conservation benefits the environment many communities are concerned of the impact conservation especially MPA, will have on their livelihood. The resource management role coordinated by PNGCLMA tries to simultaneously address this issue to benefit both the environment and livelihoods.

d) **Population pressure** – Many people are highlighting the need to control population growth. While conservation organisation are concerned the rapid population increase as one of the major difficulties in promoting marine protection, it has no options and or suggestions to controlling population growth.

e) **Need for more education in other social issues that impact the environment** – The awareness also provides an opportunity for open discussions in other cross cutting issues affecting the communities. Although we are marine focused, public awareness staff share what they know about these issues, however other groups focusing on other cross cutting issues can assist by educating our staff of these issues or alternatively accompany our staff on some awareness visits to communities.

f) **Frequency of awareness visits is irregular/inconsistent** – Inconsistency in public awareness visits has a huge impact on the loss of community trust and interest. Staff of Public awareness groups at time are physically harassed or verbally abused by communities.

11. Results of Awareness Programs

Public Education and Awareness (PEA) programs have impacted the work of marine resource management in Papua New Guinea and the results are quite notable in the Status of the Coral Triangle Report (SCTR).

This report highlights nine key results have been identified, which include:

a) Communities agree to set aside management area– The decision to set aside management areas is made by the community. A series of awareness mainly gives this result as people are educated about the benefits of resource management and impacts of continuous unsustainable fishing practices compounded by the rapid population increase. Below is a table depicting the current management areas in PNG.

	Organisation	Management Area	Province	Plans for future management areas
1.	The Nature Conservancy	Hoskins – Wulai	West New Britain	
		Lolobau		

		Numondo		
		Bialla		
		Kaiamu/Sulu		
		Tarobi		
		Kapiura		
		Baia		
2.	PNGCLMA	Kimbe Bay Area: Patanga, Pasiloke and Kilu/Tamare	West New Britain	Noau (Biala – WNB)
	PNGCLMA	Amgoreng(Kandrian District)	West New Britain	
	PNGCLMA	M'Buke	Manus	Liap (Manus)
				N'Drolokou(Manus)
				Koroji (Manus)
				Pere (Manus)
				N'Drakot (Manus)
				Andra (Manus)
	PNGCLMA	Salapiu	New Ireland Province	Salapiu (NIP)
				Ungakum (NIP)
				Patitap(NIP)
				Lavongai (NIP)
	PNGCLMA	Simbine	Madang	
		Tavulte	Madang	

	PNGCLMA	Joyce Bay	NCD	
3	Mas Kagin Tapani	Karkum	Madang	Tokains (Madang)
		Magumben	Madang	Yadigam (Madang)
		Kimadi	Madang	Mirap (Madang)

b) **Communities make good informed decisions (LRFFT) against unsustainable fisheries** - Provinces that had the LRFFT have ceased the practice due to is impacts highlighted in the awareness programs. Because of this the LRFFT was not successful in opening new operations in new locations such as Kimbe after closing operations in places like New Ireland.

c) **People are empowered to challenge large scale development and its impact on their environment** – Large scale development negotiations with communities are now arduous, compared to 10 years ago. Many communities know their rights, understand the impacts of development activities on their marine environment and can be vocal when things are not correctly done within the confines of safe and responsible environmental management. People are able to challenge the government and developers and make sound decisions to protect their environment and livelihood.

d) **Change of mindsets, attitudes towards unsustainable fishing practices -** PEA has also enabled change of attitudes and mindset of communities towards unsustainable fishing practices.

e) **Local conservation champions who are providing education to communities** – Public awareness has also motivated local conservation champions such as members of Community Educators Network (CEN) in Manus and HOBITA in Kimbe Bay who are now providing education awareness to communities. These individuals are locals who speak the local vernacular, understand local marine resource management issues in the communities and are able to provide education awareness in a culturally appropriate manner.

f) **Development of LLG marine laws** - One successful result in the local level government is that public awareness programs have identified the need to develop LLG marine laws to assist communities specifically in enforcing marine management in their sites. Talasea, Hoskins and Bialla LLGs in WNBP and Nali Sopat Penabu LLG in Manus has marine laws developed.

g) **Build collaborative partnerships with government of PNG through DEC, NFA and provincial agencies –** There is now some progress on collaborative partnership with the government of PNG through DEC, NFA and provincial agencies. The Coral Triangle Initiative is an indication of the collaboration developed and strengthened in due course as we work together to conserve and manage our marine environment.

h) **Student impact** - Students who were exposed to marine education and awareness went into professions that protected environments. Others are employed by organisations that promote environment protection. Others are motivated to take up the challenge of changing mindsets in organisations that make profits at the expense of the environment. Regardless of profession and employer organisations, environment protection and management crosses all professional boundaries'.

i) **Addressing gender issues in empowering women to take leading roles in conservation efforts in their localities -** Another key result has been the involvement of women taking leading roles in conservation efforts in their localities. Communities in matrilineal societies have women at the forefront of marine conservation and resource management such as the case in Bialla. Manus has women in conservation network that educates women to educate the female population at large in Manus Province.

12. Constraints

In any project, there are always constraints which need to be addressed in order for the smooth running of these activities.

The public awareness programs for marine conservation and resource management have identified seven major constrains as follows:

a) **Effective enforcement of marine guidelines/laws in the LMMA management plans** - Managing marine resources is challenging especially with enforcement issues and one of the constraints has been marine guidelines and laws which haven't been clearly outlined for its implementation.

b) Currently the communities are using their own enforcement penalties which are not so effective.

c) **Lacking capacity to educate communities on other social issues impacting the environment** - Managing marine conservation always has social impacts which the Public Awareness teams need to be properly educated in other social issues in order to deliver the right messages.

d) **Lack of communication skills among officers/staff of PA organisations –** While many staff has the marine knowledge, communication skills is often a problem when deciding on how to make the message simple and compelling to move people to take action. This may be a major hindrance to community action.

e) **Lacking technical/scientific expertise to provide questions from the community** - Another constraint is the lack of technical/scientific expertise to provide questions from the community and most often the officers or staff of public awareness organisations may lack the scientific evidence to support the knowledge they already have.

f) **Funding** - Funding is an important component for any education and awareness programs and it is the main constraint that has limited these activities to certain communities only, and often the awareness frequency reduces and for other organisations absence of awareness is a reality they deal with.

g) **Logistical problems such as transport, communications.** – The high cost of transport and communications often make it difficult for the teams carrying out awareness programs to reach furthest areas. These remote areas essentially require this kind of education and awareness.Often this is related to lack of funding that hinders regular awareness.

h) **Lack of coordination between all stakeholders in program implementation and administration -** The work of public education and awareness cannot be done in isolation. The lack of coordination among stakeholders hinders the effective progress of public awareness on marine conservation and resource management, and therefore all stakeholders need to work in collaboration to gain the support of all parties in the implementation and administration of these programs

13. Lessons Learnt

a) Regular monitoring to obtain statistics/number of people reached – Currently there is no records depicting the number of people reached. As a result we have little/no data to know the number of people reached.

b) **Develop monitoring and evaluation checklist** – All PA organisations must have monitoring and evaluation framework in place to ensure effective public awareness programs

c) Need for more coordination amongst Public Awareness organisations – Many organisations are doing awareness in the same location needs to be coordinated. The chances of different information disseminated and interpreted by people is cause for confusion in the community.

d) **PA officers must be equipped with knowledge to disseminate information –** Public awareness staff must go through a marine education course to obtain knowledge about; marine ecosystems, impacts of land based activities, marine protected areas, resource management, climate change, marine law and community rights etc..

e) **PA officers must be trained communications skills to disseminate information –** Apart from marine knowledge obtained, public awareness staff must have communications training. The training will enable effective awareness dissemination to communities and other stakeholders.

f) **PA officers need to take approach that are culturally appropriate for communities** – Many public awareness organisations are now using local youths to conduct awareness to the communities using the local vernacular. This allows for communities to be comfortable to ask questions and discuss issues during the awareness sessions.

g) **PA officers need to involve media organisations to cover conservation related issues/stories** – Public awareness organisations are using different media modes to promote consistent awareness to other sections of the community that are not covered in the awareness program such groups will include urban residents.

h) **Media need to cover more conservation/resource management** – There is also a need for media to feature conservation and resource management accounts for PNG as a whole. The features are also awareness for other areas in PNG that do not have access to awareness conducted by PA organisations.

i) **Sustainable funding** – Inconsistent and or lack of public awareness is often hindered by lack of funding. The realities of project implementation in PNG are a concern for many of the PA organisations. Sourcing funds is always a challenging undertaking for these organisations

14. Way Forward

a) Coordination of PA through the LTN – A coordinating group or LTN must coordinate PA. A workshop for all PA organisations must be organised to bring together organisations involved in PA. This workshop will also include partner organisations that can be utilised as trainers to build the capacity of PA organisations. Some of the agenda must include; work of each organisation, programs, methods used, weaknesses, information packaging etc...It must be interactive to maximise the limited time available where everyone is together due to the location of these organisations.

b) Coordinated capacity building of PA officers – A group to be set up or using the LTN as the body to coordinate building the capacity of PA officers in information and communications skills using partners who are experts and or competent in these areas to provide the training.

c) Development of a database on information related to marine conservation and resource management – A coordinating group or LTN is given the mandate to develop a database on information related to marine conservation and resource management.

d) Collaborate with other government departments and agencies to ensure coordinated efforts on public awareness implementation – Conservation and resource management overlaps with other cross cutting issues that affect communities. It is therefore vital that other government departments such as; Agriculture and Livestock, Commerce and Industry, Information, PNG ports to name a few be engaged to promote resource management and sustainable livelihood.

e) Develop a system to determine the number of people reached – Through a coordinating group or LTN a system to determine the number people of reached must be developed to collect data on this.

f) PA must be a regular component of conservation and resource management activities – Public awareness compels action; therefore it must be regularly conducted to maintain interest, stimulated discussions, empower people and thrust them into action. The PA organisations must be fully resourced to implement regular public awareness

g) All PA organisations fully understand the PNG marine program strategic plan and the CTI structure to identify a link for PA – All PA organisations be given copies of the PNG marine program strategic plan and the CTI structure. Having knowledge of the PNG marine program will assist them to align their programs and funding to the objectives and goals of the PNG marine program.

h) Strategic awareness needs to be developed – Organisation must develop a process to engage with communities. This process entails community entry, regular awareness sessions and community action. Additionally, PA organisations need to strategically engage with the other sectors to provide awareness discussions and eventual change of mindsets.

i) The need to up skill the knowledge content of PA staff on all cross cutting issues and other issues effective for resource management – A coordinating group or LTN must work with other partners outside the conservation movement to provide training for PA staff on other cross cutting issues that will impact the marine environment. This will assist them to educate and facilitate discussions with communities about these issues which includes; HIV/AIDS, domestic violence, drug abuse etc..

j) Funding – Funding must be readily available for public awareness organisations within the marine program of the CTI. It's no use developing policies and action plans at the national level if the major stakeholders (communities and people of PNG) are not adequately educated about the marine environment. Sufficient education about the marine environment compels community action, promotes local enforcement, protects the marine environment and sustains livelihood of Papua New Guineans.

VII. OTHER MANAGEMENT ISSUES

A. Capacity Building

The required capacity of the agencies and partners involved in the implementation of the CTI five goals and the National Plan of Action for PNG, nationally known as the PNG Marine Program is key to the effective and timely implementation of the program. The current capacity of some key agencies are lacking in a number of areas. DEC, NFA and OCCD are the focal government agencies in the implementation of the program with other implementing partners under the direction and guidance of the National coordinating committee.

National Coordination Committee – The National Coordination Committee, established through a NEC decision is the coordinating unit in the implementation of the PNG Marine Program. NCC members are from the government line agencies. Initially NGOs were not on the NCC, however they have now been included and have been participating in nearly all of the recent meetings held between 2010 and 2011.

DEC – In early 2010, DEC established a CTI desk and several staff were assigned to implement the program. At present there are four staff in the marine program responsible for the implementation of the PNG Marine Program. They include an Executive Manager, MPA manager, and two support staff. (Check with Vagi)

NFA – is the lead agency in the implementation of the second EAFM goal. NFA have yet to clarify to all other stakeholders capacity issue in relation to the implementation of the 2nd CTI goal.

OCCD- is the lead agency in the implementation of the 4th goal on Climate change and Adaptation Measures. At present, it is not very clear how OCCD will address the capacity issue in relation to the implementation of the 4th CTI goal.

Other implementing partners – civil society organisations, provincial governments, local level governments and local communities are the other implementing partners of the PNG Marine Program through the various programs they deliver including LMMA programs in the respective localities they work in.

Amongst these implementing partners, civil society organisations seem to have the required capacity for implementing their programs. Provincial and Local Level Governments still lack the required capacity for such programs, however with more and more training programs offered by civil society organisations, this is likely to improve. Provincial and local level governments also need to support this capacity needs through the necessary legal and governance frameworks that would deliver the program. (PNG Marine Program)

Table . Roles and responsibilities of NCC, DEC, NFA and NGOs/provinces. The table below has been developed to help determine the role and responsibilities of the various organisations and bodies who are key in the implementation of the PNG Marine program

Organisation/Body	Role	Responsibility	Status
NCC	Coordinating	Decision making, Providing advice, Review and approve, endorse	Regular meetings in 2011. No meetings yet in 2012.
DEC	Secretariat	Coordinating, organising, providing advice on	

	Focal point for CTI Lead in Goal 1, 3 and 5	overall program implementation, convener of all CTI related matters Funding	
NFA	Secretariat for Technical Working group Lead in Goal 2	Providing technical advice and expertise Inform the NCC on technical matters related to the implementation of five CTI goals Inform the NCC on implementation of Goal 2 funding	
OCCD	Lead in Goal 4	Provide advice on implementation of Goal 4. Inform the NCC on implementation of goal 4 Funding	
Provincial Governments	Implementor at province level	Administration role at provincial level Inform and advice on needs identified at provincial level Funding	
Local Level Government	Implementor at LLG level	Administration at local level Link to the local communities Funding	
Civil Society Organisation	Implementor	Facilitators Training providers	

Reference – PNG Marine Program Strategic Plan

Training needs to implement the program

Training and capacity needs are ongoing challenges that have been identified in the past and continue to be an issue that need to be addressed for successful marine resource management. In 2001 NGO's and other stakeholders convened a workshop that looked at fostering collaboration to meet conservation capacity needs. The Strengthening Conservation Capacity Project (SCCP) and the production of 8 training modules by SCCP is a direct result of that workshop. A similar workshop at the March Girls in October 2010 aimed at improving conservation and resource management, identified capacity and training needed to be improved for conservation and resource management practitioners. The formation of the PNG Learning and Training network is a major outcome of that workshop. The capacity and training needs in the development and management of the fishing industry has been addressed by the Training Needs Assessment conducted by National Fisheries College and National Fisheries Authority in 2006 and again in 2011. (Copied from EAFM training needs assessment, Lokani and)

At present the role of training to implement marine resource conservation and management is an important aspect that is being addressed by Civil Society Organisations. Many of these organisations are shifting their focus from working with communities and partners to do resource management to that of providing training. Members from Local coastal communities have participated in a range of trainings related to resource management and conservation in the areas of community engagement to development management plans, community biological monitoring, conflict resolution and management, ecosystem approach to fisheries management, socio economics survey, mangrove rehabilitation and management and many others.

As communities get more organised they are able to identify the kinds of trainings they need to ensure effective management of their resources through the concepts of LMMA and other management forms.

In the move to improve service delivery by the government, training needs assessments have also been conducted which in the way forward to inform on what are really the trainings needs by resource management organizations at all levels.

The move to establish a PNG Learning and Training Network is a move to ensure conservation and resource management practitioners are collaborating and are working and moving together and have the necessary capacity required.

Identify current capacity shortfalls/gaps

- Leadership – Strong and visionary leadership at all levels, community, local, provincial and national, is key in the effective management and implementation of any program, and the PNG Marine Program is no exception. Our experience is that in areas where there are dedicated and committed leaders the program has been embraced and has made good progress.
- Managers – Effective managers who have the drive and energy to lead effective teams on the ground are important in delivering their organisational programs. Our experience shows that there has been a high turnover in management positions in all sectors. It is important however, to note that more and more women have taken up management positions in conservation and resource management related organisations, particularly in the civil sector. Half of the authors of this report are managers of government agencies and civil society organisations. It is hoped that the PNGLTN will also address among many issues peer learning amongst the managers of organisations involved in implementing the PNG Marine Program.
- Technical Expertise – Having the technical expertise in any organisation enables organisational credibility, reliability and trust. Organisations with the relevant technical advice can be relied upon and are trusted for longterm collaborations and partnerships. Our experience is that while there are technical experts in their respective fields, time management and busy schedules has prevented them from fully participating in collaborative efforts related to conservation and resource management. The writing phase of this report resulted in PNG being the last country to complete its first draft mainly because the technical expertise were not able to make that commitment and timing.

B. Human resource/capacity development

- (Australian Govt. support for in-country marine resource management capacity; CTSP)
- UPNG – Offers degree programs in Bachelor of Sciences as formal learning in the School of Physical and Natural Sciences. Governments officers and staff of civil society organisations in the field of marine science are mostly graduates from this school at UPNG. Since 2008, UPNG has also been offering informal courses in Strengthening Conservation Capacity Program, which was designed mainly to address the gaps in the conservation and resource management arena. However, this program is seen to heavily lean towards terrestrial program.
- Unitech – Offers diploma and degree programs in Fisheries Science. Many of these graduates now hold senior positions in key government agencies, and also the Civil Society.
- UNRE – Offers degree programs natural resource management.
- NFC – The National Fisheries College in New Ireland province offers certificate courses related to fisheries development in the country. The courses are offered on short term and long term basis.

- Private Institutions – Some private institutions offer certificate and diploma courses related to conservation and resource management. Some offer scholarships to build technical expertise especially in the areas of research.
- Civil Society organisations trainings – Trainings and workshops offered by the Civil Society Organisations are free and have actually reached a large number of people at one time. Often the organisations award a certificate of participation to motivate and encourage the participants for their time, dedication and commitment. It is hoped that some of the trainings being offered at present by these organisations will now be tailored and offered as certificate courses in some of the institutions mentioned above. These include the EAFM course and others.

VIII. REFERENCES

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