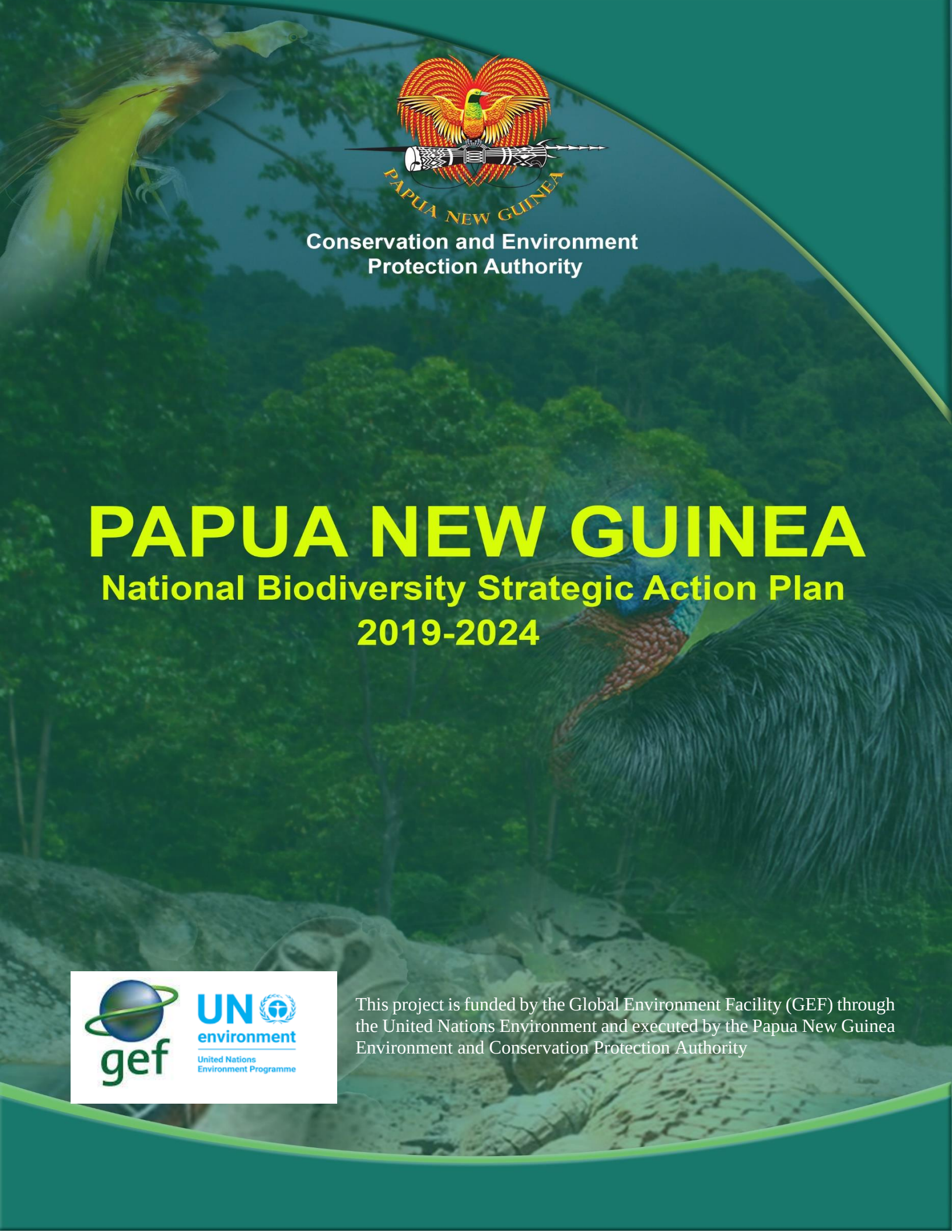


Conservation and Environment Protection Authority

PAPUA NEW GUINEA

National Biodiversity Strategic Action Plan 2019-2024

This project is funded by the Global Environment Facility (GEF) through the United Nations Environment and executed by the Papua New Guinea Environment and Conservation Protection Authority

For More information Contact;

Conservation & Environment Protection Authority
P.O Box 6601
Waigani
National Capital District
Papua New Guinea

Telephone: + (675) 3014500 /3014530
Facsimile: + (675) 3238371/3250182
Website: www.pngcepa.com

Prepared By: John Aruga (Lead Consultant), Job Opu, Michael Bongro and Carolyn Kumul
Contributions: CEPA Officers, Conservation NGOs, Conservation CBOs, Research Institutions, Academic Institutions, Provincial Governments
Cover page Designer: Nicho Gowep

Published by Stephens Printing, Port Moresby Papua New Guinea, 2020

PREAMBLE BY THE PRIME MINISTER

The Papua New Guinea National Biodiversity Strategy and Action Plan (NBSAP) fulfils in part, commitments PNG made under the Convention of Biological Diversity (CBD). It takes up the challenge of ever-increasing threat and decline of our very diverse and unique biodiversity, many of which are found nowhere else in world. Since Papua New Guinea was first settled almost 10,000 years ago, as demonstrated by the Kuk Heritage Site, its unique biodiversity has been continuously under threat, from the destruction of habitat, harvest by growing rural populations, and successive waves of erosion of biodiversity through introduction of pests, weeds and diseases. The actions of PNG's growing rural population has been by far the second largest threat responsible for growing retreat in its unique biodiversity. The actions of PNG's rural subsistence population have over thousands of years resulted in extinctions of some of our unique biodiversity and the growing threats to our unique biodiversity continues unabated today, through ever evolving forms of change.

Today, Papua New Guinea's native animals, plants, and other forms of life are under threat. Papua New Guinea boasts of being among the few mega diverse countries of world, however the State of the Forests of Papua New Guinea according to the Greenpeace report 2012 signalled a growing threat in the fast decline in PNG's primary forests and subsequent decline of native biodiversity as our '*most pervasive environmental issue'.* This growing threat continues unabated today!

Papua New Guinea first pledged to play its part in turning the tide in the decline of our unique biodiversity at the Rio Earth Summit in 1992. There, among the global community, we affirmed that biodiversity is vital to sustaining life, and offers us a unique basis protecting our equally diverse culture and languages that give us the edge in declaring ours as truly, a country of diversity. Our biodiversity plays a vital part in our culture and national identity. Our pledge to recognise biodiversity as being vital to sustaining life at the Rio Summit in 1992 has charted the roadmap to preserving PNG's biodiversity. The PNG NBSAP 2007 reaffirmed this commitment and thus charted our way forward.

The PNG 2007 NBSAP articulated our national goals to 'turn the tide' on the growing decline of our biodiversity, and to maintain and restore a full range of our remaining natural habitats and ecosystem through protected area systems and thus ensuring the survival and existence of viable populations of all native species. The 2007 NBSAP charted our way forward with a comprehensive range of actions that we needed to initiate or improve progress on, to achieve our 1992 pledge and other Multilateral Environment Agreements (MEAs) that PNG signed following Rio.

Today, nearly 97% of our land area and marine environments, remain under customary ownership largely due to our unique land tenure system. This poses huge challenges to PNG. In 1993 PNG pledged to assign 5% of its land area under protected area systems and to date we have not reached that target. Much of our land and marine environment remain outside protected areas. We need to manage our working relations with traditional landowners, we need to articulate our national and sectoral policies to accommodate traditional landowners, we need to 'fine tune' our community entry and community participatory approaches, we need to articulate innovative incentive schemes for traditional landowners to 'free' up land and marine environments for protected area systems. Policies addressing incentive schemes may be a forward for PNG to achieve its CBD targets. Several community-based conservation projects in PNG have demonstrated that conservation outcomes are achievable.

The PNG 2007 NBSAP has set the roadmap to achieving these broad range of actions. As a country, we have learned our lessons. We need to review the 2007 roadmap and set goals and targets that are achievable. Today's NBSAP (2020) should be a 'living' evolving document that accommodates the changing forms and conditions of the environment.

Biodiversity plays a myriad of significant roles in our lives, it extends to everyone's backyards in the towns and cities, into our villages and into our far-flung remote islands and into our remote high-altitude misty highland valleys and alpine communities. Biodiversity plays a vital role in sustaining our livelihoods, our languages and our culture. We depend on our biodiversity to sustain our daily livelihoods. The diverse languages and cultures set us apart from the rest of the world. Our unique traditional songs and dances and the traditional head-dress and costumes that we wear, epitomises the uniqueness of our culture and tradition and above all, this uniqueness is a manifestation of biodiversity at its best.

As the PNG 2019-2024 NBSAP charts our way forward, and recognising the multiple roles, biodiversity plays in PNG, it makes sense to adopt the theme '*biodiversity is everyone's business'* in Papua New Guinea as the roadmap and driver of the 2019 NBSAP today and beyond.

Rt.Hon. James Marape
Prime Minister of Papua New Guinea

FORWARD

Papua New Guinea has a commitment to protecting the global environment for the wellbeing of its population and its global community at large. This is demonstrated in public declarations and commitments at the regional and international forums and is party to a number of environmental conventions, treaties and protocols, most notably, the three United Nations Conventions which are; the United Nations Convention on Biodiversity (UNCBD), the United Nations Convention to Combat Desertification (UNCCD) and United Nations Framework Convention on Climate Change (UNFCCC). The ratification of these conventions signifies PNG's commitment to protecting the already threatened global environment from further degradation.

This National Biodiversity Strategy and Action Plan (NBSAP), demonstrates Papua New Guinea's commitment to the implementation of Decision X/2 of the Tenth Conference of Parties (COP10) of the Convention on Biological Diversity (CBD), which requested parties to revise their strategies in line with the Global Strategic Plan for Biodiversity 2011-2020.

The NBSAP is closely linked to the Papua New Guinea's 40-year Development Strategic Plan (2010-2050), the Vision 2050. This Plan sets in motion pathways for delivery on the National Goals and Directive Principles of the Constitution which states that, *"The Natural Resources and the Environment of Papua New Guinea should be conserved and used for the collective benefit of the people and should be replenished in the interest of future generations".* The Vision 2050 aims to maximize the benefits from natural resource while ensuring sustainable management of the environment. The Vision 2050 is complemented by other strategic planning documents such as the PNG Development Strategic Plan (2010-2030) and the Medium-Term Development Plan (2011-2015).

The NBSAP is also a guiding policy framework for provincial and district authorities, civil society and the private sector in their approaches to biodiversity conservation and ecosystems management. The success of implementing the Strategy involves close coordination among the key departments and agencies of government concerned in biodiversity conservation and natural resource management, relevant economic sectors of the government, and with the private sector. It also involves updating of current programmes and setting priorities for programming and funding.

I am optimistic that necessary mechanisms and instructions will be developed to improve coordination between Government agencies as well as private and non-government organisations to appreciate this Strategy and implement the Action Plans. I am also confident that adequate support will be solicited to sustain the efforts contained herein and above all, its implementation.

Hon. Wera Mori, MP
Minister for Environment and Climate Change

ACKOWLDGEMENT

The Government of Papua New Guinea through the Ministry and the Department of Environment and Conservation wishes to thank all representatives in key national and provincial Government agencies, the private sector, research and training institutions, Non-Government Organisations (NGOs) both national and international, who have assisted in the production of this report

The Conservation & Environment Protection Authority also wishes to acknowledge the Global Environment Facility (GEF) for funding the National Biodiversity Strategy and Action Plan (NBSAP) Project, and the United Nations Environment (UNE) for its advice and support towards the production of this Strategy and Action Plan for biodiversity conservation.

Sincere appreciation also to the individuals who were consulted and contributed in producing the National Biodiversity Strategy and Action Plan.

Finally, the staff of Conservation and Environment Protection Authority provided invaluable input into the assessment process and played a leading role in organising and supporting the consultation activities.

Thank you

GUNTHER Joku
Managing Director
Conservation and Environment Protection Authority

TABLE OF CONTENTS

LIST OF FIGURES AND TABLES

LIST OF ACRONYMS AND ABBREVIATIONS

ABS	Access Benefit Sharing
ADB	Asian Development Bank
CA	Conservation Areas
CBD	Convention on Biological Diversity
CCDA	Climate Change Development Authority
CEPA	Conservation & Environment Protection Authority
CHM	Clearing House Mechanism
CR	Critically Endangered
CTI	Coral Triangle Initiative
DAL	Department of Agriculture and Livestock
DD	Data Deficient
DEC	Department of Environment and Climate Change
DLPP	Department of Lands and Physical Planning
DPLLGA	Department of Provincial and Local Level Government Agency
E	Endangered
EIA	Environment Impact Assessment
EIS	Environment Impact Statement
EN	Endangered
EU	European Union
EX	Extinction
FAO	Food and Agriculture Organization of the United Nations
GEF	Global Environment Facility
GMOs	Genetically Modified Organisms

HDI	Human Development Index
IPCC	Intergovernmental Panel on Climate Change
IPR	Intellectual Property Rights
IUCN	International Union for Conservation of Nature
JICA	Japanese International Corporation Agency
LC	Least Concern
LMOs	Living Modified Organisms
LNG	Liquefied Natural Gas
MTDP	Medium-Term Development Plan
NARI	National Agriculture and Research Institute
NBSAP	National Biodiversity Strategy & Action Plan
NFA	National Fisheries Authority
NGI	New Guinea Islands
NGO	Non-Government Organisation
NT	Near Threatened
PAs	Protected Areas
PES	Payment for Ecosystem Services
PNG	Papua New Guinea
PNGFA	Papua New Guinea Forest Authority
PNGLCoP	Papua New Guinea Logging Code of Practice
RPF	Resettlement Policy Framework
TAC	Total Allowable Catch
TPA	Tourism Promotion Authority
TSDP	Tourism Sector Development Project
UNFCCC	United Nations Framework Convention on Climate Change

VOP	Village Oil Palm
VU	Vulnerable
WMAs	Wildlife Management Areas
WCS	Wildlife Conservation Society
WWF	World Wildlife Fund

1.0 EXECUTIVE SUMMARY

The National Biodiversity Strategy and Action Plan (NBSAP) 2019-2024 is Papua New Guinea's roadmap to conserve its rich biodiversity and serves as a guide in achieving the country's development agenda in the next two decades.

The NBSAP is closely linked to the Papua New Guinea's 40-year Development Strategic Plan (2010-2050), the Vision 2050. This Plan sets in motion pathways for delivery on the National Goals and Directive Principles of the Constitution which states that, *"The Natural Resources and the Environment of Papua New Guinea should be conserved and used for the collective benefit of the people and should be replenished in the interest of future generations".* The Vision 2050 aims to maximize the benefits from natural resource while ensuring sustainable management of the environment. The Vision 2050 is complemented by other strategic planning documents such as the PNG Development Strategic Plan (2010-2030) and the Medium-Term Development Plan (2018-2022). In addition, this strategy demonstrates Papua New Guinea's commitment to the implementation of Decision X/2 of the Tenth Conference of Parties (COP10) of the Convention on Biological Diversity (CBD), which requested parties to revise their strategies in line with the Global Strategic Plan for Biodiversity 2011-2020.

The NBSAP is also a guiding policy framework for provincial and district authorities, civil society and the private sector in their approaches to biodiversity conservation and ecosystems management. The success of implementing the Strategy involves close coordination among the key departments and agencies of government concerned in biodiversity conservation and natural resource management, relevant economic sectors of the government, and with the private sector. It also involves updating of current programmes and setting priorities for programming and funding.

1.1 PAPUA NEW GUINEA'S DEVELOPMENT VISION

The PNG Vision 2050 is a 20-year vision that reflects the aspirations of the people of Papua New Guinea to create a prosperous and strong nation, and covers three key areas: social capital, infrastructure development and economic development. The Vision 2050 projects Papua New Guinea to have reached the ranks of middle-class-income countries by ending extreme poverty, narrowing the economic gap with the emerging economies of the Association of Southeast Asian Nations (ASEAN) and fostering a democratic and environmentally sustainable society, by 2050.

The PNG Vision 2050 specifically envisions the restoration of a strong bond between the people of Papua New Guinea and their environment and the sustainable use and management of the natural resources and environment for the benefit of its people as enshrined in the 4th Goal and Principles of PNG's Constitution. The environmental sustainability focuses attention on the protection of biodiversity, priority habitats and ecosystems. The NBSAP comes at an opportune time to serve as a roadmap to achieve the environment and sustainability development targets of PNG Vision 2050.

1.2 PAPUA NEW GUINEA AS A MEMBER OF THE GLOBAL COMMUNITY

Papua New Guinea ratified and became a Party to the Convention on Biological Diversity (CBD) on 9th June 1993. As a Party to the CBD, Papua New Guinea has undertaken a national process to develop the NBSAP by engaging all sectors of the country to achieve the objectives of the CBD. The NBSAP uses the ecosystems approach in its efforts towards the maintenance of ecosystem services and functions; provision of food, water, shelter, fuel; restoration of habitat; regulation of climate; sustaining cultural services; and pollination or dispersal of seed sources and banks.

Papua New Guinea envisions its NBSAP as a living revolving process that would set the roadmap towards consolidation of actions and aspirations of its people towards a sustainable future. The NBSAP is a "living" document that compiles national laws, plans, programmes and projects; a biodiversity communication and public awareness strategy; a Clearing House Mechanism (CHM) that will serve as a platform for information and knowledge management on biodiversity to aid in policy decision-making, and a funding plan to conserve and sustainably use the country's rich and diverse biodiversity in an equitable manner.

The NBSAP also outlines Papua New Guinea's strategy to ratify and implement the Nagoya Protocol on Access to Genetic resources and Benefit-Sharing to achieve the third objective of the CBD. Papua New Guinea would need a systematic capacity-building strategy to achieve this, protect its resources and provide benefits to its people.

The NBSAP encompasses six major sections: (i) the context that describes the wealth and threats to biodiversity; (ii) the legal and policy framework that embodies the governance of the biodiversity conservation, (iii) strategy that defines the vision and prioritizes strategic goals; (iv) the national targets and key action plans that focus on key milestones and the plan for addressing issues on biodiversity; (v) the implementation plan, the national targets and the actions envisaged to reach targets and the (vi) is a section that focus on the supporting mechanisms needed to implement the NBSAP agenda to promote biodiversity conservation and sustainable use of the resources.

1.3 IMPORTANCE OF BIODIVERSITY AND NATURAL RESOURCES TO PAPUA NEW GUINEA

Biological diversity or biodiversity is the variety of all life forms. It encompasses three levels of diversity: genetic, species and ecosystems.

Genetic diversity is the variety of genetic information stored in individual plants, animals and micro-organisms. Species diversity embodies the variety among species while ecosystem diversity is the variety of habitats, ecological communities and resilience among ecological processes. The CBD defined biodiversity as thee variability among living organisms such as terrestrial, marine and other aquatic systems.

Biodiversity is constantly evolving. It can be increased by genetic changes and evolutionary processes, or it can be reduced by threats that lead to biodiversity population decline and

extinction. Biodiversity is the life-support system for all human beings. It is the 'storehouse' for food, health, shelter, medicine, fuel, water, clean air, regulates the climate, regulates the resilience of ecosystems and above all sustains the livelihoods of forest-dependent peoples.

Papua New Guinea is largely a rural-based community whose livelihoods are dependent on the natural resources, biodiversity and functioning resilience of its key ecosystems and habitats. Our development priorities to promote extractive industries, forestry, agriculture, fisheries, mining, tourism and subsistence agriculture are often in conflict with biodiversity conservation as these development activities impact on natural resources, often reducing natural ecological resilience of ecosystems, significantly reducing aesthetic values of landscapes, and threatening livelihoods and time-tested social fabrics of rural communities through conflicting land and resource use challenges.

1.4 GLOBALLY SIGNIFICANT BIODIVERSITY OF PAPUA NEW GUINEA

Papua New Guinea is home to a number of globally significant ecosystems and endemic species and is well positioned among the mega diverse countries to be recognized as one of high biodiversity countries. Papua New Guinea has a complex geological history and it has been postulated that tectonic movements associated with the colliding Australian plates have given rise to the current central cordillera effectively dividing the country into southern and northern verdant including the separation of the north coastal ranges giving rise to largely isolated biota and high levels of endemism.

1.5 STATUS AND TRENDS OF BIODIVERSITY IN PAPUA NEW GUINEA

Forest and Mountain Ecosystems -Forest cover has decreased by almost 1.41%, with 362,400 ha of forest lost to deforestation and forest degradation annually, between 1990 and 2002. Primary forest around PNG's Bismarck Archipelago and floodplains across the mainland coastal provinces have been extensively logged, most being converted to grasslands, cropland and secondary forest vegetation. Species lists are consistently being updated through intensified surveys into unknown remote regions of the country.

To date, the species richness of PNG's higher vertebrates number around 1,798 species, comprising of the following higher vertebrates; 352 species of amphibians; 335 species of reptiles, 813 species of birds and 298 species of mammals. The amphibians account for 4.6% of the world's total, reptiles account for 3.3%, birds account for 7.7 % and mammals for 5.5% of the world's" total for higher vertebrates.

Around 4,921 species of PNG's animals and plants are on the IUCN Red List (2018-2), and among the animals include the following; 1 extinct, 19 critically endangered, 47 endangered and 275 vulnerable and the remainder listed Near Threatened (NT), Least Concern (LC) or Data Deficient (DD).

Under current IUCN Red List for plants, 606 species of PNG's plants are listed as Threatened, and include the following; 17 species as Critically Endangered (CR), 20 species as Endangered (EN), 120 species as Vulnerable (VU), the remaining 449 species being listed as NT, DD or LC.

1.6 ECOSYSTEMS IN PAPUA NEW GUINEA

Papua New Guinea has a large land area of 462,840km^2, an extensive coastline covering around 20,197 km, an inshore area of around 40,000km^2 of reefs, sea grass beds and mangroves, an extensive EEZ of 3,120,000km^2, with territorial waters of 355,699km^2 and inshore fishing waters covering 170,596km^2. On the back of a very complex geological history that has been postulated to give rise to the complexity of PNG‟s terrain from the rolling undulating coastal plains and fans to the extremely rugged and mountainous montane peaks that tower over the island at around 4,500m.

To describe ecosystems in PNG is a daunting task given its complexity. However, ecosystems in PNG are best described under the auspices of ecoregions as proposed by WWF. In this context, PNG can be conveniently divided into nine (9) ecoregions (Figure 1), each comprising its own unique assemblage of ecosystems, habitats and species.

1.7 PROTECTED AREAS IN PAPUA NEW GUINEA

Having ratified the CBD in 1993, Papua New Guinea joined the global community in conservation and protection of species through the establishment of Protected Areas. The enabling legal framework for the establishment of protected areas, are the National Parks Act, Fauna (Protection & Control) Act and the Conservation Areas Act. To date most of the protected areas in PNG have been declared under the auspices of Wildlife Management Areas (WMAs), the enabling legislation being Fauna (Protection & Control) Act. To date, the protected areas in Papua New Guinea comprise around 1,897,595 hectares, with WMAs accounting for almost 91% of the areas protected, Conservation Areas (CA) with 4% and the remaining 5% comprising of wildlife sanctuaries, reserves and parks.

2.0 NATIONAL BIODIVERSITY STRATEGY AND ACTION PLAN 2019-2024

The revised NBSAP encompasses five major sections:

(i) the context that describes the wealth and threats to biodiversity
(ii) the legal and policy framework that embodies the governance of the biodiversity conservation
(iii) strategy that defines the vision and prioritizes strategic goals
(iv) the national targets and key action plans that focus on key milestones and the plan for addressing issues on biodiversity
(v) the implementation plan, that highlights lessons learned, challenges ahead and supporting mechanisms needed to implement the NBSAP agenda to promote biodiversity conservation and sustainable use of the resources in the long term

Purpose

Papua New Guinea envisions its NBSAP as a living revolving process that would set the roadmap towards consolidation of actions and aspirations of its people towards a sustainable future. The NBSAP is a 'living' document that compiles national laws, plans, programmes and projects. The NBSAP also outlines Papua New Guinea's strategy to ratify and implement the Nagoya Protocol on Access to Genetic resources and Benefit-Sharing to achieve the third objective of the CBD. Papua New Guinea would need a systematic capacity-building strategy to achieve this, protect its resources and provide benefits to its people.

Vision

"Living in harmony with nature" where "By 2050, biodiversity is valued, conserved, restored and wisely used, maintaining ecosystem services, sustaining a healthy planet and delivering benefits essential for all people."

Objectives:

The mission of this plan are;

- Sustainable development measures developed in all sectors to increase resilience to the impacts of climate change and environmental changes
- Improve understanding on environmental sustainability and climate change with educational awareness on values of biodiversity, and economic opportunities such as carbon trade, payment for ecosystem services, and ecotourism
- Conserve and wisely use our natural resources and environment, language and cultural identity for the collective benefit of the present and future generations
- Effective participation and cooperation with national and international community on environment and climate change agendas.
- Realization, enhancement and establishment of mechanisms for fair and equitable sharing of benefits arising from the utilization of genetic resources

Targets:

The Strategic Plan encompasses 20 National Targets for 2020 (Aichi Targets), which are aligned under the five UN strategic goals. The goals and targets set are both ambitious but practical through a flexible framework to achieve global biodiversity targets. Countries are flexible to decide and establish their own national targets taking into account national needs and priorities which will have to contribute towards achieving the global targets.

CHAPTER ONE

PAPUA NEW GUINEA'S BIODIVERSITY WEALTH

Setting the Context: The Biodiversity Assets and Drivers of Biodiversity Loss in Papua New Guinea

3.0 INTRODUCTION

Papua New Guinea takes place among the global community as a country that portrays a land of vast cultural diversity and is a host to one-sixth of known languages. Not to be undone, as if the cultural diversity had not done its job, the complex geology and plate tectonics pave the way for Papua New Guinea to be a host to a remarkable diversity of flora and fauna that have tested the imagination of naturalist and scientists into the millennium. Traversing New Guinea's tropical topography are 4.5 % of the world's known land mammals. The country is home to more than 800 species of birds and an estimated 25,000 to 30,000 vascular plants. Papua New Guinea is also home to the world's largest species of butterfly, the Queen Alexandra Birdwing, which was first discovered in 1906 and only found in the coastal plains of Oro Province. The world's largest species of tree frog and orchid are also found here, as are the planet's only poisonous birds and 12 of the 14 known species of tree kangaroos. The complex orogeny of PNG also gave rise to the country's diverse interior that consist of spectacular highland valleys, grasslands, vast expanses of tropical rainforests, ancient swamps and mangroves. Primary rainforests shelter under its huge umbrella around 75% of the country. The mainland's backbone consists of undulating lowland grasslands and mountain ranges that rise to Mount Wilhelm, the country's highest summit, at 4,509 m asl. Crisscrossing the country's complex and diverse topography, acting as a lifeline in terms of sustenance and access, are collection of anastomosing waterways, the largest of which are the Sepik, Purari, Markham, Strickland, Kikori and Fly Rivers.

Papua New Guinea's biodiversity wealth does not seem to be reaching its threshold. Between 2008 and 2011 at least 1060 new species have been discovered in New Guinea, including 218 species of plants, 580 invertebrates, 71 fishes, 132 amphibians, 43 reptiles, two birds and 12 mammals, according to WWF (2011). Not to be undone by this this biodiversity wealth, Papua New Guinea hosts 38 species of the 42 known species of Bird of Paradise.

This land of diversity is also rich in natural resources, with the minerals and hydrocarbon industry dominating the exports. Since 1991, over $26 bn has been invested in the oil and gas industry in Papua New Guinea, with over $6bn being invested by the sector in 2012 alone. With the completion of the LNG project, Papua New Guinea will be riding on back of an expanding extractive industry.

The agriculture also accounts for one-third of the GDP. The country's oil palm industry being seventh of the world's producer and being the third largest exporter of palm oil accounting for 1.3% of the global exports. Second in the agriculture sector to the oil palm industry in export values, Papua New Guinea's forest industry sector continues to expand on the backbone of strong regional demand for raw materials. The rate of growth for the industry has accelerated over the past decade as the government has allocated large swaths of land for agricultural development which has allowed companies to fell increasing amounts of valuable tropical timber species for export. The vast majority of PNG's forestry products are currently destined for China, which retains a substantial appetite for wood as both an input to its own domestic construction industry as well as a new raw material for the manufacturing of goods for export. The fisheries industry sector follows the agriculture sector with commercial tuna-based industry accounting for around 482,000 tonnes on an annual basis. This tuna industry represents some 11% of the global catch.

3.1 PAPUA NEW GUINEA'S BIODIVERSITY WEALTH

Tropical mountains and far-flung marine ecosystems are highly diverse natural laboratories that provide an ideal setting for evolutionary and ecological studies. The tropical island of New Guinea is exceedingly diverse (Gressitt, 1982), and naturalists ever since Wallace (Toussaint et al. 2014) have used the island as a natural laboratory to study the evolution of species and communities (Wilson, 1961; Diamond, 1972; Gressitt, 1984). Being situated in the tropics, Papua New Guinea is home to an extraordinary diversity of climate zones and landforms. These range from lowland plains with seasonal climate to alpine zones with permanent ice on summits (>4,700 m above sea level). As an island, Papua New Guinea contains many mountain ranges and some of the world's last remaining tropical wilderness. Remarkably, most of this landmass was formed in the past 5 million years, resulting from major mountain building and what is arguably the world's most complex geotectonic history (Baldwin et al.2012), further modified by extensive volcanism and glaciations (Hope, 1976). On the back of this complex geotectonic history that resulted in island arc collisions and orogenies, triggering speciation events that stand out as the key factors accounting for the high biodiversity in Melanesia and New Guinea in particular. Various studies, Diamond (1972), Gressitt (1982), De Boer & Duffels (1996), Polhemus (1996), Kalkman et al. (2013) and Georges et al. (2014) describe events for the rise and diversification of PNG's biodiversity particularly among the Aves, Chelonii, Hemiptera and Heteroptera. Results suggest that species-level diversification within New Guinea as a whole to be more recent with lowland vertebrate taxa tending exhibit north-south divergence on either side of the predominant east-west cordillera (Unmack et al. (2013); Deiner et al. 2011; Dumbacher and Fleischer, 2001). Montane taxa more commonly exhibit east-west splits, thought to result from more local allopatric speciation among drainages along the cordillera (Joseph et al. 2001).

Recent studies by Allison and Tallowin (2014) provide a comprehensive insight into Papua New Guinea's biodiversity wealth in relation to species richness and endemism among the country's terrestrial vertebrates. Tallowin et al. (2017) further show that PNG's terrestrial vertebrates species richness tends to peak along the central cordillera except for reptiles.

3.2 UNDERSTANDING BIODIVERSITY

Biodiversity is the variety of all forms of life, based on three levels of diversity: genetics, species and ecosystems. Genetic diversity is the variety of information that is inherent in individual plants, animals and micro-organisms; species diversity and the variety of species and ecosystem diversity is the variety of habitats, ecological communities and processes. Convention on Biological Diversity (CBD) defines biodiversity as the variability among living organisms that inhabit the terrestrial, marine and aquatic systems. Biodiversity is constantly evolving, and it can be changed through genetic and evolutionary processes, and it can be altered by threats that can lead to population declines or extinction. Biodiversity sustains life and livelihoods across the globe. It is the source of food, shelter, water, clear air, health, medicine, fuel, and regulates the overall climate system.

Biodiversity plays a significant role in sustaining the livelihoods of the people of Papua New Guinea. Biodiversity plays a central role in ecosystem functioning and maintenance of habitats. For many rural communities of Papua New Guinea, biodiversity is intricately embedded in their culture and traditional including sustaining daily livelihoods. Biodiversity is everyone's business in rural Papua New Guinea.

3.3 TOPOGRAPHY & GEOLOGY

Topography is suggested to influence richness most in regions experiencing the greatest climatic stability over the longest period of time, such as those in the tropics (Fine 2015). New Guinea is among the most biologically diverse regions on the planet (Brooks et.al.2006). The exceedingly rich vertebrate assemblage (c. 5% of the world's terrestrial vertebrate species on less than 0.2% of the Earth's land surface) is thought to be the product of the island's large size (785,753km^2), tropical climate, complex geological history and extensive mountain ranges (Allison, 2009; Shearman and Bryan, 2010). This remarkable degree of tectonic complexity has resulted in extensive mountain uplift accounting for over 31% of the New Guinea mainland to be above 1000m (Allison, 2009). These extensive and often isolated mountain ranges have been the driving force behind PNG"s high levels of range-restricted species products. The species radiation across the country among various taxonomic groups is also attributed to PNG's complex geological history.

3.4 ECOREGIONS AND ECOSYSTEMS

Papua New Guinea has been divided into Ecoregions, a scheme adopted by WWF and accordingly, PNG's outer island regions comprise the Admiralty, North-eastern Islands, Bougainville, the Trobriand and the Louisade island group. The Admiralty, North-eastern Islands and Bougainville Eco regions are a part of the East Melanesian Islands Biodiversity Hotspots, and each of these island group hosts some the country's endemic including IUCN threatened species.

Overall these island ecoregions are home to 195 IUCN Listed species; 6 critically endangered, 15 endangered, and 141 vulnerable species. The Manus Island in the Admiralty group is home to the endemic Manus green snail (*Papustyla pulcherrima*), the superb pitta (*Pitta superba*) and one of PNG's Critically Endangered plants (*Helecia polysomoides*).

Figure 1: Ecoregions of Papua New Guinea **Source: Government of PNG (2010)**

The North-eastern Islands ecoregion comprising the New Britain, New Ireland and the Duke of York islands, also host two of the country's Critically Endangered species, the Beck's Petrel (*Pseudobulweria becki*) and the Pondicherry Shark (*Carcharhinus hemidon*) including up to 20 endemic bird species.

The Bougainville ecoregion is home to two Critically Endangered species, the Bougainville Greater Monkey-faced bat (*Pteralopex flanneryi*) and the Poncelet‟s Giant Rat (*Solomys ponceleti*) including *three Endangered species ; Bougainville Monkey-faced bat (Pteralopex anceps), kingfisher (Actenoides bougainvellei*) and a starling endemic to the island group (*Aplonis brunneicapillus*).

A summary of species of conservation significance in each of the ecoregions is provided in Table 1.

Table 1: Summary of Species of Conservation Significance in Eco regions of Papua New Guinea

	ECOREGION	SIZE (Ha)	%	SOURCE WWF	Conservation Significance
1	Admiralty Islands – Manus	208, 505	0.5	132. Admiralty Islands	Hosts one of PNG's Critically Endangered plant species (*Helicia polysomides*), Endangered Manus Melomys *(Melomys matambuai*), Superb Pitta (*Pitta superba*) listed as Vulnerable
2	Northeastern Islands	4,699,775	10.2	111. New Britain/New Ireland Lowlands	Waters of New Britain/New Ireland host PNG's Critically Endangered Bird –Becks Petrel (*Pseudobulweria becki*). Waters of New Britain hosts PNG's Critically Endangered shark *(Carcharhinus hemidon*). This Eco region also hosts up to 20 endemic bird species
				112. New Britain/New Ireland Uplands	New Ireland uplands hosts the breeding ground for Critically Endangered Beck's Petrel.
3	Bougainville Island	939, 137	2.0	119. Bougainville Island	Host's PNG's Critically Endangered Monkey-faced Bat
4	Northern New Guinea	9,482,056	20.5	107. Huon Range	Hosts PNG's first legal CA,YUS; Tree Kangaroo Conservation
				115. North New Lowlands	Bewani and Torricelli Ranges host some PNG's restricted range and endemic species (*Dendrolagus scottae* and *Petaurus abidi*)
5	Central Range	11,821,294	25.5	105. Central Range	Hosts most of PNG's restricted-range species, including mammalian and amphibian species richness and endemism hotspot
6	Southeast Peninsula	7,457,004	16.1	120. Southeast Peninsula	Hotspot for birds, and tends to have the highest levels of species richness for birds in the country. Overall this Eco region has high levels of species richness for terrestrial vertebrates.
7	Trobriand Island	432,689	0.9	125. Trobriand Islands	Culturally rich Eco region, home to Goldie's Bird of Paradise (*Paradiseae decora)*

8	Louisiade Island (SE Island)	181,395	0.4	110. Louisiade Islands	Louisiade and D'Entrecasteaux Ecoregions host several endemic species including the Endangered *Otidiphaps insularis* and home endemic Bird of Paradise (*Paradiseae decora*) and home to highest coral reef diversity.
9	Southern New Guinea	11,053,974	23.9	121. Southern Wetlands	Hosts PNG's large wetland area including staging ground for wintering shorebirds.
				122. Southern Plains	Hosts PNG's large tracts of savannah and reptilian endemism
				708. Trans-fly	Hosts PNG's highest levels of reptile endemism and PNG's largest marine PA (Tonda WMA)
	Total (Ha)	40,428,412	100		

3.5 MARINE ECOSYSTEMS

Papua New Guinea's marine environment hosts a large, complex and highly diverse ecosystems comprising extensive inshore lagoons, fringing and barrier reef systems, and shallow banks extending into deep offshore reefs and seamounts, ridges, and abyssal ocean trenches. This marine environment also includes PNG's exclusive economic zone (EEZ) that encompasses an area of around 1.7million km^2, while the coastal near-shore habitats encompass 46,000km^2 of diverse estuaries, bays and lagoons. Of this, coral reefs and estuaries account for 6,000km^2 of the near-shore ecosystems (Manoka & Kolkolo, 2001).

Papua New Guinea's marine and coastal ecosystems play a vital role in the national economy including sustaining the livelihoods of its coastal and island-dwelling communities. At the national level, PNG's fisheries industry contributes an estimated PGK 350-400million annually to the country's economy.

Despite its extensive EEZ and near-shore environments, PNG's fisheries sector does not reap the full economic value of its marine resources in light of challenges of Illegal, Unreported and Unregulated (IUU) fishing.

For its coastal and island-dwelling communities, the rich marine environment offers significant opportunities for sustaining livelihoods. However, contingent with other natural resource sectors, there are challenges in implementing effective and sustainable management of this resource in the face of increasing pressure from a rapid growing population, costal development, land-based development activities and climate change.

Papua New Guinea is committed to the establishment of a network of marine protected areas to fulfil its national and international commitments. A recent marine priority areas analysis

based on the principles of comprehensiveness, adequacy, representation, and resilience (CARR) was conducted in PNG through development partners. Through this capacity building program, spatial planning tools have greatly assisted CEPA to project its vision into establishing a network marine PA. The Aichi Target 11 calls for at least 10% of coastal and marine areas to be conserved by Parties to CBD. The current marine protected area systems protect only 2.2% of the total reef habitat of Papua New Guinea. Using the CARR principles, the analysis found that around 12% of the features targeted meet or exceed the 10% target set under Target 11.

3.6 TERRESTRIAL ECOSYSTEMS

Various environmental factors interact and counteract, and the relationship between vegetation and habitats or ecosystems are usually complex. This complexity is further compounded because many plant communities are in the stage of succession, and, as the full range of such stages need to be pieced together. For the purposes of report, terrestrial ecosystem classes will be based on vegetation classes. Various vegetation classes have been described for Papua New Guinea since the early 1970's. Paijmans (1972) recognized seven major environmental classes; beach ridges and flats, saline and brackish swamps, lowland freshwater swamps, lowland alluvial plains and fans, hills and low mountains, lower montane zone and upper montane. Within these seven broad environmental classes or ecosystems, 57 different vegetation types were recognized, and descriptions given. Two decades later, Hammarmaster and Saunders (1995) also recognized six structural formation: forest, woodland, savannah, scrub, grassland and mangroves. The last may consist of more than one structural formation. Within these six broad structural classes 59 vegetation types were recognized, and remarkably almost two decades from 1995, Shearman et al. (2008) also recognize 6 broad structural formations to describe terrestrial ecosystems in Papua New Guinea, including herbaceous swamp, scrub and grassland (Table 2). A more recent report by Shearman et al. (2014) recognized 8 broad classes of forest types and descriptions for each ecosystem type will be based on this scheme.

Table 2: Area of Vegetation Type by Region in 2014

Vegetation Type	PNG Mainland: Coastal	PNG Mainland: Highlands	PNG Mainland: Total	PNG NGI Islands	PNG Total
Land Area (km^2)	341,581	63,731	405,312	56,427	461,739
Rainforests (km^2)	200,021	40,787	240,809	37,961	278,767
Rainforest occupies around 278,767 km^2 and represents the largest extent of vegetation in Papua New Guinea and includes various structural formation that range from below 1000m, above 1000m and extending to lower montane forest. Floristic composition for vegetation below 1000m is very diverse while as one approaches the upper montane zone, the structure changes from continuous to mosaic patterns as forests are replaced by mosses and grassland.					
Secondary Forests (km^2)	23,156	144	23,301	12,603	36,907
Secondary forest represents 36,902km^2 in Papua New Guinea and is the result of shifting agriculture practiced by PNG's rural population. This vegetation type is typically very diverse with fallow periods ranging between 3 to 25 years or more. Primary forest is cleared for new gardens, and as crops are harvested, the old regrowth are abandoned and left to fallow for various stages of advanced secondary forest to develop.					
Dry Evergreen Forests (km^2)	7,507	0	7,507	0	7,507
Dry evergreen forest occupies 7,507km^2 and is restricted to an area of low rainfall (1800-2500mm) in south-west Papua New Guinea where gently undulating, well-drained plains form the main habitat. It is less luxuriant than forest on plains (Paijman, 1972), and has a very different floristic composition. Common tree genera found in dry evergreen forest are *Acacia, Tristania, Syzygium, Rhodamnia, Xanthostemon* and *Flindersia*.					
Swamp Forests (km^2)	32,637	183	32,820	1,047	33,866
This ecosystem occupies around 33, 866 km^2 with the highlands region contributing only 183 km^2 and the remaining 1,047 km^2 by New Guinea island. In the swamp forest, the water table is permanently above or at the water surface, often with seasonal fluctuations with the rise and fall of the rivers that feed the swamp. In the lowlands, this forest type occurs on low-lying					

back-plains, old scroll ridges, and deltas of large rivers. The main areas in Papua New Guinea, associated with swamp forests are the middle and lower courses of the Turama, Fly, Strickland, Purari and Sepik Rivers. Swamp forest is rich in species and tree genera often found in the canopy are *Campnosperma, Terminalia, Nauclea, Syzygium, Myristica, Garcinia* and *Carallia*. Swamp forests subject to frequent inundation by tidal fluctuations are dominated by brackish water species such as *Inocarpus fagiferus, Camptostemon schultzii, Heritiera littoralis, Dolichandrone spathacea* and *Brownlowia argentata.*					
Mangrove (km^2)	5,221	0	5,221	513	5,734
Mangroves occupy sheltered, mostly muddy shores, tidal flats and estuaries, and grow on peat, clay, sand and coral debris, providing the environment is strongly tidal. The largest extent of mangroves in Papua New Guinea occur along the Gulf of Papua occupying around 165,000 hectares. According to Shearman et al. (2015) this vegetation type represent around 5,734 km^2 with New Guinea Island contributing some 51 km^2 to the overall coverage (Table). The main tree genera found in the mangroves include *Rhizophora, Bruguiera, Avicennia, Sonneratia, Ceriops, Lumitz*era, *Excoecaria, Heritiera and Xylocarpus. Acrostichum* and *Acanthus* are frequently present where there is opening in the tree canopy.					
Herbaceous Swamp (km^2)	11,294	0	11,2931	511	11,346
Herbaceous swamps occupy 11,294 km^2 of coastal PNG, and in the New Guinea islands around 51km^2 representing around 11,346km^2. Herbs, sedges and ferns dominate the aspect of this vegetation. Mixed herbaceous swamp is typical of lowland vegetation, while within the mountain grassland a mixed herbaceous sedge-grass association is frequently encountered.					
Scrub (km^2)	33,342	8,037	41,379	9,842	51,223
According to Shearman et al. (2015), this vegetation class occupies around 51,223 km^2. Shrubs occur on sites unsuitable for forest and woodland growth because of the harsh conditions and soil deficiencies. These ecosystems are associated with lowland regions with a strongly monsoonal climate and frequently occur on limestone hills, beach ridges and permanently inundated, alkaline plains. Along most of PNG's extensive coastal areas, *Hibiscus tiliaceus* and *Desmodium umbellatum* are the frequently found shrubs.					
Grass/ Woodland (km^2)	53,234	14,371	67,605	6,654	68,164
Grassland is a vegetation dominated by grasses and grass-like plants. Trees and shrubs are normally present together. Woodland consist of an open upper storey of trees and an undergrowth of shrubs. This ecosystem class occupies around 68,164km^2 for Papua New Guinea with varying extent across PNG coastal, PNG Highlands and New Guinea Islands					

(Table 2). Woodland subject to periodic flooding occur on poorly drained flats and trees frequently found are *Carralia, Nauclea*, and around the southwest of PNG , *Melaleuca, Acacia* and *Tristania* are generally associated with this vegetation type. Woodland on beach ridges characterised by pantropic trees such as *Barringtonia asiatica, Calophyllum inophyllum, Terminalia catappa*, and *Pandanus tectorius*. Woodland swamps are also found in the lower course of large rivers such as the Mambare, Lakekamu and Purari Rivers.					
Water (km^2)	5,377	356	5,733	341	6,074

3.7 PROTECTED AREAS

There are 57 gazetted protected areas (PAs) in Papua New Guinea covering only around 4% of PNG's territorial area. These protected areas 33 Wildlife management Areas (WMAs), five National Parks, one Conservation Area, and the remaining 18 made up of historical, natural and scenic reserves, provincial, district and memorial parks, and wildlife sanctuaries. The gazetted protected areas cover approximately 1,784,954 hectares of PNG's land area. Two Wetland of International Significance (Ramsar) sites, Tonda and Lake Kutubu covering around 590,000 hectares are not listed among the 57 PAs because they overlap with the Tonda and Lake Kutubu WMAs. Sixteen Locally Managed Marine Areas covering around 2,101 hectares are also not included in the gazetted PAs as these are awaiting gazettal. And include 2 Ramsar sites protecting wetlands values, as well as 12 locally managed marine areas (LMMAs), 3 protected seascapes and 32 terrestrial wildlife management areas (WMAs) and up to nine national parks. A recent assessment by Bryan and Shearman (2015) shows that there has been substantial changes in PNG's forest estate between 2002 and 2014. This assessment estimated that during this period, a total of 3,752km^2 of rainforest was cleared and around 7,705 km^2 of primary forest was logged. Overall, 4.1% of the 2002 forest estate was either cleared or logged by 2014. There were substantial regional differences in deforestation and logging across PNG. The largest of these changes occurred in PNG's Islands region with East and West New Britain accounting for 2.3% and 2.2. % respectively for forest estate losses in 2002-2014. Bryan and Shearman (2015) also report that annual rate of deforestation and degradation had reduced to around 0.49% for the period 2013-2014.

PNG's current protected area coverage is around 1.29 million hectares or 2.8% of PNG's total land area. A recent assessment by Shearman and Bryan (2011) show that PNG"s protected areas cover around 542,166 hectares of rainforest, 54,322 hectares of swamp forest and 8,892 hectares of mangroves. These figures represent 1.9% of the total rainforest estate as well as 1.6% of the swamp forest and 1.5% of the mangroves.

As recent gap analysis for terrestrial biodiversity in protected areas found only14% of the fauna evaluated are represented within the existing protected area system at greater than 10% (Lipsett-Moore et al. 2010). Similarly, the current marine protected area system protects only 2.25 of the total reef habitat of PNG. Critical habitats for endangered marine turtles area currently significantly under-represented (<2% of total area in reserves), less than 1% of

important bird areas (IBA) are protected, and there are currently no provision for protection of critical whale habitats.

Aichi Target 11 calls for a 10% representation target by 2020. Presently, 12% of PNG's marine ecosystems meet or exceed the 10% target.

The Aichi Target 11 also calls for at least 17% of terrestrial areas to be conserved through effective and equitable managed, ecologically representative and well-connected systems of PAs. The PNG government through CEPA is committed to the establishment of network of protected area. Current projection by CEPA for establishment of terrestrial protected area is that by 2020, PNG will have reached 6.6% of the 17% target and it will have reached or exceeded the 17% representation by 2022. The progressive increases in representation by declaration of new Conservation Areas and WMAs (see Table 3).

Table 3: Proposed Conservation Areas and WMAs for PNG in relation to Aichi Target 11

PA Designation - 2018		**Target Record**	**PA Designation - 2021**		**Target**
Sulei WMA	2,480 Ha	3.99%	Lakekamu CA	165,000	13.29%
Total	2,480		Upper Sepik Ramsar	244,000	
PA Designation – 2019			Karamui CA	4,000	
Tenkile CA	185,000	5.16%	Nakanai CA	454,522.6	
Kokoda Track CA	238,000		Total	3,073,522.6	
Kaejende PC CA	120,000		**PA Designation-2022**		
Kuk WHS CA	196		Collingwood Bay CA	80,000	17.90%
Total	543,196		Volotige WMA	6,073	
PA Designation – 2020			Hindenberg CA	41,584.93	
Bobongara WHS /CA	49,877	6.64%	Kikori Basin WHS	2,000,000	
Strickland CA	120,000		Total	2,127,657.93	
Wanang CA	10,770				
Tonda WMA	500,000				
Total	680,647				

Source:CEPA, 2017

Between 1972 and 2002, forest change due to logging accounted for 48% of total change with subsistence agriculture contributing 46% and fire 4%. In contrast, between 2002 and 2014, 81% of total change (deforestation and degradation) and 41% of total deforestation were caused by logging (Bryan and Shearman, 2015). A comprehensive review of the management effectiveness of 57 gazetted protected areas in PNG has been provided by (Government of PNG, 2018) .Overall the management effectiveness of PNG's protected area system is very limited. Only four PAs rated as achieving very good results, a further three rated as having good progress with growing concerns, and the remainder struggling to deliver even basic management. The most significant current pressures for PNG's protected areas are subsistence gardening, hunting, subsistence harvesting and commercial overfishing. The underlying threats are logging, invasive species, mining and agricultural expansion (Chatterton et al. 2006). The

study by Chatterton et al. (2006) provided a comprehensive coverage of PNG‟s protected area management. However, this report covered the terrestrial PAs particularly under the WMAs. A recent push has been made by PNG to promote the establishment of marine protected areas. CEPA database currently recognizes around 16 Locally Managed Marine Areas (LMMAs). A more recent assessment of LMMAs in Kimbe Bay by Wise et al. (2016). The Kimbe Bay LMMAs was a successful cooperative program established through community-based initiatives through TNC intervention. This recent study by Wise et al. (2016) concluded that LMMAs had delivered benefits, including livelihood benefits, but by 2013, they were no longer managed, and enthusiasm for the program had waned rapidly after TNC's departure. According to Wise et al.(2006), there was no tourism income, no fees or fines for breaches collected, and illegal harvesting had increased including many reefs being damaged.

Conclusions were that the international community were the beneficiaries of LMMAs, but for the local participating communities, the costs were seen to outweigh the benefits. Communities would not fine each other for breaches of the rules, and high-level intervention and support were needed.

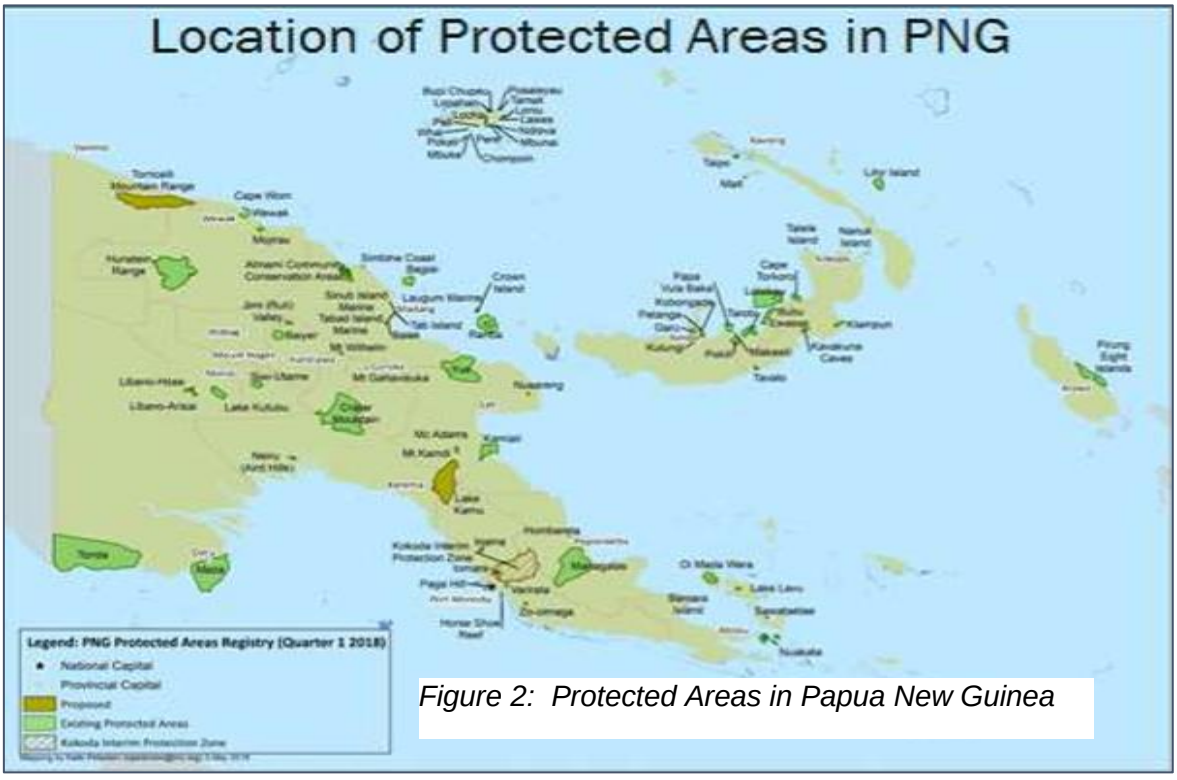
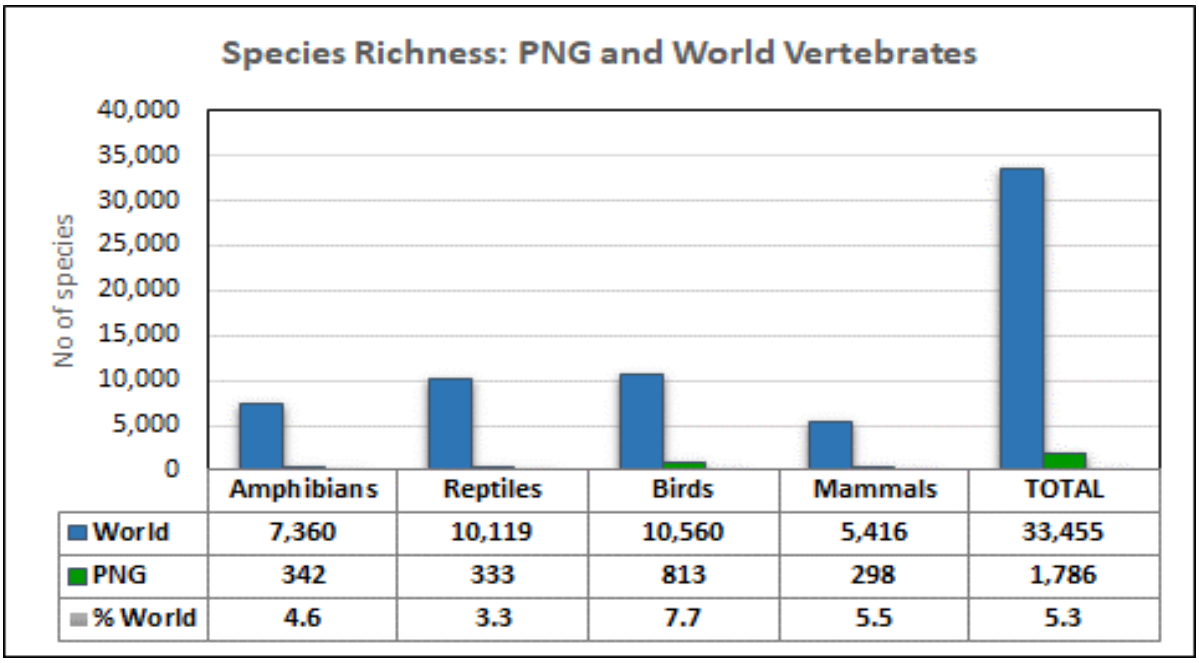


Figure 2: Protected Areas in Papua New Guinea

3.7.1 Species Richness

The forests of Papua New Guinea support some of the richest assemblages of vertebrates on the planet, and are home to at least 1786 species of amphibians, reptiles, birds and mammals, a little over 5% of the world's total (Figure 3).To put this fauna into perspective, PNG has around twice as many vertebrate species as are known from the island of Borneo, a tropical landmass that is considerably larger, but has a similar array of forest types (Allison,2009).

Similarly, the vertebrate fauna of PNG is about twice the size as that of the rainforests of West Africa, a land area nearly three times larger (Myers et al. 2000).



	Amphibians	Reptiles	Birds	Mammals	TOTAL
World	7,360	10,119	10,560	5,416	33,455
PNG	342	333	813	298	1,786
% World	4.6	3.3	7.7	5.5	5.3

Figure 3: Species Richness Comparison: PNG & World Vertebrates

Allison and Tallowin (2014) derived maps of species richness using ArcGIS (v10.3) and found that PNG amphibians reach their highest species density along the central mountains and in the mountains along the north coast (Figure 3). Amphibian species richness is lowest in the savannah regions of Western and Central provinces, which have pronounced dry seasons, and in the island provinces. The low species richness on Manus, Bougainville and the Bismarck islands are attributed to their water permeable skin, i.e. they cannot survive prolonged exposure to salt water and therefore have difficulty colonizing oceanic islands. Reptile species richness in PNG, is in many respects the inverse of the frog species richness, with the highest concentrations of species in the savannah regions of Western and Central provinces and in coastal regions, particularly along the north cost, including the Huon Peninsula. (Allison and Tallowin, 2014). Reptiles tend to have much larger geographic distributions than do amphibians, although there are slightly fewer reptiles (335) than amphibians species (342) known from PNG.

While overall amphibian species richness is highest along the central mountains (Figure 4). Allison and Tallowin (2014) found the highest amphibian species richness in PNG tend to be in places such as the Bewani Mountains in West Sepik that include a mix of lowland, hill forest and montane elements. If species richness comparisons were strictly to lowlands rain forest, such as the Utai at the foothills of Bewani mountains which has the one of the highest richest assemblages of amphibian and reptile species in PNG with around 30 species of frogs, 30 species of lizards and 15 species of snakes (Austin et al. 2008).

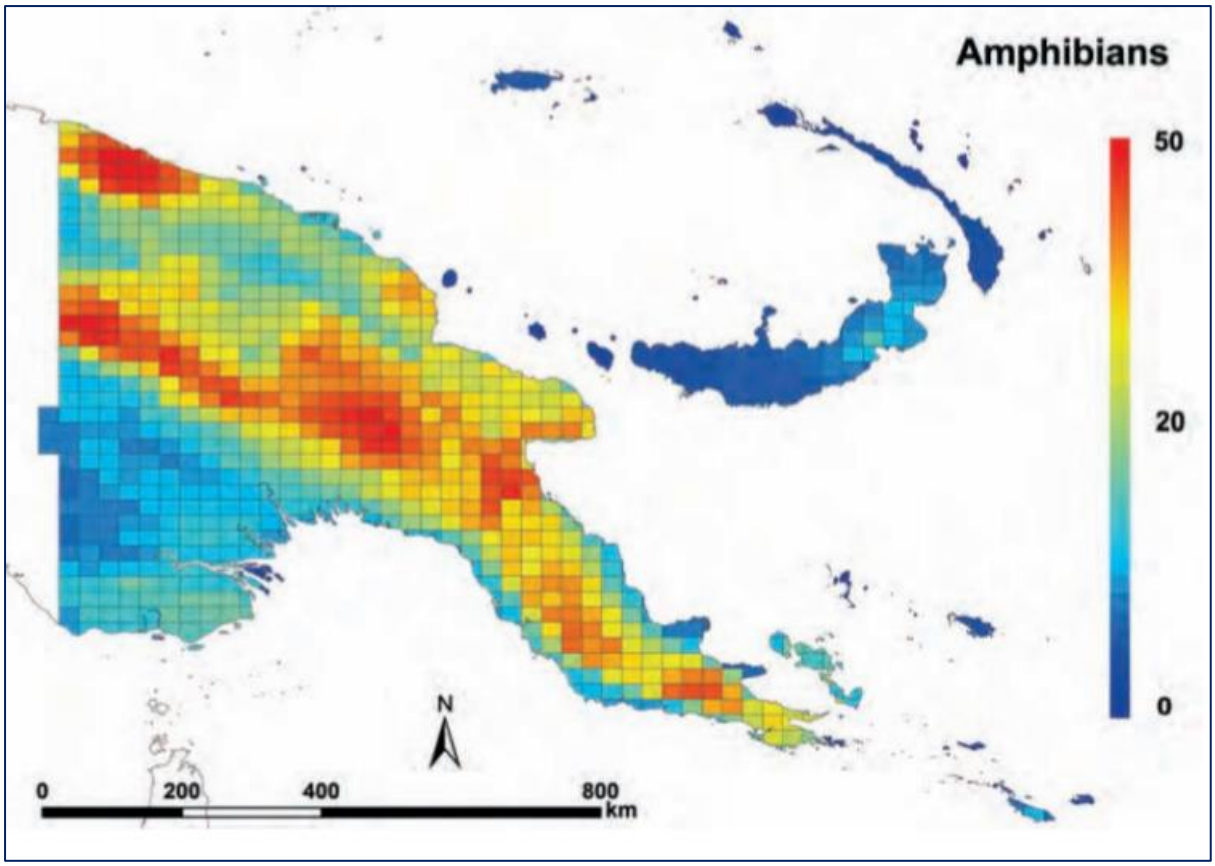


Figure 4: Amphibian species richness in Papua New Guinea (source: Allison & Tallowin, 2015)

Species richness among the birds is markedly different from the reptiles. Avian species richness for PNG is high throughout the south-eastern peninsula and along the slopes of the central mountains. Bird species richness tend to peak in the lowlands (Beehler, 1982), most lowland species range up to at least 500m elevation. At higher elevations, species tend to drop out or are replaced by montane congeners (Diamond, 1973).

Bird species richness is highest in the rainforest throughout PNG and appears to peak in the hill forest regions (Figure 5). Most mainland New Guinea bird species have relatively large geographic ranges and therefore endemism in these bioregions tends to be low. However, island endemism is high, with concentrations of restricted-range endemics confined to the Bismarck bioregions where forest loss is high. Although most of the bird species endemic to the region occur in rainforest, they are not confined to this habitat and many of them have adapted to secondary regrowth or occur in montane regions-that are relatively unaffected by rain forest loss. Nevertheless, it is clear that continuing forest loss in the Islands Region and its potential impact on the rich array of endemic birds that occur there is a matter of urgent conservation concern (Dutson, 2011).

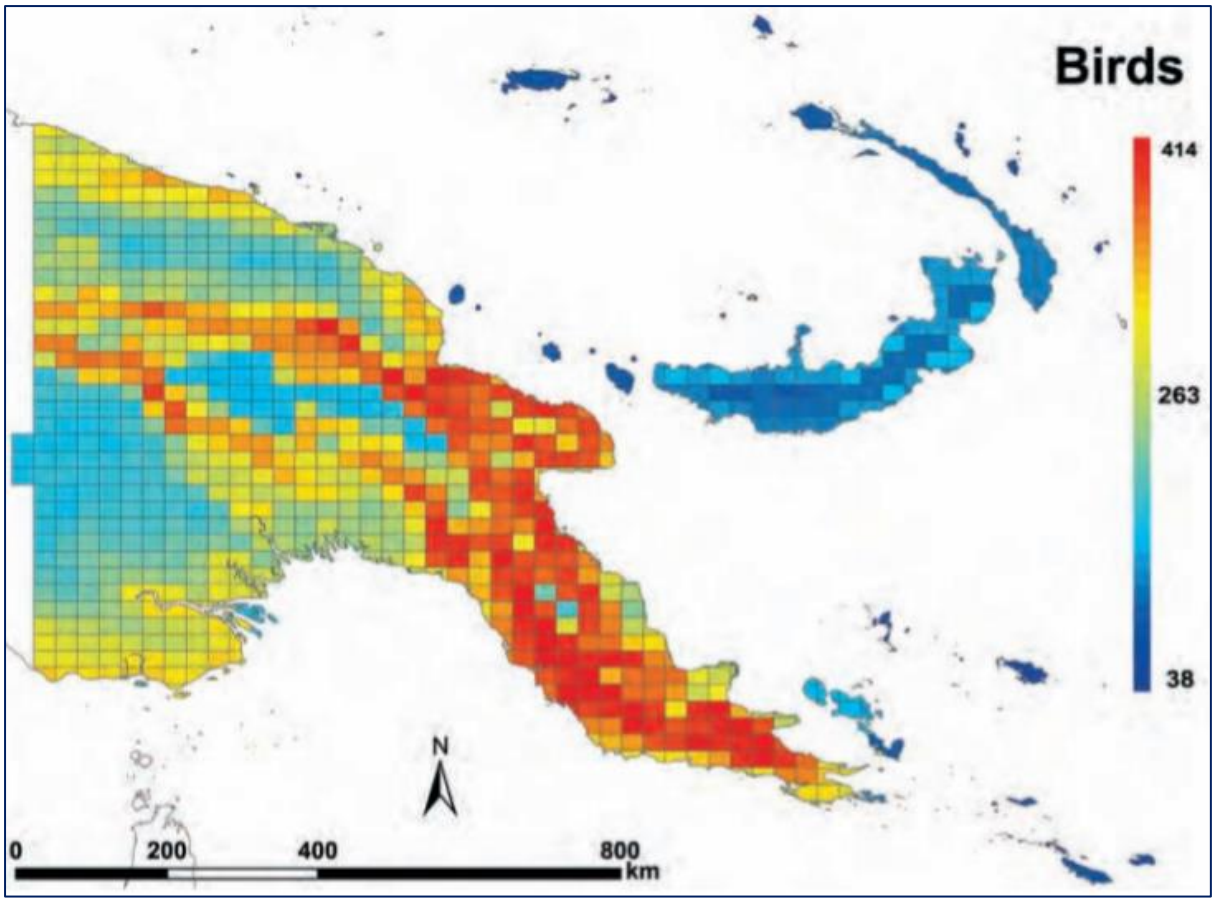


Figure 5: Bird species richness in Papua New Guinea (source: Allison & Tallowin, 2015)

Mammal species richness is similar to that for birds with highest richness along mountain slopes (Figure 6). Species richness among mammals is similar to that of reptiles and birds but centered primarily in the mid-montane regions north and south of the main ranges (Figure 6) The highest concentrations of restricted-range species is in the mountains of West Sepik Province, particularly the Torricelli Ranges, along the North Coast and the Star Mountains , adjacent to the Indonesian border. Large areas of West Sepik and adjacent parts of the central Highlands were destroyed during the El Nino event of 1997-1998. This, together with over-hunting are thought to have caused significant declines in some of the mammal species, particularly several species of tree kangaroos, largely confined to this region.

A number of zoogeographic schemes have been proposed to describe the distribution of the fauna across PNG. Polhemus and Allen (2007) proposed zoogeographic schemes for the distribution of freshwater biota in PNG, Allison (2007) for amphibians and reptiles, Pratt and Beehler (2014) for birds and Flannery (1995) for PNG mammals. Recently a number of workers have adopted the biogeographic scheme based on biogeography and climate proposed by Shearman and Bryan (2010).

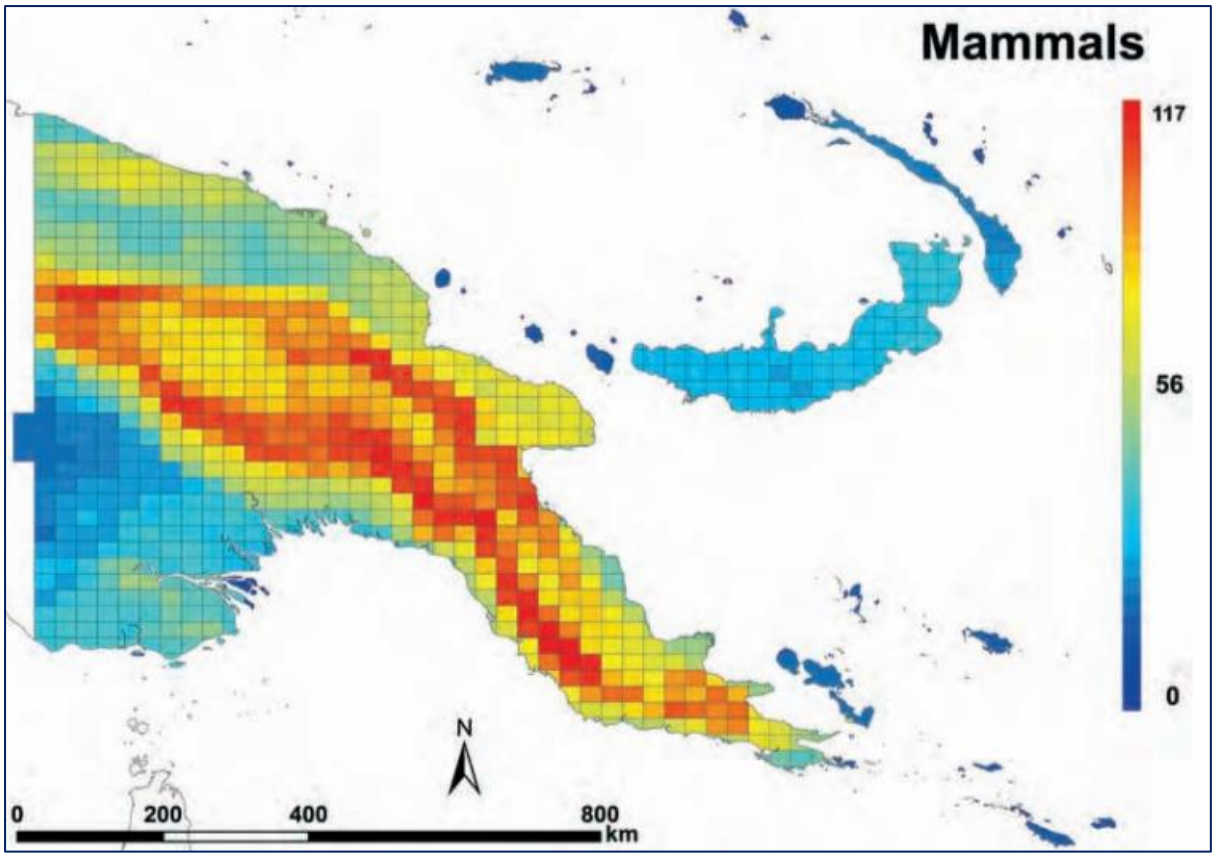


Figure 6: Mammals species richness in Papua New Guinea (source: Allison & Tallowin, 2015)

The geographic ranges of most species in PNG vertebrates are not accurately known. Most of the range maps therefore represent approximations based on all available data and expert opinion (Allison and Tallowin, 2015). The artefacts of these approximations are that actual species ranges are likely to be exaggerated. Accordingly, species are considered to be endemic to a bioregion if 90% or more of its range is within that bioregion. Based on recent literature by Allison and Tallowin (2015), the endemism among Papua New Guinea's terrestrial vertebrates can be mapped out using the biogeographic scheme proposed by Shearman and Bryan (2010).

Recent report by Allison and Tallowin (2015) , show that among the terrestrial vertebrates, the bioregion with the highest level of mammalian (Figure 10) and amphibian endemism is the Central Highlands, followed by the Owen Stanley Ranges and the Sepik-Markham ecoregions (Figure 8).These ecoregions are dominated by uplands, which represent major centres of diversification for the amphibians in PNG. The Bismarck Islands comprising New Britain and Ireland, the Admiralty Islands and the Solomon groups make up the North Bismarck Bioregion. The islands of the D'Entrecasteaux, Ferguson group make up the South Eastern Islands Eco region. These island ecoregions also host high levels of endemism among amphibians and mammals.

Reptile richness tends to peak in the coastal regions where rainforest loss is highest (Figure 7). Restricted-range endemism is highest in the islands of Milne Bay and in the mixture of savannah, sclerophyll and hill forest at the base of the Owen Stanley Ranges near Port Moresby.

There are also pockets of restricted-range endemics in the North Coast Ranges, a region with high rates of forest loss.

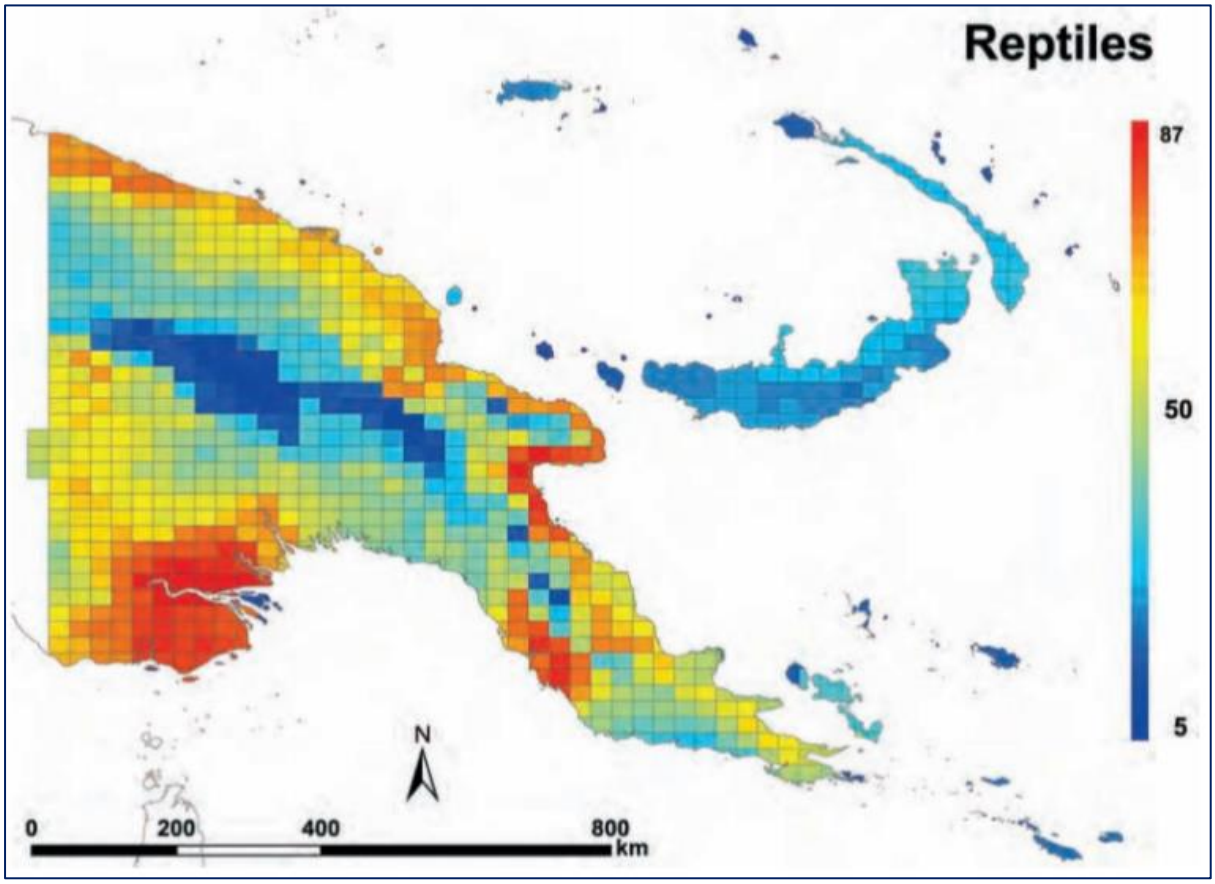


Figure 7: Reptilian species richness in Papua New Guinea (source: Allison & Tallowin, 2015)

The impacts of forest loss on reptile populations are difficult to evaluate (Allison and Tallowin, 2014). Many species of reptiles, particularly lizards, tend to have relatively large geographic ranges and are found mainly at the forest edge, in clearings or secondary regrowth forests, so their populations may be relatively unaffected by localized forest loss.

3.7.2 Endemism

A high proportion of the vertebrates in PNG are endemic. For example, 77% of the frogs are endemic to PNG. Although only 98 (17.8%) of the 636 species of resident birds are known from Papua New Guinea are endemic, a far greater number are endemic to the island of New Guinea or to the Papuan region. For example, of the 365 species of birds endemic to the island of New Guinea, 313 (85.7%) are found in PNG (Allison and Tallowin, 2014).

The Island of New Guinea has a complex tectonic history (Allison, 2009) and this has strongly influenced the distribution of the biota (Allison, 2009). A number of different zoogeographic schemes have been postulated to describe the distribution of the fauna. Polhemus and Allen (2007) for freshwater biota, Allison (2007 a) for amphibians and reptiles, Pratt and Beehler (2014) for birds and Flannery (1995) for mammals. The geographic ranges of most of PNG vertebrate are not accurately known. Current range maps therefore represent approximations based on all available data and expert opinion (Allison and Tallowin, 2014). The bioregions

with the highest level of mammalian and amphibian endemism is the central highlands, followed by the Owen Stanley Ranges and Sepik-Markham bioregions. This pattern tends to mirror species richness (Figure 7).

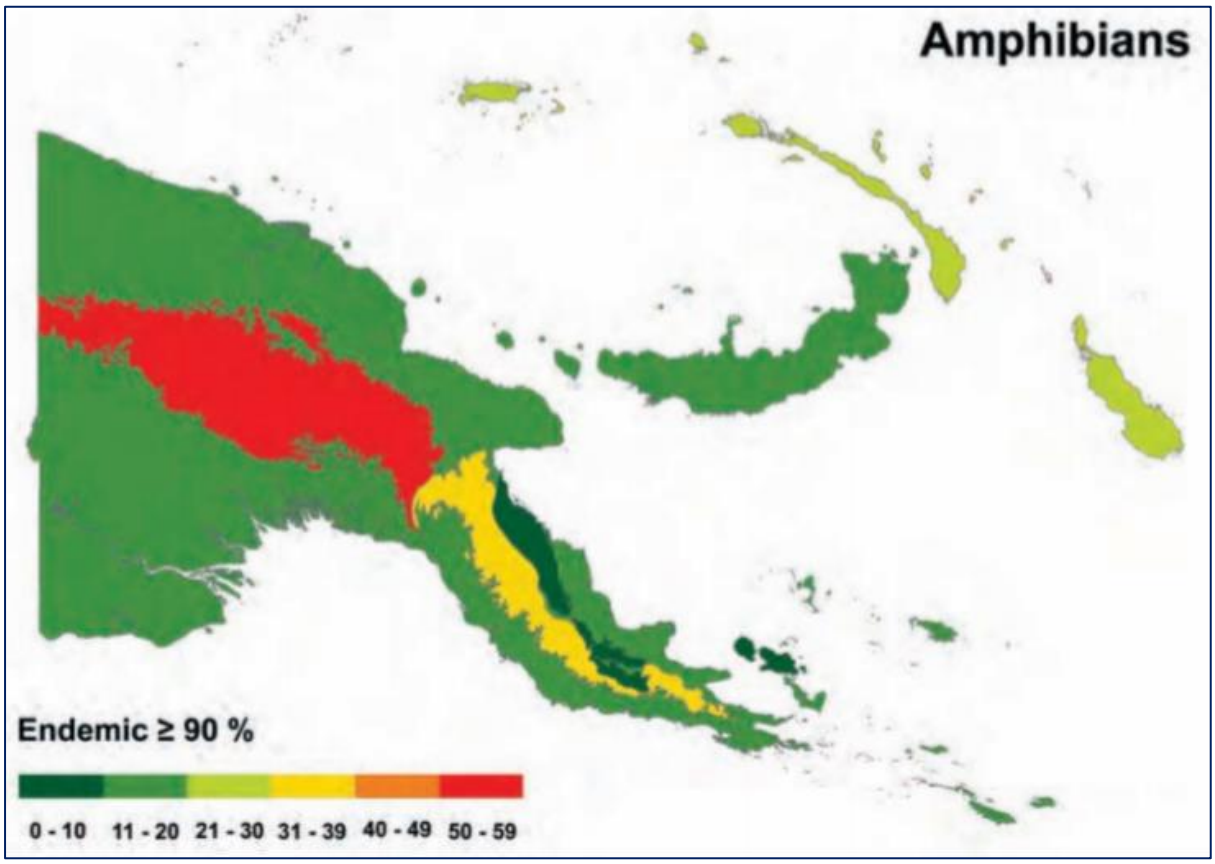


Figure 8: Amphibian endemism levels in Papua New Guinea (source: Allison & Tallowin, 2015)

Reptile endemism is highest in the offshore islands and, reaching its peak in the South Eastern Islands (Milne Bay) and the Bismarck Island bioregions (Figure 8), with many species of lizards endemic to the individual islands. The endemism among the birds show a similar pattern and reach their highest level of endemism in the North Bismarck Bioregion.

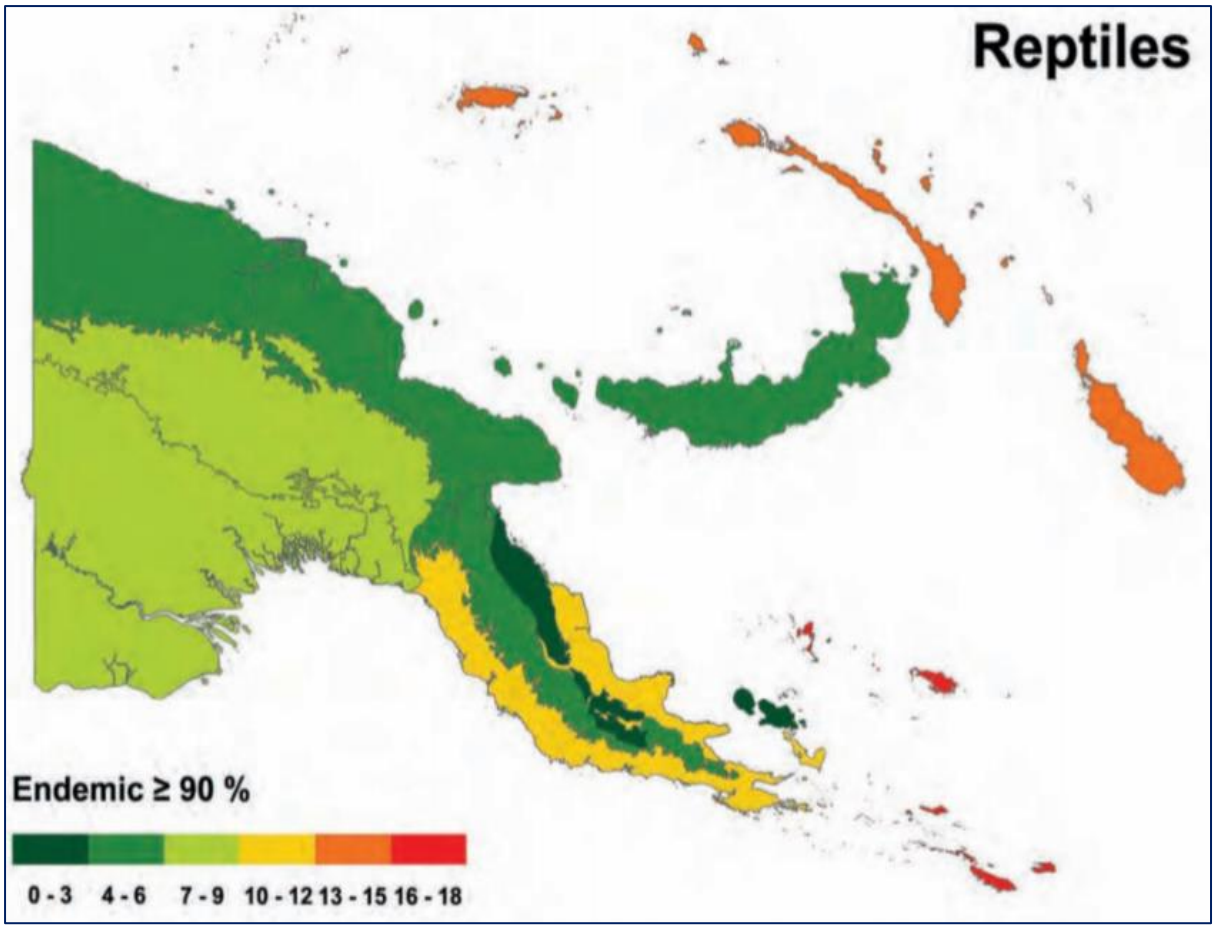


Figure 9: Reptile endemism in Papua New Guinea (source: Allison & Tallowin, 2015)

Mammal endemism is highest in the Central Highlands Bioregion (Figure 9) and to a lesser degree in the Sepik-Markham bioregions. This latter bioregion, because of the presence of many single-island endemics, has the highest overall level of endemism (Figure 9).

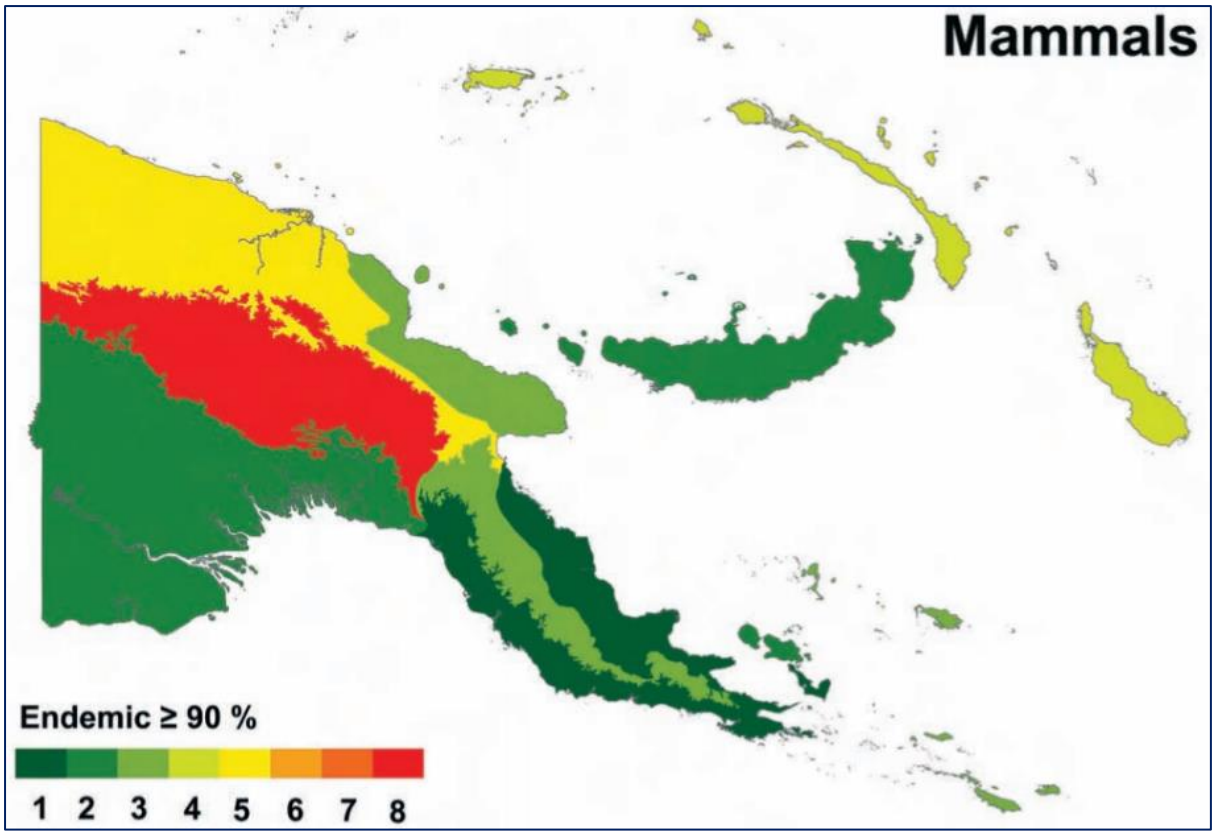


Figure 10: Mammalian endemism in Papua New Guinea (source: Allison & Tallowin, 2015)

3.7.3 Conservation Status of The Vertebrate Biota

According to IUCN Red List (2018), there are 4,315 species of animals in Papua New Guinea listed under various Threat categories from the low-ranking Least Concern (LC) to higher ranks of Extinction (EX). One marsupial species has been listed as Extinct for PNG. The Critically Endangered (CR), Endangered (E) and Vulnerable (VU) account for 341 species, of which 275 are listed as Vulnerable, 47 as Endangered and 19 Critically Endangered.

Eleven species of amphibians are listed as Threatened, according to the IUCN Red List (2018). It is likely however, that only one species of PNG frog is truly endangered (Allison, 2014). This species *Choerophryne siegfriedi*) is endemic to Mt. Elimbari in Simbu Province and is considered to be Critically Endangered due to forest loss throughout its small range.

There are currently eleven (11) species of threatened PNG reptiles (IUCN Red List, 2018) with an additional species identified during recent IUCN Red List workshop (2014). Six of these species are turtles, with two freshwater taxa, *Chelodina pritchardi* and *Pelochelys signifera*, considered to be endangered including Green Turtle (*Chelonia mydas*) and the rest listed as Vulnerable. The Leatherback (*Dermochelys coriacea*) and Hawksbill (*Eretmochelys imbricata*) listed as Critically Endangered. In addition a snake endemic to Bougainville and the Solomon Islands, *Loveridgelaps elapoides*, and a gecko from Western Province, *Cytrodactylus derongo*, are also listed as Vulnerable.

Deforestation is unlikely to have a significant impact on the freshwater turtle species which are primarily at risk due to over-harvesting for human consumption and the international pet trade.

A total of 39 species of birds are threatened in PNG (IUCN Red List, 2018) of which, 34 are considered Vulnerable, four as Endangered and one as critically endangered. In general those species listed as Vulnerable are still represented by reasonably large populations in PNG but some, such as two species of cassowaries (*Casusrius casuarius* and *Casuarius unappendiiculatus*) inhabiting the lowlands of the south and north coasts, respectively, together with the Vulturine Parrot (*Psittrichas fulgidus)* and several species of pigeons, are threatened by over-hunting and have been extirpated from many areas of the country. The rest of the species regarded as Vulnerable include taxa that are uncommon to rare, occupy a small geographic range or are migratory species impacted by loss of breeding habitat elsewhere.

The four species thought to be endangered include *Otidiphaps insularis, Pitta superba, Actenoides bougainvillei* and *Aplonis brunneicapillus.* The *Otidiphaps* is restricted to Fergusson Island in the D'Entrecasteaux group. There are no recent sightings (Pratt and Beehler, 2014). Forest loss in the D'Entrecasteaux group is around 3.5% and is particularly concentrated in the lowlands of Fergusson Island, so the continuing loss of forest there is a matter of high conservation concern.

Pitta superba is restricted to Manus and was historically widespread, but there are few recent sightings (Dutson, 2011). Forest loss on Manus is high and is likely to endanger this species. *Actenooides bougainvillea* is a kingfisher from the Solomon Islands variously classified as a Bougainville endemic. It is a little-known montane species that may be threatened by logging. *Aplonis brunneicapillus* is a starling endemic to Bougainville and several islands in the Solomon Islands group, including Choiseul, Rendova and Guadcanal. The starling is thought to be threatened by habitat loss (Dutson, 2011).

The single critically endangered bird species is a seabird, *Pseudobulweria becki*, known from PNG-Solomon Islands Eco region. Dutson (2011) reports it was originally known only from two specimens collected in the 1920s but is now known to be locally common in the seas between New Britain and New Ireland and may breed in the Hans Meyer Range of New Ireland.

Forty species of PNG's mammals listed as Threatened by IUCN Red List (2018), of these 12 are listed as Vulnerable, and these are a mix of relatively widespread but uncommon species and narrow-range endemics. Nine species of marsupials, four rodents and a bat are listed as Endangered, and include two species of wallabies (*Thylogale lanatus* and *T. calabyi*) the Woodlark cuscus (*Phalanger lullulae*), two species of bandicoots (*Echymipera davidi* and *Peroryctes broa*dbenti), three species of tree kangaroos (*Dendrolagus notatus, D.*matschiei and *D.goodfellowi*), and a triok (*Dactylopsila tatei*). The four species of rodents include *Paramelomys gressitti, Paraleptomys rufilatus, Melomys matambuai* and *Solomys salebrosus.* The only bat species listed as endangered is the Bougainville monkey-faced bat (*Pteralopex anceps*).

The Critically Endangered species include a monotreme, the Eastern long-beaked echidna (*Zaglossus bartoni),* six species of marsupials , including two cuscuses (*Spilocuscus rufiniger* and *Phalanger matanim*), the Northern glider (*Petaurus abidi*), the Black dorcopsis (*Dorcopsis atrata*), two species of tree kangaroos (*Dendrolagus scottae* and *D. pulcherrimus*),

Poncelet‟s giant rat (*Solomys ponceleti)* and three species of bats (*Pharotis imogene, Aproteles bulmerae* and *Pteralopex flanneryi).*

Mammals comprise about half the assemblage of Endangered and Critically Endangered mammals. Because many of them are relatively large, they are important sources of bush meat and threatened with over-hunting in many areas. Although the overall loss of forests is low in the Central Highlands bioregion, a hot spot for restricted range mammals, much of this loss of forests is concentrated in the north-western part of the bioregion that is especially high in restricted range endemics.

The combined effects of forest loss and over-hunting has already caused the localized extinction of relatively widespread species such as the eastern long-beaked echidna (*Zaglossus bartoni*) and Goodfellow's tree kangaroo (*Dendrolagus goodfellowi*) and may very well lead to the extinction of some of the restricted-range species. Similarly, loss of habitat and hunting pressure have extirpated many populations of large rodent (*Solomys salebrosus* and *S. ponceleti*) in the Bismarck bioregions, threatening these species with extinction.

The number of threatened species in Papua New Guinea appear to be on the increase. In 2017, the total number of threatened species in PNG was 4,702 as assessed against the IUCN Red List criteria. The current figure (2018) is 4,921 and includes 4,315 animals and 606 plants (IUCN 2018-1; Table 6a, 6b).

As a Party to the CBD, Papua New Guinea has an obligation to ensure its conservation programs are aimed at preventing any species becoming extinct or its conservation actions focused on improving the conservation status of threatened species. Aichi Target 12 addresses this concern by the statement; 'By 2020 the extinction of known threatened species has been prevented and their conservation status, particularly those most in decline, has been improved and sustained'. Forest change including deforestation and forest degradation differed across PNG's bioregions. According to Bryan et al. (2014) rain forest loss in Papua New Guinea between 2002 and 2014 was greatest in the Bismarck bioregion particularly New Britain , followed by the Sepik-Markham, Fly-Gulf and the Northern Bismarck (Manus, New Hanover, New Ireland and Bougainville) bioregions (Table 4) . All of which had rates of rainforest loss that exceed the 2002-2014 average for PNG of slightly more than 4%. Most of this loss was concentrated in the lowlands, particularly in the Adelbert Mountains and the Sepik Basin.

Most of the vertebrate biota is found in rainforest, so any loss of that habitat can potentially cause the loss of species. Amphibian species richness is highest in the mountains and is particularly high in the Bewani Mountains. These same areas are also high in restricted-range endemic species. Although pockets of these are scattered around the country. The relatively high rate of forest loss in the North Coast Ranges potentially threatens a large number of frog species endemic to the bioregion.

3.8 TRADITIONAL KNOWLEDGE AND GENETIC RESOURCES

Papua New Guinea is one of most ethnically, linguistically and culturally diverse countries on earth, with more than 850 language groups , accounting for almost one-sixth of known languages on earth , and 80% of them living in rural communities on constitutionally-

guaranteed customary land ownership and resource tenure. From the coastal communities whose livelihoods depend on fishing and collecting reef dwelling species , to the far-interior central cordillera communities reliant on freshwater and forest-dependent species, all tribal communities with equally diverse cultural diversity have a traditional classification and naming systems for the biodiversity that the present generation and their ancestors have depended upon for sustenance. The key determinants are totemic value, conspicuousness to the human eye, and utilitarian value. The greater the utilitarian value, the more fine scale the classification. For some of PNG's rural communities, a globally threatened lizard will not be identifiable in the local eyes from the dozen or more other lizard species on their land, unless that lizard is of significant totemic value to them. Totemic value can be very important in a culturally diverse country as PNG, as members of the clan believed to descend from the totem may not kill or eat totemic animal. There is therefore a need for ethno biological prioritization to be included in species conservation outcomes, where local priorities may overlap with global priorities.

Local language is the gateway to traditional ecological knowledge. With over 850 languages in Papua New Guinea, there is no simple means of accounting for the massive wealth of ethno biological detail in advance, and any project simply needs to consider traditional ecological knowledge as a necessity rather than a luxury when implementing conservation activities on customary land among PNG's rural communities (Thomas, 2011). In the face of ongoing loss of traditional knowledge in younger generations, there is the ever growing need to preserve and promote traditional ecological knowledge. Any consideration of biological diversity must take into consideration general patterns of human perceptions of biodiversity in Papua New Guinea's peoples if conservation efforts are to have any meaning to the largely rural dwelling, land-owning tribes and clans.

3.9 GLOBALLY SIGNIFICANT PLANT BIODIVERSITY AND ENDEMISM

Papua New Guinea's complex geological history has influenced its plant diversity and endemism being considered as one of the most species-rich flora areas in the world with high levels of species endemism that is estimated at around 60% (Kreft and Ketz, 2007). The country's forests consist of diverse lowland (57% of total forest cover), montane forest (29%), swamp forest (10%), dry evergreen forest (2%) and mangrove (2%). Current estimates place vascular plants at around 15,000-25,000 species. However, the general consensus among authorities is that no plant family in PNG has been adequately inventory with many species known from only single specimens or from their type localities (Conn, 1994; Takeuchi 2007b). Gideon (2015) provides a comprehensive coverage about Papua New Guinea's flora affinities, origins, species richness, and patterns of diversity and endemism.

3.10 DRIVERS AND THREATS TO BIODIVERSITY

Current threats to biodiversity in Papua New Guinea stem from various anthropogenic activities of the country's rapid growing rural population. The main threats to PNG's terrestrial biodiversity are habit loss through industrial logging, subsistence cultivation, commercial agriculture, mining, overexploitation, introduction of non-native species and climate change.

The interactions between different drivers are often complex and synergistic and in PNG's context it is important to distinguish the main drivers of biodiversity loss in order to identify and implement effective conservation strategies.

3.10.1 Industrial Logging

Land use and land use change appears to be the major driver or threat to biodiversity loss in Papua New Guinea and industrial logging has been identified as the main driver of deforestation and forest degradation accounting for 48.2 % of forest change (Shearman et al. 2008). While the actual rates of deforestation and forest degradation are contentious, Bryan and Shearman (2014) give a conservative figure of around 0.5% per annum. Logging operations across the country result in significant impacts to the forest as a result of poor logging practices (Shearman et. al. (2008). Such practice result in significant loss of forest biomass and substantial alteration in forest composition and structure including loss of habitats.

Forest cover varies greatly across the mainland Papua New Guinea and its island archipelagos. The economic value of these forests to PNG's is high and well documented. In 2005, the agriculture, fisheries and forestry sectors contributed about 38.5% of the country's real GDP which was around US$3.8 billion (PNG Forest Authority, 2007). The export of forest products alone represented 4.7% of the value of all exports from PNG, making forest products, the largest non-mineral export for the country in terms of value. The forestry industry in PNG, has been under scrutiny since in infamous Barnett Commission Inquiry in 1987. Today the balance of power between the PNGFA (representing the state), logging companies and landowners is often tilted in the companies' favour, because of their tremendous advantages in information, money and political connections. The results are commonly translated to unsustainable logging practices, social conflicts and serious environmental degradation.

Shearman et al. (2008) estimated in PNG as a whole around 1.4% 0f the country's forests were deforested annually over the period between 1972 and 2002. This percentage was equivalent to about 360, 000 hectares per year, while the FAO (2011b) calculated a rate of 0.5 % of forests, or an equivalent of around 141,000 hectares, over the last decade. The country's island archipelagos particularly the Bismarck Islands that include the Admiralty, New Ireland and New Britain recorded forests losses of up 30 - 40% with New Britain registering the highest at between 60 and 70%. Shearman et al. (2014) further conducted an analysis to estimate the contribution of each of the main drivers of forests loss between the year 2002-2014 in PNG as a whole (Table 4.)

Table 4: Change in PNG's Rainforest Area (km^2) 2002-2014

Regions	Rainforest Area 2014			Rainforest Change 2002-2014				
	Total (km^2)	Unlogged (km^2)	Logged (km^2)	Deforested (km^2)	Logged (km^2)	Deforested (%)	Logged (%)	Total Change
PNG Mainland Coastal	**200,021**	**176,865**	**23,156**	**2,553**	**5,864**	**1.3**	**2.9**	**4.2**
PNG Mainland Highlands	**40,787**	**40,643**	**144**	**406**	**0**	**1.0**	**0**	**1.0**

PNG Mainland TOTAL	**240,809**	**217,508**	**23,301**	**2,960**	**5,864**	**1.2**	**2.4**	**3.6**
PNG NGI	**37,961**	**24,359**	**13,603**	**790**	**1,842**	**2.0**	**4.6**	**6.8**
PNG TOTAL	**278,767**	**241,866**	**36,902**	**3,752**	**7,705**	**1.3**	**2.7**	**4.1**

(Source: Shearman et.al.2015)

The results showed that logging and expansion of subsistence agriculture were the main drivers although they downplay the importance of oil palm plantations, which have been the major drivers of forest loss in the lowlands of West New Britain, New Ireland including Oro and Milne Bay Provinces. A recent analysis of forest-cover change in New Britain by Buchanan et al. (2008) concluded that lowland forest is of most urgent conservation priority because it supports the largest proportion of endemic bird species ban dis under the greatest pressure from logging and oil palm plantations while forests at higher elevations are important for restricted-range bird species but are less severely threatened by deforestation at present.

3.10.2 Subsistence Agriculture

Subsistence agriculture ranks as the second biggest threat to forest degradation and deforestation in PNG accounting for around 45.6% (Bryan and Shearman, 2014). Subsistence agriculture is largely driven by PNG's rapidly growing rural population who practice shifting agriculture to sustain their livelihoods. Subsistence agriculture is largely based in PNG's highly populated highlands region. At higher population densities, more intensive gardening is required to meet local including industry driven demands for food. The latter is particularly prominent in the face of current booming mineral and hydrocarbon industry. Local and industry-driven demands for fresh food translates to increasingly shorter fallow periods and the formation of continuous garden patches and land conversion to permanent agriculture use. The current population of PNG's highlands stands at around 4 million accounting for 43% of the country's population that is accommodated within only 13.5% of PNG's land area (Shearman et. al. (2008).

Subsistence agriculture has expanded as human populations have grown and consumption patterns have changed. High population growth is driving subsistence agriculture expansion in PNG's highlands to new heights. The highlands region has become the food bowl PNG's growing towns and cities, supplying fresh vegetables and fruits. The booming mining industry gets most of its fresh food supply from the highlands, making the once subsistence level activity to a more intensified industry-driven agriculture. As cultivation is intensified, fallow period is shortened, and soil fertility is lost, and new and, often primary forest on hill slopes, is cleared. This results in deterioration in soil fertility, habitat destruction, and eventual loss of biodiversity.

3.10.3 Commercial Agriculture

Papua New Guinea is endowed with abundant natural resources that supports a robust agricultural sector. This sector is incredibly diverse that includes a wide variety of traditional "food crops" that feed the largely rural population and "commodity crops" such as coffee, cocoa, copra, rubber, spices, palm oil, sugar plantations as well as livestock production that puts cash into their pockets. The increase in demand for these commodity crops has resulted in

the clearing of large tracks of primary forest land resulting in loss of vegetation cover, loss of biodiversity and increased erosion.

Along the value chain of each crop, there is opportunity cost for loss of environmental values and commercial agriculture ranks as the third major threat to biodiversity loss in PNG. Oil palm currently leads the agricultural commodity exports and expansion and intensification of production efforts appears to be gaining momentum across the lowland of PNG and the islands in the Bismarck Archipelago. The industry has overtaken traditional commodity crops such as coffee, cocoa and copra. The provinces that have experienced large scale forest loss due to oil palm plantation expansion are West New Britain, New Ireland, Oro and Milne Bay. Most of these oil palm plantations were established during the late 1980's and many have also undergone up to 3-planting rotations including intensified VOP expansion and conversion of primary forests particularly in West New Britain and Milne Bay. It has been estimated that around 160, 000 hectares in PNG's lowlands has been converted to oil palm plantations. Associated impacts of oil palm expansion include increased settlement and smallholder agriculture and VOP blocks, as a result of people migrating to live around oil palm estates (Shearman et al. (2008).

For biodiversity, oil palm plantations are a poor substitute for native tropical forests. They support few species of conservation value, and affect biodiversity in adjacent habitats through fragmentation, edge effects and pollution.

3.10.4 Mining

Papua New Guinea's economy is undergoing an important transition, as new liquefied natural gas (LNG) production and export begin. While oil/gas sector activity in 2013/14 grew, other sectors remained relatively stagnant. Papua New Guinea ranks highly among the global mining industry and ranks 11th in gold and 13th in copper production respectively. Nickel, zinc, cobalt and chromite have been discovered including huge deposits of undeveloped mineral resources spread across the country. Oil and gas currently contribute around 9% of GDP. The mining and oil and gas industry sectors occupy dominant position in the political and economic landscape of Papua New Guinea. This has been further extended with the recent commissioning of the US$ 20 billion PNG LNG project which was projected to increase GDP to around 20 per cent (ADB, 2014). On the back of the booming mining and hydrocarbon industry, PNG has a unique opportunity to leverage significant sustainable and equitable improvements in all levels of development.

Despite the socio-economic benefit of mining, the country also faces considerable risks, if poor choices are made, the impacts of the mining and petroleum industry will be detrimental to the development prospects including high environmental costs. Mining is a significant threat to biodiversity as it leads to a large massive habitat loss which affects micro-organisms, vegetation and animals. Temperature modifications or pH as a result of mining can disrupt the livelihood of the communities that live in proximity to the site. Endemic plant and animal species are most affected since they are very sensitive and they require specific environmental conditions, even the slightest disruption of their habitats can result in extinction or put them at

high risk of being wiped out. The effects of mining activities on the biodiversity of an area is determined by the level of concentration, extent, and the nature of the contaminant.

There are species that are resistant to such disturbances while others are adversely affected to the extent of completely disappearing from the mining zone. The landscape affected by contaminants from mining sites can take a long time before they completely recover. Remediation processes do not offer any guarantees that biodiversity of the land will recover as it were before the mining activity. Aquatic organisms are also affected by the mining industry by direct poisoning from deep sea and riverine tailings disposal (Chepkemoi,2017)

The environmental aspects of the mining-led industry have in many ways the most damaging impact on sustainable human development. (UNDP, 2014). Poor environmental practices in PNG's mining industry has resulted in high environmental costs with most of the impacts of current operating mines being largely irreversible. Habitat destruction is the most important cause of biodiversity loss in the humid tropics (McNeely et al. (1995). While estimates of deforestation and forest degradation within the mining sector is not available, current assessment of the vulnerability of ecosystem in PNG where most of the mining takes place , reveals the following:

- Most of the active mines and exploration sites in PNG are located within primary forest areas
- Nearly all active mines are located in stressed watersheds
- All active mines and exploration site in PNG are located in areas identified by Conservation Assessment Needs for PNG to be of high conservation value

3.10.5 Bushfires

Wildfires are not a common natural phenomenon in tropical forests regions. Yet in 1997-1998, fires raged through 150, 829 hectares of forest in the Western Province of PNG (Shearman et al. (2008). For reptile species richness in PNG, it reaches its peak in the savannahs of the Western Province. The El Nino induced fire that raged through 160,000 hectares of forest in Western Province no doubt left a trail of destruction and significant impact on local reptilian populations.

3.10.6 Climate Change

Papua New Guinea is vulnerable to the impacts of climate change. The temperature of the ocean surrounding Papua New Guinea has a strong influence on average monthly air temperatures. Temperatures, rainfall. Tropical cyclones, droughts and prolonged flooding have frequently impacted many Papua New Guinea communities during the last several decades. Located in the West Pacific warm pool, (Figure 10), islands in the north of PNG experience rain throughout the year. Rainfall in the north of PNG is also affected by the Intertropical Convergence Zone and, to a lesser extent, the South Pacific Convergence Zone. These bands of heavy rainfall are caused by air rising over warm water where winds converge, resulting in thunderstorm activity. Being situated in the West Pacific warm pool, Paua New Guinea is among one of the island nations in the world under enormous threat from the impact of global warming and the effects of changing climate patterns.

The 4th Intergovernmental Panel on Climate Change (IPCC) report (2007) has shown scientific predictions of increased surface temperatures, thus accelerating changes in global and regional climatic patterns. In PNG, climate will likely exacerbate event-driven hazards such as coastal flooding, inland flooding and landslides, and may also introduce new hazards due to gradual shifts in climatic conditions-most prominently, further malaria penetration into the highlands, changed agricultural yields and damaged coral reefs.

Climate change will also impact on terrestrial biodiversity. The high montane peaks in PNG's interior are regularly enveloped by trade wind–derived orographic clouds, resulting in the presence of unique and diverse floral assemblages (James, 2008). Climate change simulations suggest an upward shift in the cloud layer, which may exacerbate the effects of longer and more variable dry seasons in the interior regions of PNG. Increases in air temperatures associated with climate change implies increases in evapotranspiration by vegetation which, in combination with reduced cloud contact, could lead to drying out of cloud forests, with serious implications for biodiversity (Still et al. 1999).

Papua New Guinea's terrestrial vertebrate fauna are also vulnerable to climate change impacts. The physiological boundaries of tropical terrestrial vertebrates are much narrower than temperate species, limiting their ability to cope with changing climate (Mack, 2009). Climate may impact on PNG's high elevation species. For example, increasing temperature may reduce many montane species‟ ranges, causing them to shift to higher elevations or to become locally extinct, particularly in the case of endemic restricted-range species (Colwell et al. 2008; Gasner et al. 2010).

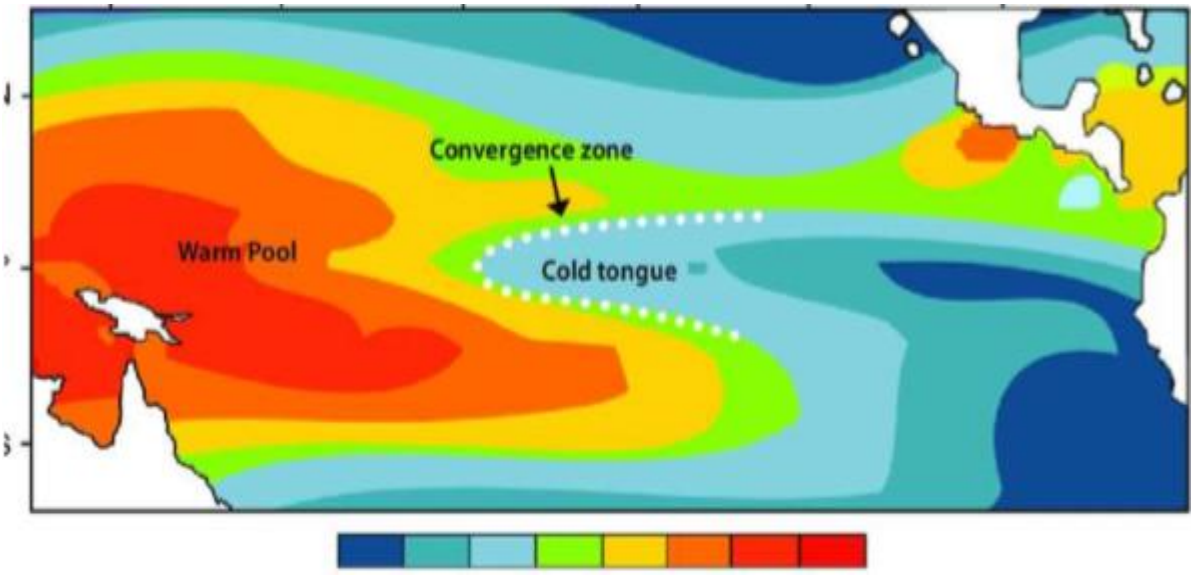


Figure 11: Located within the Pacific Warm Pool, Papua New Guinea is subject effects of

(source: https:www.researchgate.net[accessed 11 Dec, 2018).

3.10.7 Invasive Alien Species

Humans have been responsible for introducing animals and plants to new areas for thousands of years (Hartemink, 2010). With improvements in transportation and the globalization of

trade, the introduction of non-native species to new habitats and ecosystems has greatly increased. The impacts of invasive vertebrate and plant species in Papua New Guinea is difficult to assess. However, where such plants or vertebrates exist, substantial declines in species richness and displacement of native flora and fauna have been observed (Hartemink, 2010; Orapa, 2001; Allen, 1991).

A recent review by Allison & Tallowin (2014) indicates among alien invasive species reported in PNG, there are no known reptiles introduced. The cane toad (*Rhinella marina*) is the only amphibian that has established itself across the region. There are five species of birds; the rock pigeon (Columba livia), common myna (*Acridotheres tritis*), common starling (*Sturnella v*ulgaris), and two species of sparrows (*Passer domesticus, P.montanus*). There are no known invasive mammal species, despite the domestic cats (Felis catus), dog (*Canis lupus*) feral pig (*Sus scrofa*) and the rusa deer (*Cervus timorensis*) being introduced into PNG.

By far the largest introduced exotic species in Papua New Guinea are the freshwater fishes (Table 5) and exotic plants. According to Allen (1991) up to 22 species of freshwater exotic fishes were introduced to PNG since 1949. Most of these introductions were unsuccessful or were never released to the wild. Many of these early introductions were well meaning initiatives as food fish by fishery agencies. These include the common carp (*Cyprinus carpio*) introduced in 1959, including the tilapia (*Oreochromis mossambicus).* The latter now becoming naturalized in many river systems throughout the coastal regions and the former, common in few isolated localities in Sepik-Ramu river systems. Rainbow trout (*Oncorhynchus mykiss*) introduced as food fish to the PNG central highlands around 1952, where its impact has been minimal possibly due to the high elevation. A successful aquaculture hatchery and farm based on this species is now based in the highlands. Brown trout also introduced to the central highlands at around the same time as the rainbow trout, but its present status is unknown (Allen, 1991). Recent expansion of the aquaculture production in the highlands has seen the introduction of additional two species of tilapia (*Oreochromis niloticus* and *O.randalli).* Further introduction of exotic fishes of south American origin to the Sepik-Ramu River systems occurred during the late 1990's. Such introductions threaten native biodiversity by extinction or displacement (Moyle & Leidy 1992). The ecological impacts of these introductions have yet to be determined but according to local sources, both introductions have significantly reduced populations of native freshwater fishes in the areas where they occur (Correa et al. 2014).

Table 5: Native freshwater fish species

Family	Common name	Species	Source of Introduction	Reference Source
SALMONIDAE	Rainbow trout Brown trout Brook trout	*Oncorhychus mykiss* *Salmo trutta* *Salvelinus fontinalis*	Australia Australia Australia	Glucksman et al. 1976; Allen 1991; Werry 1998
CYPRINIDAE	Goldfish Common carp Grass carp Silver carp Japanese carp Green carp ?	*Carassius auratus* *Cyprinus carpio* *Ctenopharyngodonon idella* *Hypophthalmichthys molitrix* *Puntius gonionotus*	Hongkong Australia Hongkong Singapore Malaysia ? India	Glucksman et al. 1976; Allen 1991; Werry 1998

		Puntius semifasciolatus *Tor putitora*		
CHARIIDAE	Walking catfish	*Charius batrachus*	Indonesia	Glucksman et al. 1976; Allen 1991; Werry 1998
CHARACIDAE	Pacu	*Colossoma bidens*	Malaysia (native to Brazil)	Glucksman et al. 1976; Allen 1991; Werry 1998
CURIMATIDAE		*Prochilodus margravaii*	Brazil	Glucksman et al. 1976; Allen 1991; Werry 1998
POECILIIDAE	Mosquito fish Guppy Green Swordtail	*Gambusia affinis* *Poecilia reticulate* *Xiphophorus hellri*	Australia ? ?	Glucksman et al. 1976; Allen 1991; Werry 1998
CICHLIDAE	Mozambique tilapia Nile tilapia Redbreast tilapia	*Oreochromis mossambicus* *Oreochromis niloticus* *Oreochromis rendalli*	Malaysia Africa via UK Africa via UK	Glucksman et al. 1976; Allen 1991; Werry 1998
ANABANTIDAE	Climbing perch Snakehead gourami Threespot gourami	*Anabasw testudineus* *Trichogaster pectoralis* *Trichogaster trichopterus*	Indonesia Malaysia Singapore ?	Glucksman et al. 1976; Allen 1991; Werry 1998
OSPHRONEMIDAE	Giant gourami	*Osphronemus gouramy*	Malaysia	Glucksman et al. 1976; Allen 1991; Werry 1998

An overview of exotic plant species in Papua New Guinea has been provided by Orapa (2001) and Waterhouse (2003), following an earlier account by Henty and Prichard (1988). Presently, up to 90 species of exotic plant species particularly weeds were documented along the Kokoda Track (Allison and Tallowin, 2014). This recent study also recorded the presence of six of the World's worst alien invasive species; *Mikanis micrantha, Spathodea campanulata, Lanatan camara, Clidema hirta* and *Oncorhynchus mykiss*. Also recorded were seven invasive plant species that are among the top 30 weeds reported in Wet Tropics of North Queensland;mikanis *(Mikanis micrantha*),African tulip(Spathodea campanulata),Snakeweed (*Stachytarpheta spp*.),Tobacco weed (*Elephantopus mollis*), bushmint (*Hyptis spp*.), Creeping ox-eye (*Sphagneticola trilobata*) and Mexican sunflower (*Tithonia diversifolia*).

All the invasive alien plant taxa (up to 90 species) documented from the Kokoda Track represent species which have become established in Papua New Guinea, and are found commonly around villages in the lowlands, hill forests and lower montane rainforest zones throughout PNG (Allison & Tallowin, 2014). The environmental and economic costs for control or eradication of alien invasive plant species have not been given sufficient attention by relevant authorities in PNG.

Figure 12: Piper aduncum invasion of hills along the Wau-Bulolo road

3.10.8 Direct Exploitation

Hunting is a major activity for many rural men in Papua New Guinea, and it is an important part of customary practice (Dwyer 1994).The cultural reasons that underpin hunting may be changing as the global cash economy makes in roads into PNG's largely rural communities. Special considerations need to be made of cultural uses, specialised hunting practices, and the ecology of the species.

Compared to the wildlife resources available in other tropical forests, there is very little available large game in PNG forests. Because of this, a disproportionate share of the dietary income of protein from wild game for any one community comes from a very limited number of species. This creates the risk of serious consequences should any of these few species become significantly reduced in population or extirpated particularly species that are of high conservation values (e.g. tree kangaroos and echidnas). These studies strongly suggest that hunting patterns within PNG rural populations are largely unsustainable.

Government fisheries regulations such as size restrictions, gear restrictions and harvests bans exist, but are not thoroughly enforced (Huber 1994). Successful enforcement of fisheries regulations by the government is particularly complicated because.

(i) local fishers typically work on a small and dispersed scale, which makes monitoring and enforcement costly and complicated,

(ii) highly decentralized customary marine tenure regimes make coordinated management of resources over large areas difficult,

(iii) catches are multi-species which can make single-species management methods such as monitoring effort, growth and mortality expensive, and

(iv) National and provincial governments often lack adequate personnel and funding resources to monitor catch or enforce regulations.

Study by Cinner and McClanahan (2006) covered several sites across PNG showed signs of overexploitation. Their data considered mean fish lengths and trophic levels of catches were strongly related to socioeconomic characteristics such as fishing pressure, distance to markets and size of fishing grounds. Despite the subsistence nature of fisheries in PNG, the above study, found that more than half of the caught fish were bartered or sold, which suggests susceptibility to market forces. This study concluded that resource use in PNG can be driven by factors such as subsistence and market demand, resource-use rights and the prestige associated with livelihood activities (Smith 2004). Cinner and McClanahan's study found that distance to markets was positively correlated to the mean trophic level of the fish caught, suggesting that communities in close proximity to markets had likely overfished the higher value and high trophic species. Table 5 shows the types of biodiversity harvested and its uses.

Table 6: Exploitation of Ranges of Terrestrial Vertebrates in PNG

Most Hunted Vertebrates		Purpose for harvest	Method of Harvest	Source
Family	Taxon			
Tachyglossidae	*Zaglossus bruijnii*	Protein and nutrition	Cane traps, bows-arrows	Mack & West 2003
Dasyuridae	*Murexia spp.* *Dasyurus albopunctatus*	Protein and nutrition	Cane traps, bows& arrows, shotguns	Dwyer, 1985; Flannery & Seri 1990; Mack 2005; Kagl et al. 2015
Macropodidae	*Dorcopsulus vanheurni* *Dendrolagus notatus* *D.goodfellowi* *Thylogale brunii*	Protein and nutrition	Cane traps, bows& arrows, shotguns	
Phalangridae	*Phalanger gymnotis* *Spilocuscus maculatus*	Protein and nutrition	Cane traps, bows& arrows, shotguns	
Peramelidae	*Echymipera kalubu* *E. rufescens*	Protein and nutrition	Cane traps, bows& arrows, shotguns	
Muridae	*Various spp.*	Protein and nutrition	Cane traps, bows & arrows, shotguns	
Casuariidae	*Casuarius bennetti* *C.casuarius*	Protein and nutrition	Bows & arrows, shotguns	
Megapodiidae	*Aepypodius arfakianus* *Megapodius decollates*	Protein and nutrition	Cane traps, bows& arrows, shotguns	
Accipitridae	*Harpyopsis novaeguineae*	Traditional adornment	Bows & arrows	Watson & Asoyama 2001
Columbidae	*Gymnophaps albertisii*	Protein and nutrition	Cane traps, bows& arrows, shotguns	Kagl et al. 2015
Psittacidae	*Psittrichas fulgidus*	Traditional adornment, socio-cultural uses	Cane traps, bows& arrows, shotguns	Mack & Wright, 1998; Johnson et al. 2004

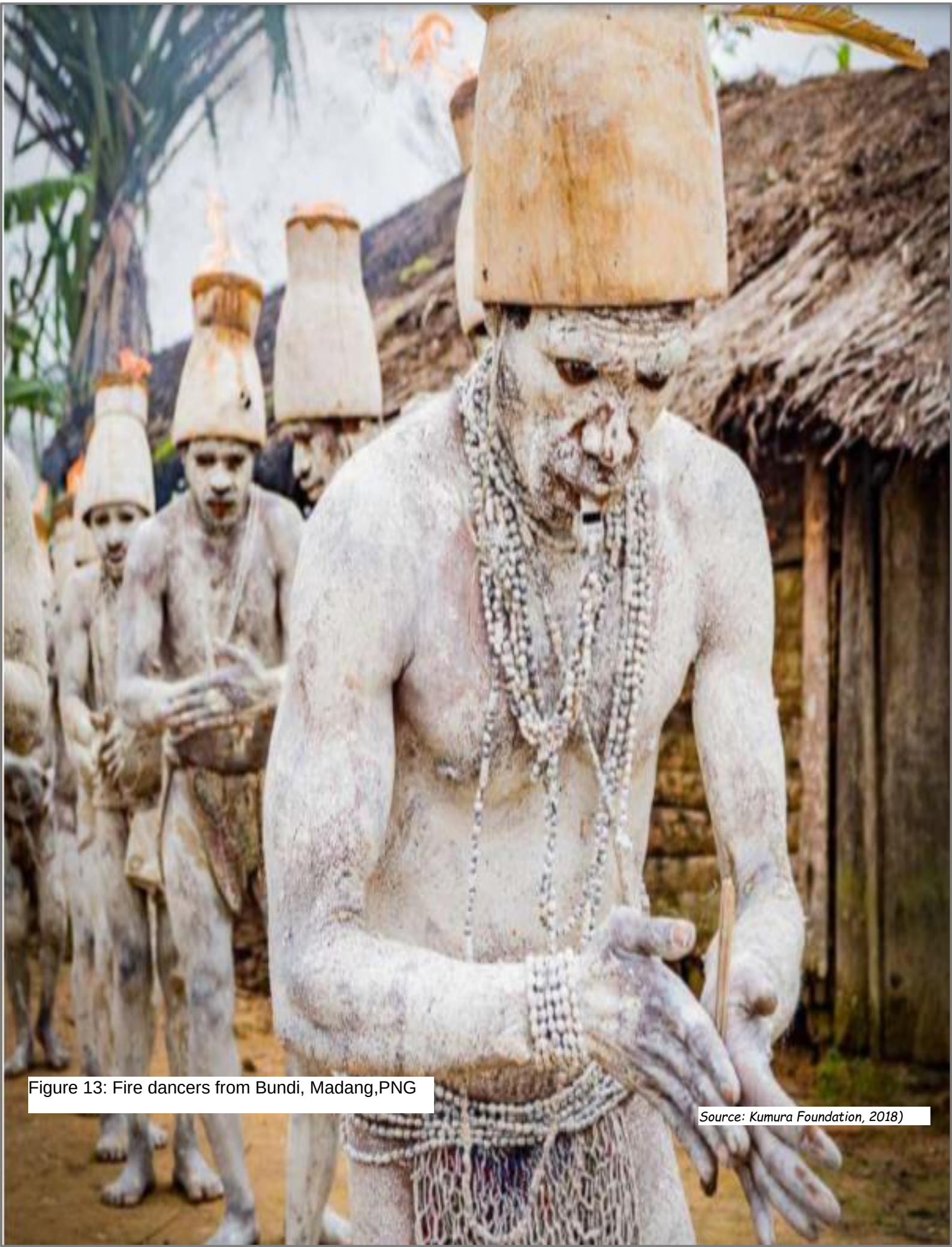


Figure 13: Fire dancers from Bundi, Madang,PNG

Source: Kumura Foundation, 2018)

CHAPTER 2

LEGAL, POLICY AND INSTITUTIONAL FRAMEWORK FOR BIODIVERSITY ACTIONS

4.0 BACKGROUND TO PNG'S ROADMAP TO THE BIODIVERSITY AGENDA

The international framework on biodiversity dates back to Stockholm Declaration of 1972. This declaration focused on the importance of human environment with the main themes on *the right to economic development of States, and the individual and collective responsibility towards environment protection, population control and poverty alleviation*. Twenty years down the environmental degradation pathway, at the Rio Conference of 1992, the global community agreed that little was done to contain environmental degradation since the Stockholm Declaration. The theme of the Rio Conference of 1992 turned to *environment and development.* The Rio Conference, two significant treaties were evolved; *The Convention on Biological Diversity (CBD)* and the *Framework Convention on Climate Change (UNFCCC).*

Since the Rio Conference, several member states adopted national biodiversity strategies called 'National Biodiversity Strategy and Action Plan' (NBSAP). The evolution of NBSAP was essentially a roadmap to guide national development programs that took into account and addressed biodiversity and development issues.

4.1 PNG'S LEGAL, POLICY AND INSTITUTIONAL FRAMEWORK ON BIODIVERSITY

The biodiversity conservation actions in Papua New Guinea are articulated within the following legal, policy and institutional framework (Table 7). Many of PNG's government agencies are sector driven and subsequently biodiversity issues are thinly spread throughout the various sectors. Many of the policies are built around the National Goals and Directive Principles, with the major themes being articulated around the 'wise use of natural resources' theme.

Conservation of the environment is enshrined PNG's Constitution and captured in the fifth pillar of the government's Vision 2050. The DSP 2010-2030 highlights concerns of deforestation and impacts of climate change and promotes specific goals to support a

sustainable environment and adopt to the domestic impacts of climate change and contribute to global efforts abate greenhouse gas emissions. Therefore, efforts to conserve natural resources and biodiversity need to become core business of government and community landowners working in partnership, whilst the governance regimes for forestry, fisheries, land and freshwater management and conservation remains to be more closely integrated. Key policies relating to environment, biodiversity and ecosystem resilience include the national Sustainable land Use Policy 2014, the Policy on Protected Areas 2014, and the Climate Change Compatible Development Management Policy 2014.

The legal and policy framework that make explicit mention of sustainability and use of certain components of biodiversity are the environment, climate change, agriculture, forestry, fisheries, and mining policies. Those policies that make implicit references to biodiversity conservation actions include the Medium-Term Development Strategies (MTDS), Transport, and Tourism.

Overall, Papua New Guinea has an extensive suite of well-developed technically sound national policies; however, the main challenge continues to be in ensuring coordinated coherent implementation of these agreed policies to deliver improved services and investments at both national and sub-national levels. Additionally, lower than anticipated government revenues, due principally to low global commodity prices, threatens to limit resources that are available for government to fund its policy agenda in the short to medium term.

Papua New Guinea's commitment to the environmental sustainability agenda is explicitly mentioned in the its Vision 2050 and the DSP 2010-2030. The country's efforts to be among the global community in addressing environment and development issues is shown by its membership to the various multilateral environmental agreements (MEAs) (Table 8).

Papua New Guinea has been among the global community in advocating the importance of the environmental sustainability agenda. Recent flux of international cooperation activity in the area of biodiversity protection and sustainable use indicates the assistance PNG is receiving to meet its obligations under the various MEAs. PNG has taken a global lead in seeking to combat climate change, particularly by proposing measures to realise the carbon abatement opportunity offered by preserving and sustainably managing tropical forests and the government of PNG through the CCDA and PNGFA have been putting much effort into the country's REDD+ readiness, with support from FAO and other development partners.

Papua New Guinea occupies a unique geographical location. It is the largest island country in the region apart from Australia and New Zealand. Given its unique biodiversity and its complex social structures, PNG faces challenges in addressing many of the obligations under the MEAS. Some of the more pertinent issues for PNG to consider in the medium to long term is to; integrate and strengthen institutional structures to implement some of the MEA obligations; the national environment sustainability agenda being given more prominence national government; the adoption of nationally designed policies and legislation on biodiversity which are conducive to PNG.

Some progress has been made towards addressing shortcomings in sustainable management issues in the agriculture, fisheries and forestry sectors. Various development partners have now taken on under their Country Programme Framework to strengthen capacity to implement biodiversity management and sustainability agenda in the country. The overall outcome sought under the assistance given by various development partners is that PNG has strengthened capacities, both human and institutional, for the sustainable management and use of fisheries, forestry, land , water, and biodiversity resources to underpin ecosystem services, store carbon, improve climate and disaster resilience and ensure food security and sustainable livelihoods.

Table 7: Key national government institutions with legal and policy framework promoting Biodiversity Conservation in Papua New Guinea

Institution/ Agency	**Policy Area/Core functions**	**Legal & Policy framework**	**Relevant Section Promoting Biodiversity Actions**	**National Programme Level**	**Alignment with agencies**
National Planning & Monitoring	Overarching National Planning & Policy Development	OLPG&LLG Act 1995 OLPG&LLG Act 1995 OLPG&LLG Act 1995 OLPG&LLG Act 1997	S25 S33A S38 S34	Provincial District LLG Ward	
Conservation & Environment Protection Authority (CEPA)	Environment Protection & Protected Areas Management	Fauna (Protection & Control) Act National Parks Act	Part IV, V & VI Section 4 & 5 Part III, Section 12-17 Part 5. Section 41 Part II, Section 4	National National Provincial National National National	PNGFA NFA CCDA DAL NAQIA
National enabling legislations and policies; Conservation Areas Act 1978; Environment Act 2000; Conservation & Environment Protection Authority Act 2014; Environment Policy 1976; Protected Areas Policy 2014					
PNG Forest Authority (PNGFA)	Forest Management	Forestry Act 1991 Forest Policy 1991	Part III, Section 48 Section 49	National Provincial	CEPA CCDA DAL NAQIA
National Fisheries Authority (NFA)	Fisheries Resource Management	Fisheries Management Act 1998 Fisheries	Part III, Section 28	National Provincial	CEPA CCDA NAQIA
Management (amendment) Act, 2015; Trial Fishing Policy; National Aquaculture Development Policy; Live Reef fish Food Policy; Fishing Aggregating Device (FAD) Management Policy; National Tuna Management Plan; Beche-de-mer Management Plan; Barramundi Management Plan; Shark Fishing Management Plan; Lobster Fishing Management Plan; Orangerie Bay Management Plan; Gulf of Papua Prawn Fishery Management Plan					

Climate Change & Development Authority (CCDA)	Climate Change Adaptation & Mitigation	Climate Change (Management) Act 2015	Part IV, Section 53 Part V ,Section 69 Part VI, Section74 & 76	National Provincial	PNGFA NFA CCDA DAL NAQIA CEPA Mining
The Climate Change (Management) Act: provides an overarching framework for Climate Change Adaptation and Mitigation in Papua New Guinea. Integration of climate change concerns into development planning and policies at all levels of government.					
Department of Agriculture & Livestock	Food Security , Sustainable agriculture & Biotechnology	NARI Act 1987	Agriculture research and development affects biodiversity through genetic modification of food crops (Biotechnology) and introduction of new food crops into the country	National Provincial	PNGFA NFA CCDA DAL NAQIA CEPA
Other enabling legislations and policies; NADP 2007-2016; NARI Strategy & Results Framework 2011-2020; National Agriculture Administration Act 2014					
National Agriculture Quarantine & Inspection Authority (NAQIA)	Biosecurity & Biotechnology	NAQIA Act 1997	Provides regulatory framework for quarantine and biosafety	National Provincial	PNGFA NFA CCDA DAL
Department of Lands & Physical Planning	Land & Landuse Planning	Physical Planning Act 1989	Part VII S67	National Provincial	PNGFA NFA CCDA DAL
Department of Mining	Sustainable mining	Mining Act 1992	Section 3,7 and 8	National	CCDA CEPA NAQIA
Department of Petroleum & Energy	Management of petroleum & energy resources	Oil and Gas Act 1998 Oil and Gas (Amendment) Act 2015 Oil and Gas Policy 2003		National	CEPA CCDA NAQIA
Department of Provincial & Local Government Affairs	Decentralization & Local level governance and enforcement of environment statues	Provincial Governments Administration Act 1997 Local –level Governments Administration Act 1997	Part III, Section 41 Section 42 Section 44	National Provincial LLG	PNGFA NFA CCDA DAL NAQIA

Department of Transport	Infrastructure development: EIS-driven road infrastructure Development & Marine pollution control	National Roads Authority Act 2003	Adoption of environmental principles in transport infrastructure development programs	National Provincial	CEPA CCDA DAL NAQIA
Other enabling legislations and policies; National Maritime Safety Authority Act 2003; National Transport Policy					
Tourism Promotion Authority	Tourism development: Protection of cultural and natural heritage properties	Tourism Promotion Authority Act 1993	Tourism Policy 2004	National Provincial	CEPA CCDA DAL NAQIA
Tourism policy is articulated to be aligned with World Bank's environmental and social safeguard policies. These safeguard policies embrace five major themes; environmental assessment, natural habitats, indigenous peoples, physical cultural resources and involuntary settlement.					
Department of Foreign Affairs & Immigration	International treaties and conventions		Lead coordination and advisory agency in signing and ratification of regional and international treaties and conventions	National	All national agencies

The MEAs in essence establish a global legal regime to address biodiversity loss. complementing national legislations in the global effort to address biodiversity loss. PNG's national legislations complement the global efforts set by the MEAs related to biodiversity conservation are of crucial importance because the legislations fill gaps and solve problems associated with the implementation of the MEAs. It is a complementary source of law for enhancing biodiversity governance process.

Table 8: List of Multilateral Environmental Agreements (MEAs) that PNG has obligations related to enhancing biodiversity governance.

Treaty	**Objectives**
1. Convention on Biological Diversity	• Conservation of biodiversity • Sustainable use of biodiversity • Equitable sharing of benefits derived from the use of biodiversity
PNG ratified the treaty in 1993. National enabling legislations that compliment CBD global objectives; Fauna (Protection & Control) Act; National Parks Act; Conservation Areas Act 1978; Environment Act 2000; Fisheries Management Act 1998; Forestry Act 1991; Climate Change (Management) Act 2015. National implementing agencies: CEPA, PNGFA, NFA, CCDA	
2. Cartagena Protocol on Biodiversity	• Contribute to the safe transfer, handling and use of LMO that may have adverse effects on the conservation and sustainable use of biodiversity, taking into account risks to human health due to transboundary movements

NAQIA Act 1997; Environment Act 2000: National implementing agencies: CEPA, NAQIA; NFA	
3. UNFCCC	• Address the universal problem of climate change
Enabling National legislations: Climate Change (Management) Act 2015; National implementing agencies: CCDA, CEPA, NFA, PNGFA	
4. UNCCD	• Land degradation
Enabling National legislations: Climate Change (Management) Act 2015; National implementing agencies: CCDA, CEPA, NFA, PNGFA	
5. Kyoto Protocol	• Evolution of issues of carbon trade and the establishment of Clean Development Mechanism (CDM), Fair & Equitable sharing of benefits on the use of genetic resources
Enabling National legislations: Climate Change (Management) Act 2015; National implementing agencies: CCDA' CEPA, NFA, PNGFA	
6. CITES	• Regulation of international trade in specimens of wild animals and plants to ensure their survival is not threatened
Enabling National legislations: International Trade (Fauna & Flora) (amendment) Act 2003; Crocodile Trade (Protection) Act Chapter 213; National implementing agencies: CEPA	
7. World Heritage Convention	• Protection of cultural and natural heritage properties
Enabling National legislations: National Parks Act, Conservation Areas Act; National implementing agencies: CEPA, NCC	
8. RAMSAR Convention	• Framework for national action and international cooperation for the conservation and wise use of wetlands and their resources
Enabling National legislations: Conservation Areas Act; National implementing agencies: CEPA	
9. Convention of Migratory Species	Framework for the conservation of migratory species of wild animals; for PNG this CMS covers marine turtles, dolphins, dugongs, all cetaceans, including migratory shore birds
Enabling National legislations: Fauna (Protection & Control) Act; National implementing agencies: CEPA, NFA	

4.2 GOVERNANCE OF BIODIVERSITY AND NATURAL RESOURCE MANAGEMENT

The mandate for the protection of biodiversity and conservation of biodiversity is vested in the Conservation Environment Protection Authority and the responsibility for the management of natural resources is a shared responsibility among state agencies such as Agriculture, Fisheries, Forestry, Mining and Petroleum. The Ministry of Environment Conservation and Climate Change through the CEPA is the lead government agency of Papua New Guinea responsible for management and conservation of biodiversity in close collaboration with Ministries of Fisheries, Forestry and Mining. These lead government agencies also have environmental sustainability aspects embedded in their sector policies and legislations. For example, the National Fisheries Authority is the lead agency for the sustainable utilization and management of fisheries and marine resources. Many of the commercial fisheries (e.g. tuna, prawn, shark,

beche-de-mer etc.) are managed under specific fisheries management plans. These management plans set out limits for sustainable fisheries through total allowable catch (TAC), size limits, closed seasons etc.

Overall, the Environment Act 2000, the CEPA Act 2014 and the recent PNG Protected Areas Policy (2014) provide the necessary framework for the management and conservation of biodiversity in Papua New Guinea. The Protected Areas Policy has five overarching pillars that provide the framework for the establishment of network of terrestrial and marine protected areas in the country.

A comprehensive review of the fisheries sector was undertaken in the early 1990‟s largely funded by external donors, primarily the Asian Development Bank, AusAid and FAO. This review led to the introduction of a new fisheries policy and a legislative enactment in 1993 and subsequent establishment of the National Fisheries Authority in 1999. The primary focus of the fisheries sector reform is the sustainable use and management of commercial fisheries resources. The narrow focus of the fisheries sector on commercial fishing activities limits its impact on generic marine biological resources including management of subsistence fishing activities of many far-flung island communities.

The forestry sector has been under close scrutiny of national and international conservation organizations since the early 1990's. A new forestry policy was introduced in 1990 on the back of the World Bank report into the forestry sector (Tropical Forest Action Plan 1986). This World Bank report also provided the fuel for the infamous Barnett Commission of Inquiry in 1987. The National Forestry Policy 1990 focused on streamlining and strengthening access to forest resources and their utilization and removing corruption from the sector. The Forestry Policy seeks to address these objectives through a series strategies that included; (1) forest management, (2) Forest Industry, (3) Forest research, (4) Forestry training and education, (5) Forestry organization and administration. The essential components of the forestry policy are designed to enhance the sector and transform it into a viable sector. Like the Fisheries Policy, the Forestry Policy also had a narrow focus on commercial production with little or no emphasis on genetic and biodiversity conservation.

National Climate Change Policy is a very recent policy that provides an overall framework for Climate Change Adaptation and Mitigation in Papua New Guinea. Climate Change being a cross-sectoral issue, the policy is very comprehensive in its coverage and is supported by and complements other national plans, policies and legislations. It further, provides mechanisms for reconciling all policies and strategies relevant to Climate Change in Papua New Guinea including integration of climate change concerns where relevant into development planning and policies at all levels of government. The Climate Change Policy is consistent and complements the main principles of the Environment Policy through the „wise use' principles ensuring that environmental protection and biodiversity conservation assume a primary role in the climate change agenda. Many of the sectoral policies include biodiversity issues in their development programs. However, biodiversity issues are spread thinly throughout the various sectors. Some policies such as the National Goals and Directive Principles, Agro-forestry

Policy, Sustainable Mining Policy do make explicit mention of certain components of biodiversity and to some extent biodiversity is treated in general context.

CHAPTER 3

THE BIODIVERSITY STRATEGY 2019- 2024

5.0 PNG VISION 2050

Papua New Guinea's Biodiversity Strategy is strongly embedded in the country's Development Strategic Plan- the PNG Vision 2050. Launched in 2009, the PNG Vision 2050 sets in motion the Government's aspiration to improve PNG‟s development index through human capital development, economic growth, better service deliver, enhanced security and international relations, environment and climate sustainability, improved community development and sound political leadership and structures.

The PNG Vision 2050 is complimented by two other development strategic plans: the PNG Development Strategic Plan 2010-2030 (PNG DSP) and Medium-Term Development Plan (MTDP) 2011-2015. Both set out key development strategies with emphasis on environment sustainability and climate resilience in the face of PNG‟s economy largely based on the extractive industries.

The Papua New Guinea Vision 2050 sets an ambitious development roadmap for the country with the vision to have PNG ranked among the top 50 nations of the world in the United Nations Development Index by 2050. The Vision 2050 nominates seven long-term priority areas: human capital development, gender, youth and people empowerment, wealth creation, institutional development and service delivery, security and international relations; environment sustainability and climate change; spiritual and community development; and strategic planning, integration and control.

The Government's Vision 2050 for Environment Sustainability and Climate Change sets out 12 targets:

- Reduction the greenhouse gas emissions by 90% to 1990 levels
- Enhance the majority of Papua New Guineans to become resilient to natural and human induced-disasters and environment changes
- Establish a Sustainable Development Policy in all sectors, particularly in forestry, agriculture, mining, energy, and oceans by 2015

- Develop, mitigation, adaptation, and resettlement measures in all impacted provinces by 2015
- Conserve biodiversity at the current 5 to 7 % of the world's biodiversity
- Establish a total of 20 national reserves, wilderness areas, and national parks
- Establish at least one million hectares of marine protected areas,
- Conserve and preserve traditional knowledge, language and cultural diversity
- Provide100% power generation from renewable energy sources
- Provide 100% of weather and natural disaster monitoring systems in all provinces
- Integrate environmental sustainability and climate change studies in primary, secondary and national high school curricula; and
- Establish an institute of Environmental Sustainability and Climate Change

5.1 GUIDING PRINCIPLES GOVERNING THE STRATEGY

Papua New Guinea's guiding principles enshrined in the Constitution under the 4th National Directive principles states "We declare our fourth goal to be for Papua New Guinea's natural resource and environment to be conserved and used for the collective benefit of us all, and to be replenished for the benefit of future generations. We accordingly call for.

- Wise use to be made of our natural resources and the environment in and on the land or seabed, in the sea, under the land, and in the air, in the interests of our development and in trust for future generations; and
- The conservation and replenishment, for the benefit of ourselves and posterity, of the environment and its sacred, scenic, an historical quality; and
- All necessary steps to be taken to give adequate protection to our valued birds, animals, fish, insects, plants and trees. These guiding principles are embedded in all the sectoral development plans and policies.

These guiding principles are further strengthened by the recent adoption of PNG's Policy on Protected Area (2014). The vision for the PNG Protected Area Network states "Our protected area network across land and sea safeguards our precious and outstanding natural and cultural heritage". Together we manage these areas effectively for all the people of Papua New Guinea.

- The PNG Protected Area Policy is built on five pillars:
- Protected area, governance and management
- Sustainable livelihoods for communities
- Effective and adaptive biodiversity management
- Managing the Protected area network; and
- Sustainable and equitable financing for protected area.

The above pillars are aligned to the fourth Goals and Directive principle of PNG's Constitution. The Guiding Principles for PNG's Protected Area Policy are therefore closely aligned to these principles and calls for:

- The PNG Protected Area Network is designed and managed for and by the PNG people
- Ecological design and management principles and practices are applied, and

- A fair and thoughtful system of management gives benefits to all

5.2 PRIORITY STRATEGIES AND TARGETS

The priority strategies for biodiversity conservation in Paua New Guinea were based on the fourth National Goal and directive principle of the PNG Constitution. PNG's environment policy promotes a sustainable development strategy through the 'wise use' principle. These principles are further enhanced through the Vision 2050, whose Environmental Sustainability and Climate Change strategy states" we owe it future generations to preserve our uniquely diverse cultures and traditions. Proper environmental management will ensure that environmental benefit will be enjoyed by the present generation and that there will be investment for future generations. It also emphasises the importance of conserving biodiversity and prompting sustainable use in development planning. PNG needs to devise appropriate strategies to deal with conservation and carbon trade issues.

Riding on the back of the PNG Vision 2050, the current MTDPIII (2018-2022) builds on the previous national development strategies with greater emphasis on sustainable and inclusive economic growth over the next five years. To achieve the overall goal of MTDPIII of '*securing our future through inclusive sustainable economic growth';* the following are the eight (8) Key Result Areas (KRAs):

- KRA1 - Increased revenue and wealth creation
- KRA 2 - Quality infrastructure and utilities
- KRA 3 -Sustainable social development
- KRA 4- Improved law and justice and national security
- KRA 5- Improved service delivery
- KRA 6- Improved governance
- KRA 7- Responsible sustainable development
- KRA 8- Sustainable population

Table 9: The alignment of the MTDP KRAs to the seven pillars of PNG Vision 2050 including the PNG DSP Objectives

PNG Vision 2050 Seven Pillars	**MTDP Key Result Areas**	**PNG DSP Objectives**	**MTDP Key Result Areas**
Sustainable social development	**KRA 3**	**Strategic Planning**	**KRA 8**
Wealth Creation	**KRA 1**	**Systems & Institutions**	**KRA 6**
Institutional Development & Service Delivery	**KRA 5**	**Human Development**	**KRA 3**
Security and International Relations	**KRA 4**	**Wealth Creation**	**KRA 1**
Environmental Sustainability and Climate Change	**KRA 7**	**Security & International Relations**	**KRA 4**
Spiritual and Community Development	**KRA 3**	**Environment & Climate Change**	**KRA 7**

Strategic Planning, Integration & Control	**KRA 6**	**Partnerships with Churches for Integral Human Development**	**KRA 3**

Papua New Guinea is a signatory to several international conventions and treaties (Table 8), including the Sustainable Development Goals (SDGs). Regular reporting to the UN General Assembly is crucial for PNG in achieving the 2030 Agenda and the SDGs. Table 10 shows the alignment of MTDP KRAs to the 17 SDGs.

The adoption of the UN Sustainable Development Goals (SDGs) in 2015, became a major new driver for information on biodiversity, and for the mainstreaming of biodiversity. The 17 Sustainable Development Goals and 169 associated targets cover all aspects of sustainable development. Of the 17 Sustainable Development Goals, three SDGs directly address the environmental dimension of sustainable development:

Goal 6: Ensure availability and sustainable management of water and sanitation for all.

Goal 14: Conserve and sustainably use the oceans, seas, and marine resources for sustainably development

Goal 15: Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss.

Other associated Sustainable Development Goals that also address environmental sustainability agenda include:

Goal 2: No Hunger

Goal 12: Ensure sustainable consumption and production patterns

Goal 13: Take urgent action to combat climate change and its impacts

In 2017, the Government of Papua New Guinea embarked on a roadmap for integrating and aligning the SDGs into its national priorities which underscored the need to fully customise the SDGs indicators to the country context in order to enhance their integration onto the processes of coordinated national development programming, including the development of national plans and strategies particularly their alignment to PNG Vision 2050 and the Development Strategic Plan (DSP) 2010-2030, and the current Medium –Term Development Plan (MTDPIII 2018-2022).

The successful localization of the SDGs has therefore paved the way for linking the SDGs to the PNG's National Strategies and cross-mapping these to the Aichi Biodiversity Targets. The four SDGs that have direct explicit environmental considerations in PNG's context and emphasized in its MTDPIII (2018-2022) are (SDGs 6,13, 14 and 15); related to water and sanitation (SDG 6), building resilience to climate change (SDG 13), coastal and marine resources and sustainable fisheries (SDG 14), sustainable use and management of terrestrial resources and ecosystem services (SDG 15). Two additional SDG goals (2 and 12),with SDG 2 addressing the genetic diversity dimension of biodiversity while SDG 12 with emphasis on

sustainable consumption and production has particular significance to PNG when considered in terms of the current trends in hunting and consumption of terrestrial vertebrate species of conservation value and coastal and marine resources subject to illegal, unreported and unregulated fishing (IUU) practices. The current MTDPIII (2018-2022) is articulated on four sustainable development growth strategies:

- Promoting PNG's environmental sustainability,
- Adaptation to climate and abatement of greenhouse gas emissions,
- Management and reduction of risks of natural disasters, and
- Sustainable use of water.

To achieve the above broad sustainable development growth considerations, the following strategies were articulated (Table 10).

Table 10: PNG's environmental sustainability goals and their alignment with SDGs.

Goals	Strategies	Alignment with SDGs
Promote PNG's Environmental sustainability	1. Improve biodiversity conservation for tourism purposes and protection of PNG's diverse flora and fauna	8, 14,15
	2. Enforce the implementation of the StaRs principle 1 associated with protecting the environment by shifting responsibility to polluters to internalise environmental cost through setting standards for penalties and fees	12.4
	3. Improve compliance of industry and municipals/urban centres for waste management regulations	12.4
	4. Improve monitoring and reporting of environmental issues and behavioural trends	13,14
	5. Promote sustainable uses of non-renewable natural assets in forestry, marine, minerals and biodiversity	14, 15
	6. Support human capital development educational, research and other environmental awareness programmes in universities aimed at developing capacities to transition to sustainable development modes of growth	12
Effective Monitoring and Mitigation of Climate Change Impacts	7. Improve systems and inventories to monitor Green House Gas emissions and account for carbon emissions	13.2 13.a
	8. Improve climate change legislative frameworks, policies, regulations and standards	9.a
	9. Seek innovative funding mechanisms for capacity building to address climate change mitigation in the country	
	10. Development policy and regulatory framework for the development of sustainable Environment and Infrastructure-development of standards and regulations for climate-proofed and resilient infrastructure	

	11. Support educational, research and development programme associated with mitigating Climate Change impacts and management	
Effective Monitoring and Natural Disaster Response System	12. Implement and enforce building standards for the construction of i8nfrastructure in disaster-prone areas 13. Establish disaster surveillance system in disaster-prone areas 14.Improve the capacity of monitoring and evaluation mechanisms to predict geophysical threats in order to raise the scope for early warning 15. Build capacity to effectively plan and deal with natural disasters	
Improve Access to Safe (drinking) Water, Reliable and Affordable Sanitation and hygiene Facilities	16. Establish National water, Sanitation and Hygiene authority to oversee and coordinate the water, sanitation and hygiene services 17. Water, sanitation, and hygiene program to provide safe water and improved sanitation services for all rural households and business houses 18. Water PNG to provide safe water and improved sanitation services to all health and education institutions in the country 19. Water PNG to provide safe water and improve sanitation services to all health and education institutions in PNG	6

5.3 KEY ACTIONS FOR BIODIVERSITY 2019-2024

Building on the actions outlined above, and the successful localization of the UN Sustainable Development Goals (SDGs) in 2017, into PNG's national context, the 2019-2023 plan maintains the core objectives and actions, while also incorporating new actions, relating to:

- Promoting PNG's Environmental Sustainability
- Building Resilience to Climate Change Impacts
- Monitoring and Reducing Risks to Natural Disasters
- Sustainable Use of Water and Improving Sanitation

PNG's environmental sustainability strategy covers three SDGs (2, 14 and 15), with dimensions of biodiversity addressed (genetic diversity, SDG 2), ecosystem and species diversity (SDG 14 and SDG 15). Climate Change is recognizing one of the direct drivers of biodiversity loss through its disruptive effects on many aspects of ecosystem function, species distributions, community structure and population dynamics. SDG 13 addresses building

resilience to climate change and natural disasters. Recognizing the synergies between the above SDGs, the 2019-2023 plan is articulated around four main environmental sustainability goals:

- Promoting biodiversity considerations and sustainability in Forests and Freshwater Ecosystems
- Promoting biodiversity considerations and sustainability in Coastal and Marine Ecosystems including Sustainable Fisheries
- Building Resilience to Climate Change and Natural Disasters
- Sustainable Use of Water Resources and Improving Sanitation

Building on the back of the above goals, the following indicative sustainable development goals and targets (Table 11) were set for the country under the current MTDP III (2018-2022).

Table 11 PNG's broad sustainable development goals and targets for MTDP III (2018-2022)

GOAL A: PROMOTE PNG'S ENVIRONMENTAL SUSTAINABILITY				
Target	**Baseline (%)**	**Indicators**	**SDGs**	**Aichi Targets**
By 2022, PNG will have ensured the protection and conservation of around 17.9% of terrestrial and freshwater ecosystems as protected areas in line with obligations under international agreements	**3.98%**	**Percentage of land area protected to maintain and improve biological diversity**	**15.1, 15.2**	**4,5**
By 2022, PNG will have conserved at least 9% of coastal and marine areas in line with its international MEA obligations	**0.21%**	**Percentage of marine area protected to maintain and improve biological diversity**	**14.4**	**5,11**
By 2022, achieve environmentally sound management of chemicals and all wastes in accordance with agreed international frameworks, and significantly reduce their release to air, water, and soil in order to minimize their adverse impacts on human health and the environment	**20%**	**Percentage of pollution complaints investigated and resolved**	**6.3**	**8**
By 2022, reduce the depletion of primary forest from the current 9% to 5% by promoting the implementation of sustainable management of	**9%**	**Primary forest depletion rate per year due to commercial agriculture, logging,**	**15.1**	**4,5,7**

all types of forests, halt deforestation, restore degraded forests and substantially increase afforestation and reforestation		**mining and urban town development**		
GOAL B: EFFECTIVE MONITORING AND MITIGATION CLIMATE CHANGE IMPACTS				
By 2022, the number of automated meteorological stations in PNG is increased for monitoring climate change impacts	**1**	**Number of automated meteorological stations increased to 5**	**13.1**	**5,10**
By 2022, PNG will have its climate change-related legal and policy framework amended, reviewed and implemented.	**1**	**Number of legislations and policies amended, reviewed, established and implemented**	**13.2**	**2,15,17**
GOAL C: IMPROVE ACCESS TO SAFE (DRINKING) WATER, RELIABLE & AFFORDABLE SANITATION & HYGIENE				
By 2022, achieve universal and equitable access to safe and affordable drinking after for all	**33%**	**Proportion (%) of rural population using an improved drinking water source improved to 50%**	**6.3, 6.5**	**8,11,14,15**
By 2022, PNG will have achieved improved access to safe (drinking) water and reliable, affordable sanitation services according to the following indicators under the WaSH project	**13%**	**Proportion of rural population using improved sanitation facilities improved to 20%**		
	88%	**Proportion of urban population using improved drinking water source improved to 100%**		
	56%	**Proportion of urban population using improved sanitation facilities improved to 80%**		
	50%	**Proportion of education and health institutions with access to safe water and sanitation services improved to 80%**		

CHAPTER 4

NATIONAL BIODIVERSITY TARGETS AND KEY ACTIONS

6.0 ACTION PLAN FOR BIODIVERSITY

Building on the sustainable development strategies and targets set by PNG in its MTDP III (2018-2022), as indicated in the previous chapter, the action plan for biodiversity encompassing national targets and key actions is articulated around CBD's five strategic goals (Table 12.). The Action Plan for Biodiversity sets the roadmap for the national actions and key actions required to achieve the global goals.

ACTION PLAN FOR BIODIVERSITY- NATIONAL TARGETS AND KEY ACTIONS

PRIORITY GOAL A: MAINSTREAMING BIODIVERSITY INTO NATIONAL, PROVINCIAL AND LOCAL LEVEL GOVERNMENT DEVELOPMENT PLANS AND STRATEGIES	
TARGETS	**KEY ACTIONS**
NATIONAL TARGET 1 **Improving our knowledge of biodiversity** With a low HDI of 0.544, PNG has a huge challenge in improving its people's knowledge of biodiversity through awareness and education	➢ Biodiversity is integrated into education curricula ➢ Empower local communities to embrace biodiversity actions, issues, and made aware of values of biodiversity and sustainable use ➢ Integrate biodiversity into universal education for all for better understanding of biodiversity values and issues ➢ Enhance partnership between local communities and NGOs to leverage biodiversity conservation actions
NATIONAL TARGET 2 Biodiversity consideration integrated into national development plans & strategies	➢ Integration to be promoted at the national level to progress government's sustainability agenda ➢ By 2030, an integrated land use planning across all sectors to promote sound management decisions on sustainable use of biodiversity ➢ Review and integrate biodiversity considerations into national, provincial and local level governments' development plans and strategies ➢ Strengthen and promote inter-agency collaboration for integration of biodiversity issues into sector policy and strategies ➢ Integrate biodiversity into universal education for all for better understanding of biodiversity values and issues ➢ By 2030, PNG people will be better informed of biodiversity values through enhanced education and awareness ➢ Enhance partnership between local communities and NGOs to leverage biodiversity conservation actions
NATIONAL TARGET 3 Strengthen capacity to limit opportunities that promote illegal and unsustainable practices in agriculture, fisheries and fisheries sectors	➢ Rationalize inefficient agrochemical usage in the agriculture, including mining subsidies that encourage contamination of surface water and ground water ➢ Integrate sustainable forest and environment management practices including Reduced Impact Logging to minimize impacts on forest ecosystem services

	➢ Effective monitoring of forest industry through PNG Logging Code of Practice ➢ Regulate certain forms of fisheries subsidies which contribute to overfishing and overharvesting, eliminate fishing activities that contribute to illegal, unreported and unregulated (IUU) fisheries ➢ Effectively promote sustainable fisheries for certain species (e.g. prawn, barramundi etc.) through fisheries management plans
NATIONAL TARGET 4 Sustainable use and protection of biodiversity promoted through improved national guidance and best industry practice	➢ By 2030, achieve sustainable management and efficient use of natural resources through the environmental sustainability agenda ➢ By 2022, PNG will strengthen sustainable forest management through a FAO capacity building assistance in PNGFA and relevant stakeholders to advocate for and implement the essential elements of a sound timber legality assurance system ➢ Upgrade infrastructure and retrofit industries to make them sustainable with increased resource-use efficiency and adoption of environmentally sound technologies ➢ Enhance sustainable fisheries through effective regulation of fisheries management plans ➢ By 2022, sustainable harvesting of wildlife and reducing threats to endangered species in PNG will be promoted through improved customary management incorporating a shift from harvesting low productivity endangered species to more productive native and domestic species through an EU-sponsored initiative implemented by FAO-WCS partnership
NATIONAL ACTION 5 Significantly reduce habitat loss through sound management practices. Degradation and fragmentation significantly reduced.	➢ By 2030, Papua New Guinea will have biodiversity integrated into its forest management system ➢ Ensure conservation, restoration and sustainable use of forests, wetlands, freshwater ecosystems and their services in line with obligation under international agreements ➢ Papua New Guinea will continue to restore ecosystem services of logged–over areas through its reforestation and forest plantation development to meet plantation-managed forest target by 2030 ➢ By 2025, review and strengthen PNG Logging Code of Practice for safeguarding ecosystem services including significant reduction in degradation and fragmentation. ➢ Enhance ecosystem services through forestry plantation development, tree planting and ‘reforestation naturally’ programmes ➢ By 2022, Papua New Guinea will have developed a National REDD+ Strategy (NRS) that addresses the negative impacts of significant drivers of forest cover change while

	supporting economic development and enabling incentives for resource owners and local communities ➢ By 2022, operational and technical capacity in PNGFA will be enhanced by FAO-funded initiative to facilitate forestry planation development and to provide guidelines on responsible governance of land tenure to support acquisition and secure land for tree growing and forest plantation development

PRIORITY GOAL B: ENHANCE BIODIVERSITY PROTECTION AND PROMOTE SUSTAINABLE USE

In 2015, Papua New Guinea, took centre stage among the 193 countries that adopted Sustainable Development Goals (SDGs), setting a new platform for achieving an ambitious set of social, economic and environmental global goals. Clearly, PNG has relatively strong policy and legal frameworks that include institutional arrangements with appropriate national development plans and strategies. However, experience has shown that enforcement and implementation of monitoring and surveillance systems to ensure compliance and adherence to PNG's laws, policies and international standards remains a challenge. In terms of biodiversity conservation, PNG's protected areas network remain small by global standards. At only four percent of the country, across 53 protected areas, the majority of which are wildlife management areas (WMAs), PNG's protected area network is limited in terms of effectiveness, ecosystem representativeness, with low levels of active management and significant evidence of infringement. Environmental protection and conservation remain a challenge in PNG's as efforts to enhance biodiversity protection and sustainable use, fall short due to resource and capacity constraints.

NATIONAL TARGET 6 **Sustainable forest management** Safeguard and maintain ecosystem services through effective management of forest, best management practices for water and soil conservation	➢ By 2022, PNGFA has strengthened capacity on monitoring forest resources across the country ➢ PNGFA will continue to progress the work on national forest inventory ➢ PNG will strengthen legislative and policy framework in the forest industry sector to support natural resource management ➢ By 2022, PNG's stakeholders have the capacity to advocate for and implement a sound timber legality assurance system ➢ By 2022, PNGFA will have secured instruments to facilitate acquisition of land for tree growing and forest plantation development ➢ By 2030, PNG will integrate ecosystem and biodiversity values into forest management and operational procedures ➢ Strengthen capacity to review and effectively implement the PNG Logging Code of Practice

NATIONAL TARGET 7 Effective pollution and waste management measures in place to minimize impacts on human health and environment	➢ Upgrade infrastructure and retrofit industries to make them sustainable with increased resource-use efficiency and adoption of environmentally sound technologies to reduce pollution ➢ By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous mining wastes including contamination of surface and ground water by agrochemicals used by expanding palm oil industry ➢ Effective monitoring and management of chemicals and all wastes through their life cycle and significantly reduce their release to air, water, and soil to minimize their impacts on human health and environment ➢ Encourage large multinational companies in PNG, to adopt sustainable practices and to integrate sustainability information into their reporting cycle ➢ Promote awareness on the need to reduce marine pollution from land-based activities including marine debris
NATIONAL TARGET 8 Invasive alien species and pathways identified, prioritized and measures are in place to manage pathways that threaten native species and ecosystems	➢ By 2030, Papua New Guinea will strengthen measures to prevent the introduction and significantly reduce the impact of invasive alien species on land, and water ecosystems ➢ Strengthen capacity including resources to assess the status of aquatic invasive alien species in the freshwater ecosystems particularly along the border areas ➢ PNG's Biosecurity Statement will be in place to ensure its biosecurity system is strong and resilient to meet challenges to its biodiversity ➢ By 2030, Papua New Guinea's border biosecurity measures will be implemented to ensure all significant invasive alien pests are controlled
NATIONAL TARGET 9 **AGRICULTURAL BIODIVERSITY**	➢ Strengthen and develop effective national strategies for conservation PNG's rich Plant Genetic Resources (PGR) ➢ Increase capacity and training in PGR conservation, evaluation, utilization and documentation ➢ Promote country-wide advocacy and awareness on the importance PGR ➢ Effective conservation and maintenance of ex-*situ* collection of crop genetic resources ➢ Strengthen and promote protected areas network for *in-situ conservation* of biodiversity resources

	➢ Strengthen on-going international collaboration on PGR programmes
NATIONAL TARGET 10 **Biodiversity & Sustainable Fisheries** Integrate biodiversity into sustainable agriculture, aquaculture, fisheries, forestry, and mining including climate change resilience agenda are practiced	➢ By 2030, Papua New Guinea will have moved towards an ecosystem approach to fisheries management that enhances sustainable tuna harvests including protection of tuna spawning and juvenile growth areas ➢ By 2030, Papua New Guinea will have in place strong legislative, policy and regulatory framework for achieving Ecosystem Approach Fisheries Management (EAFM) ➢ By 2030, PNG will effectively regulate harvesting and overfishing, illegal, unreported and unregulated fishing and destructive fishing practices ➢ Enhance capacity for local fishermen to understand sustainability of tuna fishery including the need for protection of juveniles ➢ By 2030, Papua New Guinea will have achieved a more effective and sustainable trade in live reef fish and reef-based ornamental fishery ➢ Papua New Guinea will continue to improve income, livelihoods and food security of an increasingly significant number of its coastal communities through a new sustainable coastal fisheries and poverty reduction initiative ("COASTFISH")

PRIORITY GOAL C: BUILDING RESILIENCE TO CLIMATE CHANGE MITIGATION & DISASTER RISK RESPONSE & REDUCING THREATS TO BIODIVERSITY

PNG is exposed to arrange of natural hazards-floods, landslides, drought, frost, earthquakes, cyclones, tsunamis, volcanoes, king tides, and seasonal fires. Climate change further exacerbates these risks by causing extreme weather events to occur more frequently. With limited institutional capacity and fiscal resources, including limited coordination for disaster management, PNG faces formidable challenges in addressing climate change and disaster impacts. However, developing partners have to date provided the catalyst for Papua New Guinea to enhance institutional capacity for building resilience to climate change and disaster risk. Partnerships with UN agencies (UNDP, UNEP, FAO, etc.) through the UN Development Assistance Framework (UNDAF) including Australia, EU, and Japan have greatly enhanced PNG's capacity to be resilient to climate change and disaster impacts. Much of the targets and actions for this plan have been built on the support by such partners

NATIONAL TARGET 11 Vulnerable Ecosystems	➢ PNG will continue to improve measures to manage and protect marine and coastal ecosystems to avoid significant adverse impacts vulnerable species ➢ Minimize and address the impacts of ocean acidification through enhanced cooperation at all levels ➢ By 2030, PNG will effectively regulate harvesting and overfishing, illegal, unreported and unregulated fishing and destructive fishing practices ➢ By 2030, PNG will have conserved over 10% of coastal and marine areas as protected areas through the Locally Managed Marine Areas (LMMAs) ➢ Empower local communities with capacity and resources to enhance conservation of vulnerable coastal and marine ecosystems ➢ By 2030, improved understanding of climate science will enable better prediction of PNG's future climate and identification of impacts of climate on natural resources ➢ Establish a sustainable development policy in agriculture, fisheries, forestry, mining and oceans ➢ A resilient, sustainable society through the protection and preservation of the natural environment ➢ By 2030, the management of vulnerable ecosystems and species will be increasingly considered in the face of climate change impacts ➢ By 2030, Papua New Guinea's understanding of the compounding pressures of climate change and other anthropogenic pressures on native biodiversity will have improved from current levels
NATIONAL TARGET 12 **Protected Areas** A growing nationwide network of terrestrial and marine protected areas established and effectively managed	➢ Papua New Guinea will continue to manage its 57 gazetted protected areas through improved management regimes ➢ By 2025, Papua New Guinea will have achieved 6.6% of the 17% representation and will reach or exceed the required 17% representation by 2022 ➢ By 2025, Papua New Guinea will have developed a Marine Protected Area (MPA) Policy to guide the development of MPAs ➢ By 2025, Papua New Guinea will have MPAs representing 12% of the marine ecosystems, reaching or exceeding the 10% representation target ➢ Aligned with Vision 2050, establish at least one million hectares of marine protected areas Aligned with Vision 2050, establish a total of 20 national reserves, wilderness areas and national parks

	➢ By 2022, Papua New Guinea will have effectively implemented Protected Areas Policy ➢ By 2022, Papua New Guinea will have in place the Protected Areas Bill ➢ By 2030, more PNG businesses will increasingly consider integrating best management practice principles in their development actions
NATIONAL TARGET 13 **Preventing Extinctions**	➢ By 2030, have measures in place to effectively regulate fisheries management plans to restore fish stocks or at least to levels that sustains their biological characteristics ➢ PNG will continue to take actions to reduce the degradation of natural habitats, to halt the loss of biodiversity and protect and prevent the extinction of threatened species ➢ PNG will continue improve measures to regulate CITES-listed wildlife including PNG's Red-listed threatened plant species ➢ Improve trans-border cooperation to control illegal and unregulated trade in threatened plant and wildlife species
NATIONAL TARGET 14 Integrate climate mitigation and adaption measures into national policies and strategies	➢ Mainstream climate change adaption and disaster risk reduction into development strategies and plans including budget and planning process ➢ Strengthen capacity building in CCDA and provincial and local level government staff on adaptation techniques ➢ Climate change and vulnerability assessments carried out and adaptation plans developed for target communities ➢ Enabling framework for climate-resilient infrastructure and early warning and communication network extended
NATIONAL TARGET 15 Empower communities to manage climate risks and develop resilience to climate impacts	➢ Promote an inclusive, gender-sensitive and participatory approach to decision-making on resource management and land use activities ➢ Empower communities to manage climate risks ➢ Strengthen community capacity to be climate resilient through improved awareness ➢ Strengthen and integrate climate and disaster risk resilience into national, provincial and local level government development planning ➢ Pilot early warning systems for climate change and disaster risk impacts to facilitate planning and adaptation measures

	➢ Build climate and disaster risk reduction resilient communities through education, awareness and capacity building

PRIORITY GOAL D: ENHANCING BIODIVERSITY VALUES AND ECOSYSTEM SERVICES TO BENEFIT ALL

Papua New Guinea has globally significant natural assets in forests, fisheries, inland freshwater and biodiversity. The country's natural ecosystem-based assets comprise of terrestrial ecosystems (forests and mountains etc.), inland freshwater (rivers, lakes and wetlands), coastal and marine (coral reefs, coastal wetlands, extensive maritime EEZ). The country's terrestrial ecosystem hosts over 5% of the global plant and animal species, its maritime EEZ is the source of over 10% of the global tuna harvest. The country is equally rich in water resources, yet this resource remains untapped owing to lack of human resources and political will, and to underlying financial constraints. Despite being blessed with abundant natural assets, PNG continues to face challenges in maintaining ecosystem function and resilience and biodiversity loss. Unsustainable logging, illegal, unreported and unregulated (IUU) fishing activities, including a largely fragmented and poorly coordinated water resource sector underpin challenges to sustaining biodiversity values and ecosystem services. Interventions by development partners have provided the catalyst in enhancing biodiversity values and ecosystem services to benefit PNG. Unlo9cking the vast knowledge and expertise of development partners has been the key to effectively strengthening the capacity for PNG to progress its environmental sustainability agenda for forests, fisheries, land, inland freshwater and biodiversity.

NATIONAL TARGET	KEY ACTIONS
NATIONAL TARGET 16 Enhancing biodiversity values and ecosystem services through restoration and rehabilitation	➢ By 2022, the management of vulnerable ecosystems and species will be increasingly considered in development plans in the face of climate change impacts ➢ By 2030, Papua New Guinea's understanding of the compounding pressures of climate change and other anthropogenic pressures on native biodiversity will have improved from current levels ➢ By 2022, Papua New Guinea will have improved rehabilitation of logged-over areas through 'reforestation naturally' programme ➢ PNG will continue to implement a nation-wide reforestation target of 4,200 hectares per annum ➢ By 2022, Papua New Guinea will have established Marine Protected Areas through Locally Managed Marine Areas (LMMAs) including restoration of ecosystem resilience

	➢ PNG will continue to manage and protect marine and coastal ecosystems to minimize adverse impacts including strengthening their resilience to achieve healthy and productive coastal marine waters
NATIONAL TARGET 17 Increased accessibility of PNG's urban and rural population to safe drinking water, improved sanitation and hygiene practices	➢ Improved sector coordination, including the establishment of a new authority to take on the WaSH policy implementation ➢ Increase population's access to clean drinking water and sanitation facilities for rural communities ➢ Improve access to clean drinking water and sanitation facilities for peri-urban communities ➢ Empower and engage NGOs to support the WaSH scheme through community entry ➢ Adopt and enhance management arrangements of rural water and sanitation pioneered by NGOs to be basis for WaSH sector implementation ➢ Increase capacity building in the WaSH sector
NATIONAL TARGET 18 **Enhance capacity on traditional ecological knowledge** Strengthen and develop effective national legal and policy that are aligned to Nagoya Protocol on Access and Benefit Sharing arising from the utilization of genetic resources	➢ By 2020, expand awareness-raising, experience-sharing and capacity-building actions in relation to Nagoya Protocol ➢ Develop legal and policy framework for Nagoya Protocol implementation ➢ Strengthen local communities' participation in ABS, PIC and IPR ➢ Develop greater dialogue and mutual respect and understanding on equitable benefit-sharing

PRIORITY GOAL 5: ENHANCING IMPLEMENTATION

PNG's economy has tripled in size since independence, and the growth in gross domestic product (GDP) has averaged 3.4 percent per year. In 2018, PNG successfully hosted the Asia Pacific Economic Cooperation (APEC) leaders' summit, the first time an event of this size has been managed in the country. Notwithstanding these gains, the country continues to fall short of its development potential against a backdrop of its enormous natural wealth, strategic geographic location, and young and diverse population. Despite rapid economic growth over recent decades and significant increases in government expenditures, progress on development indicators has been insufficient to support PNG's ambitious 2030 agenda including addressing its international commitments to global sustainability agenda.

NATIONAL TARGET	KEY ACTIONS
NATIONAL TARGET 19 **NBSAP adopted as a Policy Instrument and effectively implemented**	➢ By 2020, PNG will have completed its NBSAP revision through a participatory process ➢ By 2021, PNG will have effectively implemented protected area network and LLMAs, through the Protected Area Policy and Protected Area Bill
NATIONAL TARGET 20 PNG's linguistic diversity, traditional knowledge and practices on the use of biodiversity and conservation respected and integrated into development planning	➢ Papua New Guinea's institutions and local and international NGOs will continue to enhance community-led conservation programs, sustainable use of biological resources and traditional biodiversity protection practices respected and enhanced ➢ Papua New Guinea will continue to support research related to traditional ecological knowledge and practices to enhance management of natural resources ➢ Build capacity for local communities to take greater action for preservation and effective application of traditional knowledge and customary systems of sustainable use
NATIONAL TARGET 21 Sharing information and knowledge relating to biodiversity, its values, function, status and trends, and the consequences of its loss, are improved and widely shared	➢ By 2030, raising awareness and access to information on various dimensions of sustainable development including biodiversity use and ecosystem resilience are made available to local communities ➢ PNG will continue to leverage partnerships with regional and international research institutions to strengthen knowledge on biodiversity status, trends and sustainable use

	➢ Papua New Guinea will continue to support local and international NGOs to leverage the establishment of protected areas network, enhancing capacity on the utilization of terrestrial and marine resources within sustainable limits ➢ Establish improved mechanisms for collective actions and ways to aggregate and share data and scale up actions on information gaps on biodiversity knowledge, status and trends. ➢ By 2025, the collection, collation, retrieval, publication and reuse of biodiversity data across central government agencies will be improved ➢ By 2025, Papua New Guinea will have strengthened capacity and transferred biodiversity conservation, strategies and actions plans to the provincial, district, and local level governments
NATIONAL TARGET 22 Mobilize resources and identify sustainable funding mechanisms for implementing NBSAP and other biodiversity conservation actions	➢ By 2022, strengthen partnerships with development partners to identify or scale up resources for sustainable funding of NBSAP ➢ By 2022, PNG will seek development assistance to significantly increase financial resources to sustainably implement NBSAP and other conservation actions in the medium to long term

National Biodiversity Strategy , Targets and Actions

6.1 NATIONAL BIODIVERSITY STRATEGY, TARGETS AND ACTIONS

Papua New Guinea's Action Plan for Biodiversity sets forth the country's national targets and the key actions needed to achieve the CBD's five global strategic goals. This Action Plan has been expanded from Table 12 into the National Strategy, Targets and Actions. The National Strategy, Targets and Actions provide a synthesis of PNG's national targets, actions and indicators which are cross mapped to CBD's five global strategic goals, the UN Sustainable development Goals (SDGs) and relevant Aichi Targets. National institutions responsible for implementing the action plans and development partners who provide the significant catalyst to achieving the targets are also indicated. Building on the sustainable development strategies and targets set by PNG in its MTDP III (2018-2022), the national targets and actions of many of development assistance framework are also aligned to the MTDPIII as required by the Government of Papua New Guinea.

PRIORITY GOAL A: MAINSTREAMING BIODIVERSITY ACROSS GOVERNMENT AND SOCIETY

Overall, Papua New Guinea has an extensive suite of technically sound national policies; however, the major challenge continues to be ensuring coordinated coherent implementation of these agreed policies to deliver improved services and investments at both national and sub-national levels. Achieving SDGs will require a stronger government partnership with community landowners and the private sector. Mainstreaming biodiversity considerations in national development plans and strategies will remain a challenge for PNG as many national policies are sector-focused with little coherent integration opportunities

Global Strategic Goal	Target	Action	Indicators	Executing Agency	Partner (duration)/US$	SDGs	Aichi Target
GOAL A **Address the underlying causes of biodiversity loss by mainstreamin**	**National Target 1** **Improving our knowledge of biodiversity values through awareness**	**1.1** Promote mechanisms for raising capacity for effective climate change – related planning and management on climate-and disaster-prone provinces in PNG	Evidence that PNG has received technical support, including finance, technology and capacity building, for mechanisms for raising capacities for effective	CCDA, CEPA	UNDP, IOM, EU	 **13.2**	

g biodiversity across government and society			climate change-related planning and management				
	National Target 2 **Capacity building**	**2.1** Promote mechanisms for raising capacity for effective climate change – related planning and management on climate-and disaster-prone provinces in PNG	Evidence that PNG has received technical support, including finance, technology and capacity building, for mechanisms for raising capacities for effective climate change-related planning and management	CCDA, CEPA	UNDP, IOM, EU	 **13.b**	
		2.2 Improve education, awareness raising and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning	Evidence that PNG has received technical support, including finance, technology and capacity building, for mechanisms for raising capacities for effective climate change-related planning and management	CCDA, CEPA		 **13.1** 	
		2.3 Promote and strengthen awareness and education in disaster risk reduction, including disaster risk	Reduce disaster mortality in PNG by 2030, aiming to lower average mortality rate per	CCDA		 **11.5**	

		information through mass media and community mobilization	100,000 in the decade between 2020-2030 compared to 2005-2015				
		2.4 By 2030, PNG people have acquired the knowledge and skills needed to promote sustainable developments through education	Proportion of primary, secondary, technical and vocational, tertiary educational institutions having effectively integrated education for sustainable development including biodiversity conservation into the curricula	DoE		 **4.7**	
		2.5 By 2030, PNG people have the relevant information and awareness for sustainable development and lifestyles in harmony with nature	Mainstreaming of education for sustainable development (including biodiversity, climate change and disaster risk reduction) into secondary and tertiary training institutions in PNG	DoE		 **12.8**	

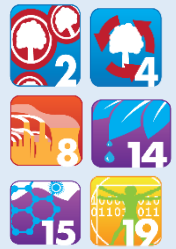
	NATIONAL TARGET 3 **Integrate biodiversity consideration across government and society**	**3.1** By 2022, PNGFA has strengthened capacity on monitoring forest across the country	National forest inventory completed, and report produced by early 2020	PNGFA; CCDA. UNITECH ; BRC	GCF	**15.1, 15.2, 15.9**	
		3.2 By 2022, PNG capacity enhanced to monitor GHG emissions and report on NDC implementation	Promotion by 2021 of a PNG agenda inspired by the Voluntary Guidelines on Responsible Governance of Tenure of Land, Fisheries and Forest	PNGFA; DAL; DLPP	$350,000	**15.9**	
		3.3 By 2022, PNG's stakeholders have capacity to advance for and implement a sound timber legality assurance system	PNGFA institutional capacity enhanced to implement timber legality assurance system BY 2022	PNGFA	GCF	**15.9**	
		3.4 By 2022, PNG forest stakeholders have technical and institutional capacity enabling them to apply tools and instruments	**3.4.1** Promotion by 2021 of a PNG agenda inspired by the Voluntary Guidelines on Responsible	PNGFA; DAL; DLPP	$350,000	**15.9**	

		for responsible governance of tenure of land to facilitate acquisition and security of land for tree growing and forest plantation development	Governance of Tenure of Land, Fisheries and Forest				
		3.5 By 2022, PNGFA will have operational and technical capacity including resources to mobilize plantation forestry development	**3.5.1** PNGFA report on plantation forestry	PNGFA;	$300,000	**15.2**	
		3.6 By 2020, research and technical capacity within PNG Forest Research Institute (FRI) strengthened	**3.6.1** Existing FRI data compiled, analysed and made available for publication, distribution and communication by 2020	FRI; PNGFA; UNITECH ; ACIAR	$100,000	**15.9**	
		3.7 By 2020, integrate ecosystem and biodiversity values into national and local planning, development processes, poverty reduction strategies and accounting	**3.7.1** Revision of National Plans to ensure environmental conservation and safeguard is captured	DNPM		**15.9**	
		3.8 climate change measures into national policies, strategies and plans	**3.8.1** Evidence that PNG has received technical support, including finance,	CCDA, CEPA	UNDP	**13.2**	

			technology and capacity building, for mechanisms for raising capacities for effective climate change-related planning and management				
		3.9 By 2021, strengthen and substantially increase the number of provinces, districts and LLGs adopting and implementing integrated policies and plans that incorporate climate change mitigation and adaptation, disaster risk reduction strategies in line with the Sendai Framework for Disaster Risk Reduction 2015-2030	Number of provinces that adopt and implement disaster risk reduction strategies in line with the National Disaster Risk Reduction Framework Percent of local governments that adopt and implement local disaster risk reduction strategies in line with National Disaster Risk Reduction Framework	CCDA	UNDP	 **1.5**  **11.b**	
	NATIONAL TARGET 4 **Strengthen institutional**	**4.1** Institutional capacity strengthened to correct and prevent incentives including subsidies that are	Existence of an effective monitoring and enforcement system	PNGFA, DAL, NFA		 **2.b**	

	capacity to eliminate or phase out incentives including subsidies that are harmful to biodiversity	harmful to biodiversity in the agriculture, fisheries and forestry sectors					
		4.2 Develop and implement measures to monitor sustainable development impacts for sustainable agriculture, fisheries and forestry	Existence of an effective regulatory system (FSC) certification	PNGFA, DAL, NFA		**12.b**	
		4.3 Prohibit certain forms of fisheries subsidies which contribute to overcapacity, overfishing including destructive fishing practices, and eliminate subsidies that contribute to illegal, unreported and unregulated (IUU), and introduce subsidies that contribute to and promote sustainable fisheries	Existence of an effective fisheries management plan for targeted species	NFA		**14.6**	
		4.4 Reduce direct disaster economic loss	Direct economic loss attributed to	CCDA			

		in relation to national gross domestic product (GDP) by 2030	disasters in relation to national gross domestic product			**11.5**	
	NATIONAL TARGET 5 **Promoting measures that sustain impacts of use of natural resources within safe ecological limits**	**5.1** By 2022, sustainable harvesting of wildlife is promoted through adoption of ecologically sustainable, culturally acceptable, and economically viable approaches for increasing the production of alternative sources of animal protein that balance demand and shift consumption away from threatened and vulnerable wildlife	Data compiled, analysed and made available for publication, distribution and communication by WCS	WCS; CEPA; PNGFA; DAL	EU	**15.5**	
		5.2 By 2022, NFA has received FAO technical support to strengthen community-based fisheries management in pilot sites for Locally Managed Marine Areas (LMMAs)	Number of FAO-supported initiatives that use inclusive and participatory approaches to validate and facilitate uptake of innovative practices for sustainable coastal fisheries management	NFA; Provincial Fisheries; NGOs	FAO $100,000	**14.5**	

		5.3 By 2030, upgrade infrastructure and retrofit industries to make them sustainable, with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes	CO_2 emission per unit of value added	CEPA, CCDA, NSO		**9.4**	

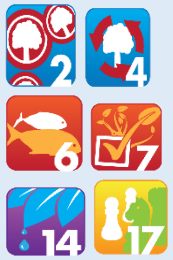
PRIORITY STRATEGY B: ENHANCE BIODIVERSITY PROTECTION AND PROMOTE SUSTAINABLE USE

Papua New Guinea's environmental sustainability agenda calls for the agriculture, fisheries and forestry sectors to be sustainable and highly profitable. The DSP 2010-2030 highlights concerns of deforestation and impacts of climate change. Therefore, efforts to conserve natural resources and biodiversity need to become core business of government and local communities.

Global Strategic Goal	Target	Action	Indicators	Executing Agency	Partner (duration) /US$	SDGs	Aichi Target
GOAL B **Reduce the direct pressures on biodiversity and promote sustainable use**	**NATIONAL TARGET 6** **Loss of all habitats at least halved, forest degradation and fragmentation significantly reduced**	**6.1** Strengthen institutional capacity in the forestry sector to significantly improve sound harvest practices to achieve sustainable management and efficient use of natural resources	Domestic material consumption, domestic material consumption per capita, and domestic material consumption per GDP	DNPM			
		6.2 Strengthen resilience and adaptive capacity of climate-related hazards and natural disasters	Existence of a national and local disaster risk reduction strategy in PNG	DMA		 **13.1**	
		6.3 Conserve designated 'fragile' areas in terrestrial and marine ecosystems consistent	Proportion of marine and coastal areas designated as protected areas	NFA, CEPA		 **14.5**	

		with national protected areas policy					
		6.4 Ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services in particular forests, wetlands, mountains drylands, in line with obligation under international agreements	Proportion of important sites for freshwater and terrestrial biodiversity that are covered by protected areas	CEPA, PNGFA		**15.1**	
		6.5 PNG will continue to promote the implementation of sustainable management of all types of forests, halt deforestation, restore degraded forests and substantially increase afforestation and reforestation	Proportion of important sites for freshwater and terrestrial biodiversity that are covered by protected areas	CEPA, PNGFA		**15.2**	 ,
		6.6 By 2030, PNG will have rehabilitated logged-over areas through 'reforestation naturally' through provincial nursery and	Proportion of land that is degraded over total land area	PNGFA		**15.3**	

		plantation forestry programmes.					
		6.7 Take urgent and significant action to the degradation of habitats, halt the loss of biodiversity and prevent extinction of threatened species	IUCN Red List Index	CEPA		**15.5**	
	NATIONAL TARGET 7 **Promote sustainable fisheries; no significant adverse impacts on threatened species and vulnerable ecosystems; ensure impacts of fisheries on stocks, species and ecosystems are maintained within safe ecological limits**	**7.1** By 2030, sustainably manage and protect marine and coastal ecosystems to avoid significant adverse impacts on vulnerable ecosystems	Proportion of PNG's EEZ managed using ecosystem-based approaches	CEPA, NFA, CCDA		**14.2**	
		7.2 By 2030, effectively regulate harvesting and end overfishing, illegal, unreported and	Proportion of fish stocks within biologically sustainable levels	NFA, CI		**14.4**	

		unregulated fishing and destructive fishing practices and implement ecosystem-based fisheries management plans					
		7.3 By 2030, increase the economic benefits to coastal and island communities from the sustainable use of marine resources	Sustainable fisheries as a percentage of GDP in PNG			**14.7**	
		7.4 By 2022, capacity built within NFA to successfully implement FAO instruments for fisheries that deter and reduce Illegal, unreported and unregulated (IUU) fishing in PNG waters	Number of processes and partnerships supported by FAO to facilitate international instruments and mechanisms that foster sustainable fisheries production and natural resource management by 2022	NFA; FFA	FAO $200,000	**14.4**	
		7.5 By 2025, PNG will have moved towards ecosystem-approach to fisheries management that enhances sustainable harvests of its tuna resources, including protection of	PNG's EEZ managed using ecosystem-based approaches			**14.2**	

		tuna spawning and juvenile growth areas					
		7.6 By 2025, empower local communities to have greater participation in conservation actions by conserving at least 10% of coastal and marine as protected areas	Proportion of marine and coastal areas designated as protected areas	CEPA, NFA		**14.5**	
		7.7 By 2025, promote ecosystem-based approaches for targeted species for sustainable production	Management plans for targeted fisheries	NFA		**14.4**	
	NATIONAL TARGET 8 **Land-based pollution monitored to levels not detrimental to human health, biodiversity and ecosystem functioning**	**8.1** Achieve environmentally sound management of chemicals and all wastes throughout their lifecycle and significantly reduce their release to air, water and soil in order to minimize their adverse impacts on human health and the environment	Hazardous waste and treated, by type of treatment	CEPA		**12.4**	

		8.2 By 2025, prevent and significantly reduce marine pollution of all kinds, in particular from land-based activities, including marine debris and nutrient pollution	Index of coastal eutrophication and flo9ating plastic debris density	CEPA, NFA		**14.1**	
	NATIONAL TARGET 9 **Improve management strategies that prevent the introduction and establishment of invasive alien species**	**9.1** By 2030, effectively strengthen measures to prevent the introduction and significantly reduce the impact of invasive alien species on land and water ecosystems and control or eradicate the priority species	Existence of relevant national legislation and adequate resourcing the prevention or control of invasive alien species	DAL, NFA, NAQIA		**15.8**	

PRIORITY STRATEGY C: BUILDINGT CLIMATE AND DISASTER RESILIENT ECOSYSTEMS, EFFECTIVE PROTECTED AREAS AND REDUCING THREATS TO BIODIVERSITY

Papua New Guinea is one of the disaster-prone countries and ranks closely behind Philippines, Indonesia and Vanuatu in having the highest percentage of population exposed to severe volcanic risk, including a range of natural hazards- floods, cyclones, landslides, droughts, frost, earthquakes, tsunamis, king tides and seasonal fires. Over 80% of PNG's population is also susceptible to extremes of climate related to the El Nino Southern Oscillation. Climate change further exacerbates the risks of natural disasters by causing extreme weather events to occur more frequently. Climate change Mitigation/Adaptation and Disaster Risk Reduction/Mitigation strategies are vital for addressing these challenges

Global Strategic Goal	Target	Action	Indicators	Executing agency	Partner (duration)/US$	SDGs	Aichi Target
GOAL C **Improve the status of biodiversity by safeguarding ecosystems, species and genetic diversity**	**NATIONAL TARGET 10** **Multiple anthropogenic pressures including climate and disasters on coral reefs minimized to maintain biological integrity and functioning**	**10.1** By 2021, targeted vulnerable island communities with CCVAP, climate resilient development plans incorporated into LLG, district and provincial plans	Twenty-one (21) vulnerable island communities with CCVAP, climate resilient development plans incorporated into LLG, district and provincial plans	CCDA; NARI; CFDA; PNG Ports	ADB (2016-2021)	13 CLIMATE ACTION **13.b**	2, 15, 17
		10.2 Climate change and vulnerability assessments carried out and adaptation plans developed for target communities	Gender responsive disaster response strategies developed in 21 vulnerable island communities	CCDA; NARI; CFDA; PNG Ports		13 CLIMATE ACTION **13.b**	2, 15, 17
			Provincial, NGOs and local community members (30%) being women) trained in	CCDA; NARI; CFDA; PNG Ports		4 QUALITY EDUCATION **4.7**	1, 19

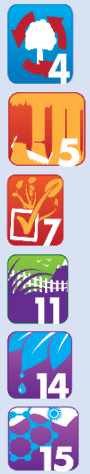
			adaptation to climate change				
			50% reduction in the incidence of waterborne and water-related diseases in target communities	CCDA; NARI; CFDA; PNG Ports		 **6**	
		10.3 By 2021, sustainable fishery ecosystem and food security investments piloted in nine (9) vulnerable island and atoll communities	Nine LMMAs established, registered with approved management plans being implemented	CCDA; NARI; CFDA; PNG Ports		 **13.b**	
			Fish populations increased by 20% in target LMMAs and food insecurity reduced by 20% from baseline figures	CCDA; NARI; CFDA; PNG Ports		 **13.b**	
			Adaptation measures against climate change in home gardens demonstrated in	CCDA; NARI; CFDA; PNG Ports		 **15.1**	

			nine target communities				
		10.4 By 2022, PNG has strengthened seven existing environment legislation/ policies including two additional natural resource management and environment protection policies/ laws forestry policies, REDD+ policy and strategy Safeguard policies	Number of sectoral policies, legislations, plans, and strategies integrating environmental protection and sustainable resource management endorsed by PNG government	Lead Agency UNDP	Partners: FAO, UNEP, IOM, CEPA, CCDA, PNGFA, MRA, NFA, DAL, DLPP, EU, JICA, ADB, WCS, TCA, TKCA	**14.2** **15.2**	
		10.5 By 2022, PNG has strengthened six medium term development plan 2018-2022 & two additional sector strategies, Renewable Energy policies, Biannual Updated Report, Third national Communication	Number of sectoral policies, legislations, plans, and strategies that incorporate Climate Change and Disaster Management strategies			**13.2**	
		10.6 By 2022, PNG, people, particularly marginalized and	International environment and climate			**1.5**	

		vulnerable, are empowered to manage climate risks, develop community resilience and generate development through significant international environment and climate funding	financing mobilized for PNG 2018-2022 (Green Climate Fund, Global Environment facility)			 **13**	
		10.7 Facilitate for development of quality, reliable, sustainable and climate and disaster resilient infrastructure in disaster-prone and vulnerable communities	Damage to number of critical infrastructures attributed to disasters			 **11.5**	
		10.8 By 2022, PNG has strengthened six medium term development plan 2018-2022 & two additional sector strategies, Renewable Energy policies, Biannual Updated Report,	Number of sectoral policies, legislations, plans, and strategies that incorporate Climate Change and Disaster Management strategies			 **13.2**	

		Third national Communication					
		10.9 By 2022, PNG, people, particularly marginalized and vulnerable, are empowered to manage climate risks, develop community resilience and generate development through significant international environment and climate funding	International environment and climate financing mobilized for PNG 2018-2022 (Green Climate Fund, Global Environment facility)			**1.5**  **13**	
	NATIONAL TARGET 11 Network of Protected Areas Established	**11.1** Strengthen PNG's efforts to protect and safeguard its cultural and natural heritage	List of nominated World Heritage sites in PNG	CEPA	UNESCO	 **11.4**	
		11.2 By 2030, sustainably manage and protect marine and coastal ecosystems to avoid significant adverse impacts on vulnerable areas	Proportion of PNG's EEZ managed using ecosystem-based approaches	CEPA, NFA, CCDA		 **14.2**	

		11.3 By 2025, conserve at least 10% of coastal and marine areas, based on ecosystem representativeness and connectivity	Proportion of protected areas established in relation to marine areas in PNG			 **14.5**	
		11.4 By 2020, ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands, mountains and drylands, in line with obligations under international agreements	Proportion of important sites for freshwater and terrestrial biodiversity that are covered by protected areas			 **15.1**	
		11.5 By 2030, ensure the conservation of mountain ecosystems, including their biodiversity, in order to enhance their capacity to provide benefits that are essential for sustainable development	Coverage by protected areas of important areas for mountain biodiversity	CEPA		 **15.4**	

		11.6 By 2022, PNG has increased its Protected Areas Network by gazettal of additional 350,000 hectares	Percentage of PNG land area including marine environment, identified and established as a Protected Area			**15.1**	
	NATIONAL TARGET 12 PNG's known threatened species prevented from extinction. Conservation status of threatened species improved through species management plans	**12.1** By 2030, effectively regulate harvesting and end overfishing, illegal, unreported, unregulated fishing (IUU) and destructive fishing practices and implement science-based management plans, in order to restore fish stocks well within safe ecological limits	Proportion of fish stocks within biologically sustainable limits	NFA, CI		**14.4**	

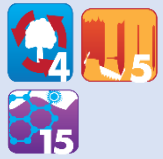
		12.2 Take urgent and significant action to reduce the degradation of natural habitats, halt the loss of biodiversity and progressively protect and prevent the extinction of threatened species	IUCN Red List Index	CEPA		 **15.5**	
	NATIONAL TARGET 13 Genetic diversity of PNG's seeds and cultivated plants and wild relatives protected and maintained in secured facilities	**13.1** By 2030, maintain the genetic diversity of seeds, cultivated plants and farmed domesticated animals and their related wild species, including through soundly managed and diversified seed and plant banks at the national level, and promote access to and fair and equitable sharing of benefits arising from the utilization of genetic resources and associates	Number of plant and animal genetic resources for food and agriculture secured in either medium or long-term conservation facilities	DAL		 **2.5**	

PRIORITY STRATEGY D: ENHANCING BIODIVERSITY VALUES AND ECOSYSTEM SERVICES TO BENEFIT ALL SUSTAINABLE USE OF WATER AND SANITATION

Majority of PNG's population (85%) live in rural communities with access to abundance of freshwater. However, PNG ranks low in terms of access to clean water and safe sanitation in the Pacific Region. An estimated 4.2 million people (61% of PNG's population) do not have access to safe drinking water and a further 3.8 million (55%) do not have access to improved sanitation. Water-borne diseases are leading causes of mortality in PNG, especially among young children. The need for access to clean drinking water and sanitation remains a development challenge. Among the development partners, EU and WBG have played a leading role in financing the Water, Sanitation and Hygiene (WaSH) project. The objective of the WaSH Policy is to provide equitable access to safe, convenient and sustainable water supply and sanitation, and to promote improved hygiene practices across PNG's under-served rural and urban areas.

Global Strategic Goal	Target	Action	Indicators	Executing agency	Partner (duration)/ US$	SDGs	Aichi Target
GOAL D **Enhance the benefits to all from biodiversity and ecosystem services**	**NATIONAL TARGET 14** **Improve PNG urban and rural populations' access to safe drinking water, sanitation and hygiene practices**	**14.1** A National Water, Sanitation and Hygiene (WaSH) Authority established to oversee WaSH project	An effective WaSH Authority established For Rural Water Supply, Sanitation and Hygiene Subsector:	NPMD		**6.1**	11 14 15
		14.2 Increase the capacity of provincial, district, and local level governments to plan and manage rural	Around 50% of Papua New Guinea's rural population has access to improved drinking water source. Around 20% of PNG's rural			**6.2**	11 14 15

		water supply development	population has access to a safe, convenient and sustainable sanitation facility				
		14.3 Develop a coherent approach for sustainable sanitation and hygiene promotion based on current initiatives	Around 80% of PNG's urban population has access to a safe, convenient and sustainable sanitation facility			 **6.2**	
		14.5 By 2030, implement integrated water resource management at all levels	Existence of an integrated water resources management implementation system in PNG	UNEP, IWRM survey		 **6.5**	
		14.5 By 2030, protect and restore water-related ecosystems including mountains, forests, wetlands, rivers, aquifers and lakes	Change in the extent of water-related ecosystems over time	CEPA, CCDA		 **6.6**	
	NATIONAL TARGET 15 **Ecosystem resilience, contribution of biodiversity to carbon stocks**	**15.1** By 2030, ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular	Forest area as a proportion of total land area	PNGFA, FRI		 **15.1**	

	enhanced through conservation and restoration	forests, wetlands, mountains, and drylands, in line with obligations under international agreements					
		15.2 By 2030, combat desertification, restore degraded land and soil, including land affected by desertification, drought and floods, and strive to achieve a land degradation-neutral world	Proportion of land that is degraded over total land area	CEPA, PNGFA, UPNG		15 LIFE ON LAND **15.3**	
		15.3 Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in PNG	Existence of a national and district and LLG disaster risk reduction strategy in PNG	CCDA		13 CLIMATE ACTION **13.1**	
	NATIONAL TARGET 16 **Develop legal and policy framework to address access genetic resources and traditional knowledge**	**16.1** By 2025, PNG will initiate national –level legal and policy framework to address issues related to Nagoya Protocol on Access to Genetic Resources.	Existence of enabling legal conditions at the national level that address a fair and equitable sharing of benefits to local people with traditional knowledge associated with utilization of genetic resources	NARI, DAL, FRI, IMR		15 LIFE ON LAND **15.6**	

	associated with these resources including a fair and equitable sharing of benefits arising from the use of genetic resources						
		16.2 Strengthen awareness among local communities on issues related to ABS, PIC and IPR	Informed decisions by local communities on ABS, PIC and IPR issues			**4.7**	

PRIORITY STRATEGY E: Enhancing Implementation

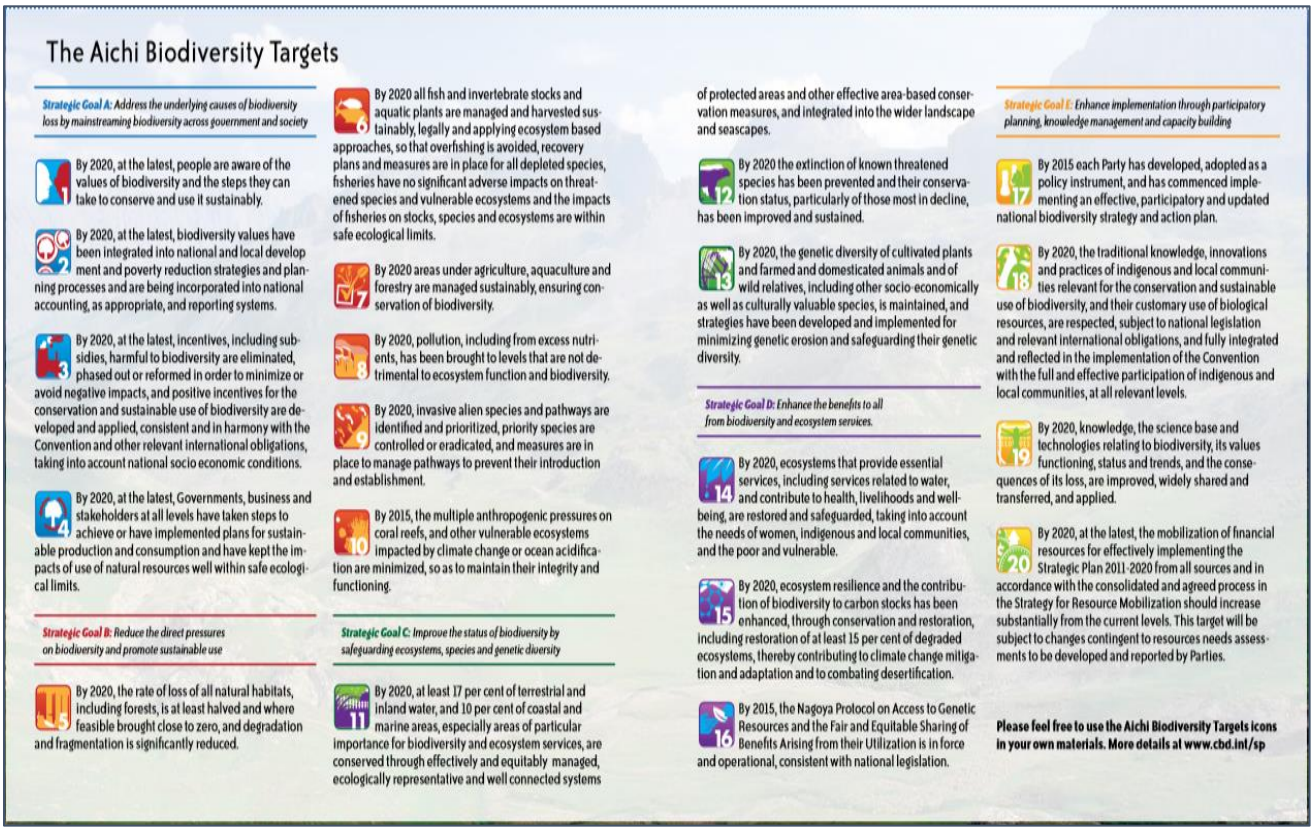
Conservation of the environment is enshrined in PNG's Constitution and captured in the fifth pillar of the government's Vision 2050. The Government of PNG has launched a new Development Cooperation Policy. This policy reflects the government's desire for improved cooperation, under which development partners will work closely with the government to ensure that programs are aligned with the new MTDPIII. The current MTDPIII (2018-2022) also calls for development cooperation to be aligned to PNG's plans and strategies. Given the magnitude of the needs across many sectors, a key challenge in PNG is to ensure close alignment and collaboration with donors in various sectors. The overall outcome sought under this NBSAP and development cooperation is that PNG has enabled capacities, both human and institutional, for the sustainable management and use of fisheries, forestry, agriculture inland freshwater, and biodiversity resources to underpin ecosystem services, store carbon, improve climate and disaster resilience and ensure food security and sustainable livelihoods.

Global Strategic Goal	Target	Action	Indicators	Executing agency	Partner (duration) /US$	SDGs	Aichi Target
GOAL E **Enhance implementation through participatory planning, knowledge management and capacity building**	**NATIONAL TARGET 17** **NBSAP strategies and action plans Adopted as policy document**	**17.1** Integrate NBSAP strategies and Action plans into national development planning, policies, and strategies	PNG's NBSAP adopted	CEPA	UNEP/UNDP	13 CLIMATE ACTION **13.2**	17
	NATIONAL TARGET 18 **Promote traditional knowledge on medicines**	**18.1** By 2030, PNG will strengthen collections and research on traditional knowledge associated with genetic resources	Trends in degree to which traditional knowledge are respected and safeguarded and incorporated into development strategies	DAL		2 ZERO HUNGER **2.5**	18

	derived from biodiversity						
		18.2 PNG's rural population depends on traditional medicines derived direct from biodiversity for their health care needs	Research and publications communicated	UPNG, IMR		3 GOOD HEALTH AND WELL-BEING **3.9,** 5 GENDER EQUALITY **5.5,** 10 REDUCED INEQUALITIES **10.2**	18
	NATIONAL TARGET 19 **Biodiversity information and knowledge shared among all stakeholders**	**19.1** Knowledge of biodiversity and ecosystem functions underpin understanding of sustainable development and conservation actions	Species checklist on major groups of terrestrial and freshwater species	CEPA, UPNG		12 RESPONSIBLE CONSUMPTION AND PRODUCTION **12.2, 12.8,** 14 LIFE BELOW WATER **14.3, 14.4**	19
		19.2 Compile a list of threatened species for PNG to guide conservation actions	IUCN Red List Index	CEPA		14 LIFE BELOW WATER **14.4**	19
	NATIONAL TARGET 20 **Mobilization of resources for sustainable implementation of NBSAP**	**20.1** Mobilize and significantly increase financial resources from all sources to conserve and sustainably use biodiversity and ecosystems including	Total Official development assistance received by PNG for conservation and sustainable use of biodiversity and ecosystems	DNPM/'CEPA		15 LIFE ON LAND **15.a**	20

		sustainable funding for national NBSAP implementation					

6.2 CBD STRATEGIC GOALS AND AICHI BIODIVERSITY TARGETS



The Aichi Biodiversity Targets

Strategic Goal A: *Address the underlying causes of biodiversity loss by mainstreaming biodiversity across government and society*

1 By 2020, at the latest, people are aware of the values of biodiversity and the steps they can take to conserve and use it sustainably.

2 By 2020, at the latest, biodiversity values have been integrated into national and local development and poverty reduction strategies and planning processes and are being incorporated into national accounting, as appropriate, and reporting systems.

3 By 2020, at the latest, incentives, including subsidies, harmful to biodiversity are eliminated, phased out or reformed in order to minimize or avoid negative impacts, and positive incentives for the conservation and sustainable use of biodiversity are developed and applied, consistent and in harmony with the Convention and other relevant international obligations, taking into account national socio economic conditions.

4 By 2020, at the latest, Governments, business and stakeholders at all levels have taken steps to achieve or have implemented plans for sustainable production and consumption and have kept the impacts of use of natural resources well within safe ecological limits.

Strategic Goal B: *Reduce the direct pressures on biodiversity and promote sustainable use*

5 By 2020, the rate of loss of all natural habitats, including forests, is at least halved and where feasible brought close to zero, and degradation and fragmentation is significantly reduced.

6 By 2020 all fish and invertebrate stocks and aquatic plants are managed and harvested sustainably, legally and applying ecosystem based approaches, so that overfishing is avoided, recovery plans and measures are in place for all depleted species, fisheries have no significant adverse impacts on threatened species and vulnerable ecosystems and the impacts of fisheries on stocks, species and ecosystems are within safe ecological limits.

7 By 2020 areas under agriculture, aquaculture and forestry are managed sustainably, ensuring conservation of biodiversity.

8 By 2020, pollution, including from excess nutrients, has been brought to levels that are not detrimental to ecosystem function and biodiversity.

9 By 2020, invasive alien species and pathways are identified and prioritized, priority species are controlled or eradicated, and measures are in place to manage pathways to prevent their introduction and establishment.

10 By 2015, the multiple anthropogenic pressures on coral reefs, and other vulnerable ecosystems impacted by climate change or ocean acidification are minimized, so as to maintain their integrity and functioning.

Strategic Goal C: *Improve the status of biodiversity by safeguarding ecosystems, species and genetic diversity*

11 By 2020, at least 17 per cent of terrestrial and inland water, and 10 per cent of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem services, are conserved through effectively and equitably managed, ecologically representative and well connected systems of protected areas and other effective area-based conservation measures, and integrated into the wider landscape and seascapes.

12 By 2020 the extinction of known threatened species has been prevented and their conservation status, particularly of those most in decline, has been improved and sustained.

13 By 2020, the genetic diversity of cultivated plants and farmed and domesticated animals and of wild relatives, including other socio-economically as well as culturally valuable species, is maintained, and strategies have been developed and implemented for minimizing genetic erosion and safeguarding their genetic diversity.

Strategic Goal D: *Enhance the benefits to all from biodiversity and ecosystem services.*

14 By 2020, ecosystems that provide essential services, including services related to water, and contribute to health, livelihoods and well-being, are restored and safeguarded, taking into account the needs of women, indigenous and local communities, and the poor and vulnerable.

15 By 2020, ecosystem resilience and the contribution of biodiversity to carbon stocks has been enhanced, through conservation and restoration, including restoration of at least 15 per cent of degraded ecosystems, thereby contributing to climate change mitigation and adaptation and to combating desertification.

16 By 2015, the Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization is in force and operational, consistent with national legislation.

Strategic Goal E: *Enhance implementation through participatory planning, knowledge management and capacity building*

17 By 2015 each Party has developed, adopted as a policy instrument, and has commenced implementing an effective, participatory and updated national biodiversity strategy and action plan.

18 By 2020, the traditional knowledge, innovations and practices of indigenous and local communities relevant for the conservation and sustainable use of biodiversity, and their customary use of biological resources, are respected, subject to national legislation and relevant international obligations, and fully integrated and reflected in the implementation of the Convention with the full and effective participation of indigenous and local communities, at all relevant levels.

19 By 2020, knowledge, the science base and technologies relating to biodiversity, its values functioning, status and trends, and the consequences of its loss, are improved, widely shared and transferred, and applied.

20 By 2020, at the latest, the mobilization of financial resources for effectively implementing the Strategic Plan 2011-2020 from all sources and in accordance with the consolidated and agreed process in the Strategy for Resource Mobilization should increase substantially from the current levels. This target will be subject to changes contingent to resources needs assessments to be developed and reported by Parties.

Please feel free to use the Aichi Biodiversity Targets icons in your own materials. More details at www.cbd.int/sp

CHAPTER 5

THE IMPLEMENTATION PLAN

7.0 KEY LESSONS LEARNED

Implementing the 2019-2023 NBSAP holds important lessons for Papua New Guinea. Improving NBSAP's future performance requires sustained, long term commitment and engagement by core implementing agencies such as CEPA, who is the focal point for biodiversity conservation actions in the country. The 2007 NBSAP holds many important lessons for PNG and highlights the importance of strong government and stakeholder ownership; the need for increased government engagement in project governance and oversight, and the importance resource allocation and capacity of personnel engaged for projects. Many of the programmes for the 2007 plan were ambitious and lack overall ownership and governance by the government and its implementing agency.

The 2019-2024 NBSAP faces the same challenges. There is no doubt, PNG has a suite of well-defined legal, policy and institutional framework to address biodiversity actions but there is greater interagency coordination and mainstreaming required to progress PNG's sustainability agenda as well as fulfilling its international obligations.

Building the 2019-2023 action plans on the back of continuing support from developing partners is an intervention that needs to be consolidated. Some of the action plans for 2019-2023 have achievable targets due to greater transparency and project governance by development partners. Projects supported by development partners whose timeframe range from 2017-2025 are among those that may have greater success in achieving the plan's targets. Such examples of donor interventions include World Bank sponsored (WaSH), UN agencies (UNDP, UNEP, GEF, UNFCCC, FAO etc.). One such intervention is the FAO Country Programming Framework (CPF) 2018-2022 that enhances capacity in the PNGFA, CCDA, NFA, DAL, DLPP as indicated in the Actions Plans (Table 4.2).

7.1 FUNDING SUPPORT

The importance of strong government ownership and increased government funding support for implementing national biodiversity actions cannot be overemphasised. There is a need to harness the support for external funding to support a long-term sustainable mechanism for NBSAP.

7.2 AGENCIES RESPONSIBLE FOR IMPLEMENTATION AND COORDINATION:

The NBSAP Technical Steering Committee

The Technical Steering Committee function is to bring together the key stakeholders to decide on all aspects of policy priority and programming in respect of the NBSAP. They should be purely executive in nature and will not have any managerial or administrative function. Existing Government Departments, NGOs and other agencies should take ownership of their strategic areas where their focus of work lies.

Sustainable development goals (SDGs), conservation and sustainable use of biodiversity are cross-cutting issues that require the joint effort of everyone involved in the resource sector (agriculture, forestry, fisheries, aquaculture, climate etc.). The active participation of agencies responsible will be crucial to achieving PNG's 2019-2024 targets. Greater interagency coordination is required to address the mainstreaming biodiversity and awareness and education, climate change and water and sanitation across all sectors in PNG. There is an urgent need to establish an interagency Working Group to coordinate the implementation of the NBSAP. The working group will be chaired by CEPA, with members from CCDA, DAL, PNGFA, NFA, UPNG, IMR and DLPP.

7.3 MONITORING AND EVALUATION

Monitoring and evaluation of the plan will be a challenge considering some of the lessons learned. It is important that the NBSAP is monitored and regularly reviewed as a part of an adaptive process. Monitoring is necessary to evaluate the progress and the effectiveness of the action plan. It sets the basis to see whether the deliverables have been aligned with the vision and mission, and whether the efforts and resources invested have delivered the desired results. The process will provide valuable feedback for future updating of the NBSAP.

A dedicated team will be established in CEPA whose task will be to compile the progress of implementation of specific actions listed in the Actions Plans. The inter-agency working group will monitor and evaluate the implementation of the NBSAP and recommend any necessary changes or adaptation to the actions in view of changing environment in Papua New Guinea.

APPENDICES

Appendix A: Consultation List

Title	Name	Designation	Organization	Contact Details	
				Email	**Ph number (+675)**
	Non-Government Organisations/Community-Based Organisations				
Mr	Ambroise Brenier	Country Director	Wildlife Conservation Society		
Mr	John Kuange	Program Manager - Highlands Region	Wildlife Conservation Society	jkuange@gmail.com	
Ms	Murralyn Kume	Project Manager	ASPLES Association	murraykume@gmail.com	
Mr	Henry Ru	Local Site Manager	KUK Heritage	henry.rud53@gmail.com	
Mr	Poka Kar	Local Manager	Kuk - Heritage	henry.rud53@gmail.com	
Mr	Dominic Titip	Team Leader	The Seed Foundation	dtitip@gmail.com	
Mr	Tobias Benzamin	Technical Support	The Seed Foundation	dtitip@gmail.com	
Mr	Vincent Kumura	Team Leader	Kumura Foundation Inc. (Eco-Tourism)	kumurafoundation@gmail.com	7912 7021
Mr	Gandine Rudolf	Technical Support	Kumura Foundation Inc. (Eco-Tourism)	kumurafoundation@gmail.com	7942 6525
Mr	Glen Timothy	Technical Support	Kumura Foundation Inc. (Eco-Tourism)	kumurafoundation@gmail.com	7433 2450
Mr	Tuaninga Isidor	Technical Support	Kumura Foundation Inc. (Eco-Tourism)	kumurafoundation@gmail.com	
Mr	Mark Doa	Site Manager	Baiyer Wildlife Sanctuary	kukipa46@gmail.com	
Mr	Wanpis Waya	Technical Support	Baiyer Wildlife Sanctuary	kukipa46@gmail.com	
Mr	John Anuabo	Project Manager	KCRMPI	januabo.sethie@gmail.com	
Mr	Kumiya Par	Ward Councilor & Community Leader	Kindkup Comm. Conserv. Area	markgeril@gmail.com	
Mr	Mark Geril	Conservation Project Lead	Kindkup Comm. Conserv. Area	markgeril@gmail.com	
Mr	Simon Simin	Project Manager	KK Reforestry Gumine Digine		73759474/7 458 3600
Mr	Dokta Gare Aina	Tabare Reforest	Tabare Reforestation Project	D.Gare@gmail.com	
Mr	David K. Mitchell	Ecology Specialist, Lead Consultant & Founder	Eco Custodian Advocates	dmitchell@conservation.org	
Mr	More Muka	Technical Person	Digne Reforestation Project		
Mr	Keith Yaen	NGO Representative	Enga Province - NGO Representative	keithambwres@gmail.com	7206 3504
Mr	Joe Korugl	Team Leader	NGO - Sughran RDA Kundiawa, Simbu Province		7064 8976
Mr	Wapo Guna	Team Leader	Forestry & Whoty Conserv., SSY, Simbu Province		7476 6997
Mr	Samson K.Dom	Tabare Reforest - Ranger	Sinesine Yongumugl District, Simbu Province		

Mr	Mr. Harry Agua	Coordinator	Callan Services Disable Association		7352 9952
Mr	Nepi Matan	Conservation Project Team	Karamui/Purari Conservation Project		7954 0911
Mr	John Ben	Team Leader	ARMF	jbenmatu@gmail.com	
Mr	Daniel S. Okena	Conservation Program Lead	Tree Kangaroo Conservation Project	daniel. okena@treekangaroo.org	
Mr	Warren Jano	Senior Field Techical Officer	Tree Kangaroo Conservation Project	wjano2009@gmail.com	
Mr	Passaro Rick	Conservation Officer	Tree Kangaroo Conservation Project	rick.passaro@treekangaroo.org	
Mrs	Rosemary Moses	Program Coordinator	TULELE PEISA INC		
	Academic Institutions				
Mr	Doris Bamna	Pri/Sch Teacher	St. Josephs, Mingende Simbu Province		7458 3091
Mr	Joe Aswe	Pri/Sch Teacher	St. Josephs, Mingende Simbu Province		7103 3045
Mrs	Christina Kapaia	Teacher	Kondiu secondary school, Simbu Province		7933 8107
Mrs	Daka Paglau	Teacher	Kondiu secondary school, Simbu Province		7042 0884
Mr	Oscar Pilang	Representative	Bulolo Forest University	olo.gebia@pnguot.ac.pg	
Mr	Tombo Warra	Senior Researcher & Forester	Bulolo Forest University	tomswarra@gmail.com	
Mr	Mr. Selarn Kaluwin	Manus Local Councillor	Community Conservation Project Lead	tskaluwin@gmail.com/	
Dr	Pongie Kichawen	Pro-vice chancellor	University of Natural Resources & Environment (UNRE)		
Dr	Aisak Pue	Pro-vice chancellor	University of Natural Resources & Environment (UNRE)		
Mr	Stanis Tavune	3rd Yr BFMR	University of Natural Resources & Environment (UNRE)		
Mr	Venantius Barubia	3rd Yr BFMR	University of Natural Resources & Environment (UNRE)		
Mr	David John	4th Yr BFMR	University of Natural Resources & Environment (UNRE)		
Ms	Jacinta Jonathan	4th Yr BFMR	University of Natural Resources & Environment (UNRE)		
	Private Sector				
Mr	Alfred Mani	Senior Research Officer	New Guinea Binatang Research	alfredmani0111@gmail.com	

Mr	Martin Mogia	Field Research Technician	New Guinea Binatang Research	mmogia16@gmail.com	
Mr	Oscar Pilang	Wildlife Officer	WWF PNG	opilang@wwfpacific.org	
Mr	John Joseph	Lead Fisheries Officer	Morobe Fisheries	jstekwiya@gmail.com	
Mr	Michael Pai	Managing Director	Power Boss PNG	Power Boss PNG Website	
	Government Department/Entity				
Mr	Benside Thomas	CEPA	CEPA	benside.thomas@gmail.com	71648530/7 624 8212
Mr	Job Opu	Senior Marine Biologist	CEPA - JICA	jobopu122@gmail.com	
Mr	Robin Yakumb	Disaster & Climate Change - Senior Officer	Disaster & Climate Change - Western Highlands Provincial Government	ryakumb777@gmail.com	
Mr	David Bonson John	Parks & Wildlife Officer	Western Highlands Provincial Government	db17john@gmail.com	
Mr	Max Yomba	Coordinator, Climate Change	Simbu Provincial Government	maxyomba7@gmail.com	
Mr	Paul Brown	Technical Officer	Disaster & Climate Change, Simbu Provincial Government	paulbrownkaupa6@gmail.com	
Mr	Peter Koima	Representative	Kundiawa Gembogl District - Reafforestation Project	peterkoima.kimdor@gmail.com	
Mr	Arnold Mundua	Representative	Kundiawa Forest Authority	arnoldmundua@gmail.com	
Mr	John Mondo	Representative	Kundiawa Gembogl District Administration		7473 3596
Mr	Junior Paul	EPG Representative	Enga Provincial Government	aijaylawton@gmail.com	7206 3504
Mr	Sakias Aine	Provincial Forest Officer	Western Highlands Provincial Government	sbundro@gmail.com	7113 2979
Mr	Matan Nepi	Conservation Tech assistant	Karamui District Administration		7954 0911
Mr	Eric Gore	Crops Officer	Simbu Provincial Government	ericdgore443@gmail.com	7259 7229
Mr	John Nime Casper	Director	Simbu Provincial Government Secretariat	nime.casper@gmail.com	7292 5998
Mr	Anton Waie	Special Projects Manager	Kerowagi District, Simbu Province		7276 6407
Mr	David Phile	First Secretary	Kerowagi District, Simbu Province		7383 9335
Mr	Bkey Sengi	Special Projects & Program Officer	Kerowagi District, Simbu Province		7165 5325
Mr	John Nilles Siune	Consultant	Market Dev. Kerowagi MP Office	jsiune@gmail.com	7196 5536
Mr	Michael Bongro	Director - Special Projects	Conservation Environment Protection Authority	mbongro@dec.gov.pg	
Mr	Victor Kerwane	Project Assistant	Conservation Environment Protection Authority	vkerwane@gmail.com	
Mr	Lawrence B. Anggo	Lead Partner PPAP Project	Simbu Province	iggypalma@2016.com	
Ms	Rose Singadan	Manager, Non-renewables	Conservation Environment Protection Authority	rose.singadan@gmail.com	

Mrs	Carolyn Kumul	NBSAP Secretariat - Project Assistant	Conservation Environment Protection Authority	carolynkumul@gmail.com	7105 1637
Mr	Roy Sai Bruce	Senior Policy Officer	Conservation Environment Protection Authority	bsroy@dec.gov.pg	
Mr	John Aruga	NBSAP Lead Consultant	Conservation Environment Protection Authority	johnaruga62@gmail.com	7388 0285
Mr	Dulex Mawegola	DAL Crops Officer (PHQ)	Simbu Provincial Government	delexmave13@gmail.com	7018 9822
Mr	Ps. Jocob Ole	Reforestation Project	Digine LLG, Simbu Province		7381 1034
Mr	Thomas Kapnil	Area Manager	Coffee Indistry Corporation, Simbu Province	tkgaria27@gmail.com	
Mr	Fredrick Ohmana	Marine Officer	Conservation Environment Protection Authority	fredrick.ohmana@gmail.com	
Mrs	Yvonne Tio	Executive Manager, Marine Environment Division	Conservation Environment Protection Authority	tioyvonne11@gmail.com	
Mr	Kelly Surum	Environment Officer	ESP Provincial Govt	surumkelly@gmail.com	
Mr	Vagi Rei	Senior Marine Officer	Conservation Environment Protection Authority	rei.vagi@gmail.com	
Mr	Derek Warakai	Climate Change Officer	WSP Provincial Govt	derekwarakai@gmail.com	
Mr	Luke Ndrasal	Senior Environment Planning Officer	Manus Provincial Government	luke.ndrasal02@gmail.com/7556 0846	
Ms	Sharon Koitut	Senior Environment Officer	Manus Provincial Government	sharon.koitut@gmail.com/7196 0957	
Mr	Desmond Vaghelo	Senior Marine Officer	West New Britian Provincial Government	dmvaghelo@gmail.com/7355 1117	
Mrs	Jane (Atip) Larme	Environment & Conservation Planner	East New Britian Provincial Government	atipjane1@gmail.com/jane.larme2018@gmail.com	
Mr	Wilson Matava	Provincial Administrator	ENB Provincial Administration		
Mr	Bernard Suruman	Manager, Marine Environment Division	Conservation Environment Protection Authority	bsuruman@gmail.com	
Mr	Levi Mano	Deputy Prov. Administrator - Socio Economic Services	ENB Provincial Administration		
Mr	Nicholas Larme	Deputy Prov. Administrator - Corporate Services for Districts & LLGs	ENB Provincial Administration		
Mrs	Rose Waigl Alphonse	Senior Policy Officer	Conservation Environment Protection Authority	rwalphonse@gmail.com	
Mr	Ludwig Ngori	Provincial Planner	ENB Provincial Administration		
Ms	Nasain Karpo	Economics Planner	ENB Provincial Administration		
Mr	Ted Mamu	Senior Techical Lead, in-country	CEPA/JICA Project	chrysencious@gmail.com	
Mr	James Sabi	Manager, Terrestrial	Conservation Environment Protection Authority	james.sabi.roaming@gmail.com	
Mr	Burney Wogan	Infrastructure Planner	ENB Provincial Administration		

Mr	Blaise Magaga	Advisor DPI	ENB Provincial Administration		
Mr	Jim Onga	World Heritage Officer	Conservation Environment Protection Authority	peiajim@gmail.com	
Mr	Enoch Pabon	Advisor Fisheries	ENB Provincial Administration		
Ms	Christina Sakato	Policy Intern	Conservation Environment Protection Authority	csakato749@gmail.com	
Mr	Tau Vegata	Policy Officer	Conservation Environment Protection Authority	tauvegata@gmail.com	
Ms	Florence Paisparea	Forestry Officer	ENB Provincial Administration		
Mr	Biatus Bito	Consultant - National Report on PNG's Conservation Status	Conservation Environment Protection Authority	bitobiatus@yahoo.com	
Ms	Joyce Linge	Advisor Lands	ENB Provincial Administration		
Ms	Gladys Piniau	Regional DAL	ENB Provincial Administration		
Ms	Nialangis Posanau	Project Assistant - UNCCD/LDN Project	Conservation Environment Protection Authority	alice.posanau@gmail.com	
Ms	Misbyl Garalom Wartovo	Regional DAL	ENB Provincial Administration		
Mr	Chris ToWatikai	Regional DAL	ENB Provincial Administration		
Mr	Wan Ruin	Regional Forestry	ENB Provincial Administration		
Mr	Simon Passingan	Representative	PFMC		

Appendix B: Multi-lateral Environment Agreements 'signed' or 'ratified' by PNG

List of Agreements where PNG's Current Status is as a 'Signatory'
ACP-EEC Conventions (Lome, 1984; and Lome, 1989)
Comprehensive Nuclear Test-Ban Treaty (New York, 1996)
Convention on Conservation of Nature in the South Pacific (Apia, 1976)
Kyoto Protocol to the United Nations Framework Convention on Climate Change (Kyoto, 1997)

List of Agreements where PNG's Current Status is as a 'Party'
Agreement establishing the South Pacific Commission (Canberra, 1947; and Amendments, Noumea, 1951 and London, 1964)
Agreement establishing the Asian Development Bank (Manila, 1965)
Agreement establishing the South Pacific Regional Environment Program (Apia, 1993)
Agreement establishing a Regional Animal Production and Health Commission for Asia and the Pacific
Agreement of the International Bank for Reconstruction and Development (Bretton Woods, 1944)
Agreement of the International Monetary Fund (Bretton Woods, 1944)
Agreement on the Rescue of Astronauts and the Return of Objects launched into Outer Space (Washington, 1968)
Articles of Agreement of the International Development Association (Washington, 1960)
Charter of the United Nations (San Francisco, 1945)
Constitution of the Food and Agriculture Organization of the United Nations (Quebec, 1945)
Constitution of the International Labour Organization (Versailles, 1919)
Constitution of the United Nations Educational Scientific and Cultural Organization (London, 1945)
Constitution of the United Nations Industrial Development Organization (Vienna, 1979)
Constitution of the World Health Organization (New York, 1946)
Convention concerning the Protection of the World Cultural and Natural Heritage (Paris, 1972)
Convention for the Protection of the Natural Resources and Environment of the South Pacific Region (Noumea, 1986)
Convention for the Protection of the Ozone Layer (Vienna, 1985)
Convention of the World Meteorological Organization (Washington, 1947)
Convention on International Civil Aviation Annex 16 - Aircraft Noise (Chicago, 1944)
Convention on International Liability for Damage caused by Space Objects (Washington, 1972)
Convention on International Trade in Endangered Species of Wild Fauna and Flora (Washington, 1973; and Amendments to Article XI, Bonn, 1979
Convention on Persistent Organic Pollutants (Stockholm, 2001)
Convention on Road Traffic (Geneva, 1949)
Convention on Wetlands of International Importance especially as Waterfowl Habitat (Ramsar, 1971; and Amendments, Paris, 1982)
Convention on the Control of Trans boundary Movements of Hazardous Wastes and their Disposal (Basel, 1989)
Convention on the International Regulations for Preventing Collisions at Sea (London, 1972)
Convention on the International Maritime Organization (Geneva, 1948)
Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (Washington, 1972; and the Amendments, Torremolinos, 1978 and Colombo, 1980)

List of Agreements where PNG's Current Status is as a 'Party' continued
Convention on the Prohibition of Military or any other Hostile Use of Environmental Modification Techniques (Geneva, 1976)

Convention on the Prohibition of the Development Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on their Destruction (Washington, 1972)
Convention on the Prohibition of the Development Production and their Destruction (Paris, 1993)
Convention to ban the Importation into Forum Island Countries of Hazardous Wastes and Radioactive Wastes and to control the Trans boundary Movement and Management of Hazardous Wastes within the South Pacific (Waigani, 1995)
International Convention for the Prevention of Pollution from Ships Hazardous Substances (London, 1978, and Amendments on Sewage and Garbage)
International Convention for the Safety of Life at Sea (SOLAS) (London, 1974)
International Convention on Civil Liability for Oil Pollution Damage (Brussels, 1969; and Amendments, Brussels, 1992)
International Convention on Standards of Training Certification and Watch keeping for seafarers (London, 1978)
International Convention relating to Intervention on the High Seas in Cases of Oil Pollution Casualties (Brussels, 1969)
International Convention relating to the Limitation of the Liability of Owners of Sea-going Ships (Brussels. 1957)
International Plant Protection Convention (Rome, 1951; and Revised Texts, Rome, 1979 and Rome, 1997)
International Tropical Timber Agreement (Geneva, 1983; and Amendments, Geneva, 1984)
Plant Protection Agreement for the Asia and Pacific Region (Rome, 1956; and Amendments, Rome, 1967)
Protocol concerning Co-orporation in Combating Pollution Emergencies in the South Pacific Region (Noumea, 1986)
Protocol for the prevention of Pollution of the South Pacific Region by Dumping (Noumea, 1986)
Protocol for the Prohibition of the Use in War of Asphyxiating Bacteriological Methods of Warfare (Geneva, 1925)
Protocol on Substances that Deplete the Ozone Layer (Montreal, 1987; and Amendments, London, 1990)
South Pacific Fisheries Treaty (Port Moresby, 1987)
South Pacific Forum Fisheries Agency Convention (Honiara, 1979)
The Antarctic Treaty (Washington, 1959)
The South Pacific Nuclear Free Zone Treaty (Rarotonga, 1985)
Treaty Banning Nuclear Weapon Tests in the Atmosphere Outer Space and Under Water (Washington, 1963)
Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, the Moon and other Celestial Bodies (London, 1967)
Treaty on the Non-Proliferation of Nuclear Weapons (Washington, 1968)
Treaty on the Prohibition of the Emplacement of Nuclear Weapons of Mass Destruction on the Sea-bed and the Ocean Floor and in the Sub-soil thereof (Washington, 1971)
United Nations Convention on the Law of the Sea (Montego Bay, 1982; and Agreements relating to the Conservation & Management of Straddling Fish Stocks and Highly Migratory Fish Stocks, New York, 1995; and implementing Part XI, New York, 1994)
United Nations Framework Convention on Climate Change (New York, 1992)
United Nations Convention on Biological Diversity (Rio de Janeiro, 1992)

List of Agreements where PNG's Current Status is as a 'Former Party'
International Convention for the Prevention of the Sea by Oil 1962 and 1969 (London, 1954)
International Convention for the Safety of Life at Sea (London, 1960)

References

Allen, G.R. (1991) Freshwater fishes of New Guinea. Christensen Research Institute, Madang: Papua New Guinea, 268pp.

Allison, A. (2009) New Guinea, biology, p.652-659. In: Encyclopaedia of islands. R.C. Gillespie and D.A. Claque (eds.). University of California, Berkley.

Allison, A., Pratt,L., Pratt,L. and Imada, C. 2015.Exotic species survey of the Kokoda Track , Papua New Guinea. A report prepared for CEPA, Port Moresby. Bishop Museum Technical Report No.67

Allison, A., and Tallowin, O. (2015) Occurrence and status of Papua New Guinea vertebrates. In: J.E. Bryan and P.L.Shearman (eds.) The state of forests of Papua New Guinea: measuring change over period 20022014. Port Moresby: University of Papua New Guinea, pp.87-101

Austin, C.C., Hayden, C.J., Bigilale, I, I and Dahl, C. 2008. Checklist and comments on the terrestrial amphibians and reptiles of Utai, north-western, Papua New Guinea. Herpetological Review 391 (1):40-46

Baldwin, S.L., P.G.Fitzgerald, and L.E.Webb (2012) Tectonics of the New Guinea. Annual Review of Earth and Planet Science, 40:495-520

Barrows, L.R., Matainaho, T.K, T.K., Ireland, C.M., Miller, S., Carter, G.T et al. 2009. Making the most of Papua New Guinea‟s biodiversity: establishment of an integrated set of programs that link botanical survey with pharmacological assessment in “The Land of the Unexpected”. Pharmaceutical Biology, 47 (8): 795-808

Beehler, B.M. (1982) Ecological structuring of forest bird communities in New Guinea, p.837-861. In: Monographiae Biologicae.Vol.42. J.L. Gressitt (ed.). Dr.W.Junk Publishers, The Hague.

Bickford, d., Howard, S.D., Ng, D.J.J., and Sheridan, J.A. (2010) Impacts of climate change on the amphibians and reptiles of Southeast Asia. Biodiversity and Conservation 19.1043-1062.

Brooks,T.M., Mittermeier, R.A., da Fonseca,G.A., Gerlach, J., Hoffmann,M., Lamoreux,J.F., Mittermeier,C.G.,Pilgrim,J.D., & Rodrigues,A.S. 2006. Global biodiversity conservation priorities. Science 313 (5783):58-61

Butler, J.R.A., T.Skewes, D.Mitchell, M.Pontio and T.Hill (2014) Stakeholder perceptions of ecosystem declines in Milne Bay, Papua New Guinea: is human population a more critical driver than climate change ?Marine Policy 46:1-13

Chatterton, P., Yamuna,R., Higgins-Zogib,L., Mitchell,N., Hall,M., Jano,W., Duguman,J., Mogina,J., Mowbray,D.,Melick,D., and Leggett,M. 2006. Papua New Guinea: Management effectiveness of PNG‟s Protected areas using WWF‟s RAPPAM Methodology WWF and Partners.

Cinner, J.E. (2009) Migration and coastal resource use in Papua New Guinea.iOcean and Coastal Management, 52 (8), pp.411-416

Cinner, J.E., and McClanalan, T.R, T.R. (2006) Socioeconomic factors that lead to overfishing in small-scale coral reef fisheries of Papua New Guinea. Environmental conservation 33:73-80

Colwell, R.K., Brehm, G., Cardelus, C.L., Gilma, A.c., and Longino, L.T. (2008) Global warming, elevational range shifts and lowland biotic attrition in the Wet Tropics. Science 322: 258-26 De Boer, A.J., Duffels, J. 1996. Historical biogeography of the cicadas of Wallacea, New Guinea and the West Pacific: a geotectonic explanation, Palaeogeography, Paleoclimatology Palaeoecology, 124:153-177

Diamond, J.M. 1972. Avifauna of the eastern highlands of New Guinea.Nuttall Ornithological Club, 438

Diamond, J.M. 1973. Distributional ecology of New Guinea birds, p.759769. In: Science, Vol.179

Drew, J.A., Amatangelo, K.L., and Hfbauer, R.A. 2015. Quantifying the human impacts on Papua New Guinea reef communities across space and time. Plos ONE 10 (10):eo140682, p.1-11

Dutson, G.C.L. 2011. Birds of Melanesia: The Bismarck's, Solomons, Vanuatu and New Caledonia. Christopher Helm London.

Dwyer, P.D. 1975.Observations on the breeding biology of some New Guinea murid rodents. Australian Wildlife Research 2:33-45

Fine, P. 2015. Ecological and evolutionary drivers of geographic variation in species diversity. Annual Review of Ecology, Evolution and Systematics, 46: 369-392

Flannery, T.F. (1995) Mammals of the south-west Pacific and Mollucan islands. Chatswood: Australian Museum and Reed Books.

Flannery, T.F. (1995) Mammals of New Guinea. Chatswood and Reed Books, Australia, 568pp.

Flannery, T.F., and Serial. (1990) the mammals of southern west Sepik province, Papua New Guinea: their distribution, abundance, human use and zoogeography. Records of the Australian Museum 42 (2):173-208 Gasnier, M.R., Jankowski, J.E., Cieka, A.L., Kyle, K.O., and Rabenold, K.N. (2010) projecting the impacts of climate change on a Central American montane avian community. Biological conservation 143: 12501258

Georges, A., Zhang, X., Unmark, P., Reis, B.N., Le, M., and McCord, W.P (2014) Contemporary genetic structure of an endemic freshwater turtle reflects Miocene orogensis of Papua New Guinea. Biological Journal of the Linnean Society, 111:196-208

Gideon, O. (2015) the flora of New Guinea: its origins, affinities, and patterns of diversity and endemism. In. J.E. Bryan and P.L.Shearman (eds.) the state of forests of Papua New Guinea: measuring change over period 2002-2014. Port Moresby: University of Papua New Guinea, pp.115-135.

Government of Papua New Guinea. 2014. Papua New Guinea Policy on Protected Areas. Conservation and Environment Protection, Port Moresby, Papua New Guinea.

Government of Papua New Guinea. 2014. National climate change compatible development strategy. Climate Change Development Authority, Port Moresby, Papua New Guinea.

Government of Papua New Guinea. 2015. National Marine Conservation Assessment for Papua New Guinea, Port Moresby. www.environment.gov.au/marine/publications/national-marineconservation-assessment-png.

Government of Papua New Guinea. 2015. National Strategy for Responsible Sustainable Development for Papua New Guinea (STaRs): Department of National Planning and Development, Port Moresby.

Government of Papua New Guinea. 2015. National Marine Conservation Assessment for Papua New Guinea, Port Moresby. www.environment.gov.au/marine/publications/national-marineconservation-assessment-png.

Government of Papua New Guinea. 2015. National Marine Conservation Assessment for Papua New Guinea, Port Moresby. www.environment.gov.au/marine/publications/national-marineconservation-assessment-png.

Government of Papua New Guinea. 2015. National Marine Conservation Assessment for Papua New Guinea, Port Moresby. www.environment.gov.au/marine/publications/national-marineconservation-assessment-png.

Government of Papua New Guinea. 2015. National Marine Conservation Assessment for Papua New Guinea, Port Moresby. www.environment.gov.au/marine/publications/national-marineconservation-assessment-png.

Gressitt, J.H. 1982 (ed.). Biogeography and Ecology of New Guinea. Vol.1, Monographiae Biologicae, Dr.W Junk Publishers, the Hague Gressitt, J.H. 1984. Systematic and biogeography of the longhorn beetle tribe Tmesisterini. Pac. Insects Monogr. 41:1-263

Hartemink, A.E. (2010) the invasive shrub Piper aduncum in Papua New Guinea: a review. Journal of Tropical Forest Science, 22 (2): 202213 Henty, E.E. and Pritchard, G.H. 1988.Weeds of New Guinea and their control. Department of Forests, Lae.

Hope, G.S. 1976. The equatorial Glaciers of New Guinea, Results of the 1971-1973 Australian Universities' Expedition to Irian Jaya, Survey, Glaciology, Meteorology, Biology and Palaeoenvironments, Balkema.

IUCN (International Union for Conservation of Nature), 2018-late update, the IUCN Red List of Threatened Species. Version 2018-1 Table 5, 6a, 6b, 8a, 8b, 8c Available at: http://www.iucnredlist.org. Accessed 12 August, 2018

James, S.A. (2008) Climate change impacts on native plant communities in Melanesia.Honululu: Bishop Museum.

Joseph, I., Slikas,B., Alpers,D., & Schodde,R. (2001) Molecular systematics and phylogeography of New Guinea logrunners (Orthonychidae).Emu 101:273-280

Kagl, J.P., Whitmore, N., and Aplin, K.P (2015) Traditional and local ecological knowledge. In: Richards & Whitmore (Eds.)

Kalkman, V.J., Dijkstra, K.B., Dow, R.A., Stokvis, F.R., &van Tol, J. (2013). Out of Australia: the Argiolestidae reveal the Melanesian Arc system and East papua Composite Terrane as possible ancient dispersal routes to the Indo-Australian archipelago (Odonata, Argiolestidae), Natural Biodiversity Centre, Leiden.

Kreft, H., and Jetz, W. (2007) Global patterns and determinants of vascular plant diversity. Proceedings of the Natural Academy of Science, USA, 104:5925-5930. Kwa, E.L.2004. Biodiversity Law and Policy in Papua New Guinea. PINBIO, Papua New Guinea.

Lipsett-Moore,G., Game,E., Peterson,N., Saxon,E., Sheppard,S. ,Allison,A., Michael,J., Singadan,R., Sabi,J., Kula,G., and Gwaibo,R. (2010) Interim national terrestrial conservation assessment for Papua New Guinea: Protecting biodiversity in a changing climate. Pacific Islands Country Report No.1/2010.South Brisbane; the Nature Conservancy.

Mack, A.L., West, P. (2005) Ten thousand tonnes of small animals: Wildlife consumption in Papua New Guinea, a vital resource in need of management. Research School of Pacific and Asian studies. The Australian National University

Mack, A.L. (2009) predicting the effects of climate change on Melanesian bird communities: the constraints of too many variables and too few data. In: Climate change and biodiversity in Melanesia Bishop Museum Technical Report 42 (9). Leitz S.J. and Burnett, B (eds.), Bishop Museum, pp.1-15.

Manoka, B and Kolkolo, U. (2001). Fisheries resource development and management in Papua New Guinea.: Law, Biology and Economics. In: Kwa, E.L (ed.) Natural Resources law of Papua New Guinea. Law book Co. Sydney.

Mittermeier, R.A., Gil, P.R., and Mittermeier, C.G. (1997) Mega diversity. Earth's biologically wealthiest nations. CEMEX, Mexico City, Mexico.

Myers, N., and Mittermeier, R.A. (2000) Biodiversity hotspots for conservation priorities. Nature 403 (6772): 853-958

Orapa, W. 2001. Impediments to increasing food security in Papua New Guinea: the case of exotic weed species, p.308-315. In: Bourke, R.M., Allen, M.G. and Salisbury, J.G. (Eds.). Food security for PNG 2000 conference, ACIAR, Lae.

Pratt, T.K. and B.M.Beehler. 2014. Birds of New Guinea, 2nd Edition, Princeton University Press, New Jersey,USA and Woodstock, Oxfordshire,UK, 528pp.

Polhemus, D.A., and Allen, M.G. (2007) Freshwater biogeography, p. 207-240. In: Marshall, A.J., and B.M.Beehler (eds.) Ecology of Papua. Periplus Editions, Singapore.

Polhemus, D.A., and Allen, M.G. (2007) 5.5 Inland water systems of Papua: classification, biota and threats. In: Marshall, A.J., and B.M.Beehler (eds.) Ecology of Papua. Periplus Editions, Singapore, pp.858-900

Polhemus, D.A. (1996) Island arcs and their influence on Indo-Pacific biogeography. In: A.Keast and S.E. Miller (eds.) the origin and evolution of Pacific island biotas, New Guinea to Eastern Polynesia: patterns and processes. SPB Academic Publishing, Amsterdam.

Polhemus and Allen 2007 Roos, M.C., P.J.A.kessler, S.R. Gradstein and P.Baas. 2004. Species diversity and endemism of five major Malesian islands: diversity-area relationships. Journal of Biogeography, 31(12): 1893-1908

Shearman,P.L.,Bryan,J.E.,Ash,J.,Hunnam,P.,Mackey,B., and Loks,B. (2008) The state of forests of Papua New Guinea: mapping the extent and condition of forest cover and measuring driver of forest change in the period 1972-2002. Port Moresby: University of Papua New Guinea

Shearman, P.L. and J.E.Bryan. 2010. A bioregional analysis of the distribution of rainforest cover, deforestation and degradation in Papua New Guinea. Austral Ecology, 36 (1):9-24

Still, C.J., Foster, N.F., and Schneider, S.H. (1999) Simulating the effects of climate change on tropical montane cloud forests. Nature 398:608610 Takeuchi, W.N.2007. Introduction to the flora of Papua. In: A.J.Marshall & B.M.Beehler (Eds.). The Ecology of Papua, Part 1.Periplus Editions, Singapore.

Tallowin, O., Allison, A., A.Algar. F.Kraus and S.Meiri (2017) Papua New Guinea terrestrial vertebrate richness: elevation matters most for all, except reptiles. Journal of Biogeography 44 (8): 1734-1744

Taylor, S. and L.Kumar (2016) Global climate change impacts on Pacific islands terrestrial biodiversity: a review .Tropical Conservation Science 9 (1): 203-223

Thomas, W.H. (2010) Finding common ground: Birds, biodiversity, and the implications for collaboration with traditional landowners in Papua New Guinea. Environmental management, 45 (1): 82-92

Toussaint, E.F.A., Hall, R., Monaghan, M.T., Sagata, K., Ibalim, S., H.V. Shaverdo., A.P. Vogler, J.Pens and M.Balke (2014) the towering orogeny of New Guinea as a trigger for arthropod mega diversity. Nature Communications: 11pp Waterhouse, B. 2003. Know your enemy: recent records of potentially serious weeds in northern Australia, Papua New Guinea and Papua. Telopea 10:477-485 Whitmore, N. 2015. Harnessing local ecological knowledge for conservation decision making via Wisdom of Crowds: the case of the Manus green tree snail Papustyla pulcherrima. Oryx, 50 (4): 684-692

Wilson, E.O. 1961.The nature of the taxon cycle in the Melanesian ant fauna. Am.Nat. 95,169-193

Wise, R., Butler, J., Skewes, T., Bou, N., Peterson, N., Masike-Liri, B. 2016. Locally managed marine areas in Kimbe Bay: reflections and future possibilities. In: 60th AARES Conference, February 2016, Canberra.