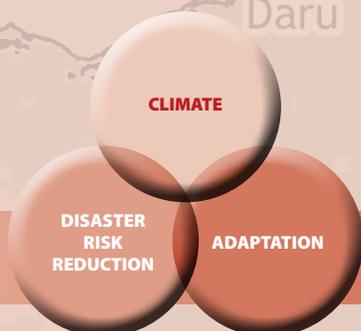


Vulnerability, Risk Reduction, and Adaptation to Climate Change

Papua New Guinea



GFDRR
Global Facility for Disaster Reduction and Recovery

CLIMATE
INVESTMENT FUNDS



COUNTRY OVERVIEW

At 463,000 square kilometers, Papua New Guinea (PNG) is the largest Pacific island state. Located in the South West Pacific, it is bound by the Gulf of Guinea and the Coral Sea to the south, Indonesia to the west, the Solomon Sea to the east, and the Bismarck Sea to the northeast. PNG comprises the eastern half of New Guinea island, four additional islands (Manus, New Ireland, New Britain, and Bougainville), and 600 smaller islets and atolls to the north and east¹. PNG is home to a diverse range of ecosystems, including mountain glaciers, humid tropical rainforests, swampy wetlands, and immaculate coral reefs. Approximately 30% of the country's landmass is covered by forests² and four of the world's remaining significant forests are found in PNG³. In addition to harboring abundant natural resources such as gold, copper, oil and natural gas, PNG boasts 7% of the world's biodiversity.

Key Sectors

Agriculture
Coastal Zones
Water Resources
Human Health
Biodiversity
Fisheries

Source: Papua New Guinea's Initial National Communications on Climate Change, and Adaptation Learning Mechanism.

PNG has a total population of approximately 6.7 million⁴, and the majority of these (87%) live in rural areas where access to markets, services, and income-generating opportunities is limited. Agriculture, fishing, community forestry, and artisanal and small-scale mining are primary livelihood activities in rural areas. It is estimated that over 50% of the population lives below the poverty line⁵; the number of people living on less than \$US 1 per day rose from 25% to 39% between 1996 and 2006, respectively.

Widespread poverty, limited and expensive access to inputs and markets, poor infrastructure, ineffective extension services, limited access to credit, corruption, safety and security concerns, and insufficient awareness or mitigation of environmental impacts all heighten the vulnerability of the local population across PNG. PNG is already prone to numerous natural disasters such as earthquakes, volcanic activity, and tsunamis. Climate variability and change are set to accelerate the occurrence of landslides, soil erosion, deforestation, and loss of biodiversity, as well as increase occurrence of recurrent floods and droughts. The agriculture and water resources sectors, as well as ecosystems and health sectors, will be hardest hit.

PRIORITY ADAPTATION MEASURES

Papua New Guinea submitted its First National Communication to the United Nation's Framework Convention on Climate Change, where priority sectors identified included agriculture, coastal zones, water resources, human health, biodiversity, and fisheries. The document also outlined specific adaptation measures to be taken in each of these priority sectors to address both current and projected changes in climate across the country⁶. These are outlined in subsequent sections of this document.

¹ World Bank, Global Disaster Risk Reduction Facility and South Pacific Applied Geoscience Commission. "Reducing the Risk of Disasters and Climate Variability in the Pacific Islands: Papua New Guinea Country Assessment."

² World Bank Country Data: Papua New Guinea. Accessible at <http://data.worldbank.org/country/papua-new-guinea>.

³ Global Environmental Facility, UNDP, SPREP. Pacific Adaptation to Climate Change Papua New Guinea Report of In-Country Consultations.

⁴ World Bank Country Data: Papua New Guinea. Accessible at <http://data.worldbank.org/country/papua-new-guinea>.

⁵ World Bank, 2007. Country Assistance Strategy for Papua New Guinea for the Period FY08-FY11.

⁶ Second National Communication of the Papua New Guinea to the UN Framework Convention on Climate Change, 2009.

CLIMATE BASELINE AND CLIMATE FUTURE

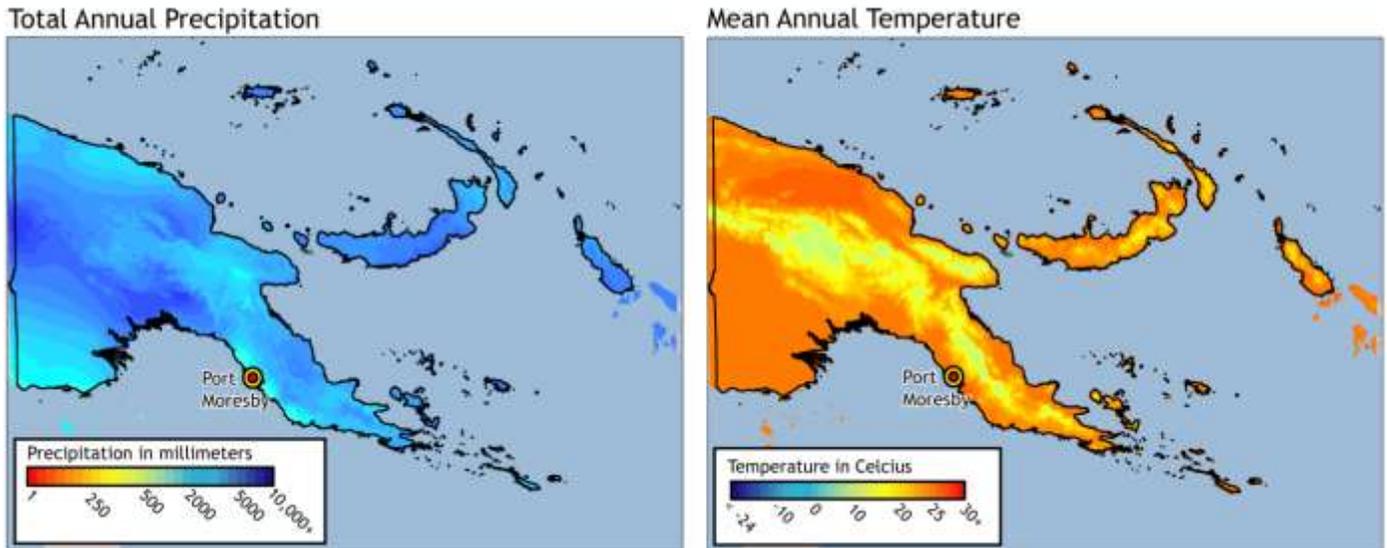


Figure 1: Annual Climate Baseline for Papua New Guinea⁷

BASELINE

Papua New Guinea has a monsoonal climate characterized by high temperatures and humidity throughout the year. Two monsoonal seasons are recognized: the northwest monsoons, which occur from December to March, and the southwest Monsoons, which occur from May to October. Indeed, the country is home to one of the wettest climates of the world and rainfall in many areas of the country exceeds 2500 mm⁸, with the heaviest events occurring in the highlands. Temperatures are relatively steady across the country, and mean temperatures in Port Moresby range from 26°C to 28°C.

Climate in this part of the Pacific is governed by a number of factors, including the trade winds and the movement of the South Pacific Convergence Zone (SPCZ), a zone of high pressure rainfall zone that migrates across the Pacific south of the equator. Year to year variability in climate is also strongly influenced by the El Niño conditions in the southeast Pacific, which bring drought conditions to PNG, especially in the drier areas of the country⁹. Areas with a pronounced wet and dry season that receive less than 2000 mm rainfall include: Markham Valley, Bulolo Valley, Maprik—Angoram area, Eastern highlands, and coastal areas near Cape Vogel, Port Moresby, and Daru¹⁰.

Major Climate Processes

- Monsoons
- El Niño
- South Pacific Convergence Zone (SPCZ)

Impacts on Climate

- Drive Summer Rainfall (June-September)
- Droughts and frosts
- Regulate temperatures

Source: IPCC 4th Assessment Report and UNDP Climate Profiles

⁷ WorldClim 1960-1990 averages. Robert J. Hijmans, Susan Cameron, and Juan Parra, at the Museum of Vertebrate Zoology, University of California, Berkeley, in collaboration with Peter Jones and Andrew Jarvis (CIAT), and with Karen Richardson (Rainforest CRC). www.worldclim.org/current.

⁸ PNG rainfall ranges from 1000 mm in Port Moresby to over 8000 mm in the northern areas of the Gulf. However, over 50% of the country receives +2500 mm of rainfall annually.

⁹ Papua New Guinea Initial National Communication under the United Nations Convention on Climate Change, 2000.

¹⁰ National Integrated Water Resource Management Diagnostic Report Papua New Guinea. GEF, UNDP, SOPAC, UNEP, 2007.

RECENT CLIMATE TRENDS

- ➔ For Papua New Guinea, the overall observed near surface temperature trend (0.50°C) resembles both the global and tropical Asian trend, with an overall error of +/- 0.15°C¹¹.
- ➔ Mean temperatures across the South Pacific have increased by 1°C since 1970 (0.3°C per decade).
- ➔ Sea surface temperatures in the Pacific have increased between 0.6 to 1.0°C since 1910, with the most significant warming occurring after the 1970s¹².
- ➔ The numbers of category 4 and 5 storms in the Pacific region have more than doubled when comparing their frequency and occurrence between 1975-1989 and 1990-2004.
- ➔ The numbers of hot days and hot nights¹³ have increased significantly across the Pacific.

CLIMATE FUTURE

The climate science community sources a suite of models to inform decision makers on future climate. Among the most widely used are GCMs (Global Climate Models), RCMs (Regional Climate Models), and downscaling techniques (both empirical and statistical), and several comprehensive reviews are available on the subject. GCMs are our primary source of information about future climate. They comprise simplified but systematically rigorous interacting mathematical descriptions of important physical and chemical processes governing climate, including the role of the atmosphere, land, oceans, and biological processes. Unfortunately, Papua New Guinea, as all small island nations, faces specific challenges when viewing the projected changes from these models. This, “island dilemma”, is attributable to the fact that single grid-cell values from GCMs are considered by the IPCC (2007) as the least accurate measure of projected changes, and the relatively spatial resolution of GCMs renders interpretation of climate change in small island nations difficult. The following insights into a changing climate are thus derived for the Pacific region as a whole, rather than for Papua New Guinea specifically, from a suite of GCMs used by the Intergovernmental Panel on Climate Change.

- ➔ The future of rainfall patterns across the Pacific region is a subject of continued debate, with models projecting +/-25% changes in rainfall. As yet it is not possible to get a clear picture for precipitation change, due to large model uncertainties.
- ➔ While average annual and monthly rainfall changes are inconsistent across this region of the Pacific, recent evidence and model simulations point to a more frequent occurrence of El Niño weather patterns, bringing an increase in drought conditions along this region. These more frequent El Niño events are believed to be associated with climate change, although some disagreement exists within the science community on this point.
- ➔ More frequent El Niño events could also increase the intensity of tropical cyclones along the Pacific, with important implications for disaster management and response in Papua New Guinea.
- ➔ Temperatures in the Pacific are projected to increase between 1.4 and 3.1°C.
- ➔ Sea-level rise of 0.19—0.58 m by 2100, leading to an accelerated coastal erosion and saline intrusion into freshwater sources.
- ➔ Increased surface air temperature between 1.0—4.17°C in the northern Pacific and 0.99—3.11°C in the southern Pacific by 2070, resulting in increases in sea surface temperature of 1.0—3.0°C.
- ➔ Acidification of the ocean through increased absorption of CO₂, causing pH to fall by an approximately 0.3—0.4 units by 2100; the growth rates of coral reefs will consequently suffer.
- ➔ Rainfall increases or decreases from -2.7% to +25.8% in the northern Pacific, and -14% to +14.6% in the

¹¹ Pacific Adaptation to Climate Change, Papua New Guinea Final Report.

¹² Folland, C.K., J.A. Renwick, M.J. Salinger, N. Jiang, and N.A. Rayner, 2003: Trends and variations in South Pacific Islands and ocean surface temperatures. *Journal of Climate*, 16, 2859-2874 and Folland, C.K., J.A. Renwick, M.J. Salinger, and A.B. Mullan, 2002: Relative influences of the Interdecadal Pacific Oscillation and ENSO on the South Pacific Convergence. Zone. *Geophysical Research Letters*, 29, 21-1-21-4.

¹³ Hot days/nights are defined as the temperature exceeded on 10% of days or nights in current climate of that region and season.

southern Pacific, worsening floods or droughts; despite large uncertainty surrounding rainfall projections, future El Niño-related events are likely to drive many of the changes in rainfall, past experience with El Niño may be used as a proxy for considering future changes in climate.

- ➔ Sea levels are projected to rise by the end of the century (2090-2099) by 0.35 m (0.23 to 0.47 m), although the spatial manifestation of this rise will not be uniform.

CLIMATE CHANGE IMPACTS ON NATURAL HAZARD VULNERABILITY

AT A GLANCE

Papua New Guinea is vulnerable to several hazards, including floods, droughts, and sea-level rise¹⁴. Some of these are expected to increase in frequency, magnitude, and intensity due to climate change. The El Niño -Southern Oscillation (ENSO) phenomenon has already been observed to have an increasingly negative effect on PNG's climate, triggering more intense drought and flood events.

- ➔ **Floods**—Most of PNG experiences flooding during the monsoons. The highlands in particular, where average rainfall can reach 10,000 mm, have a long history of severe floods. In the coastal plains, floods cause erosion and heavy sedimentation that impact agricultural productivity and downstream settlements. In the lowlands, coastal ecosystems such as mangroves, estuaries, and coral reefs endure damage due to heavy silt loads and debris brought in by flood events¹⁵. About 18% of total landmass is permanently inundated or regularly flooded¹⁶. The lower Sepik-Ramu region will be particularly affected, where approximately 4500 kilometers out of a total of 17100 kilometers of shoreline are projected to experience moderate to severe inundation; up to 30% of PNG's population may be adversely affected. In addition, when water resources are inundated, incidence of water-borne diseases (i.e. diarrhea, dysentery, typhoid) rise and potable water becomes scarce¹⁷. Coastal infrastructure, including parts of the Magi and Hiritano Highways and urban centers and settlements found along the coast in Hanuabada, Vabukori, and Koki in Port Moresby are at risk from damage by flood events¹⁸.
- ➔ **Droughts** affect the Southwestern plains, Central Province plains, Cape Vogel area, Markham valley, Bulolo valley, Maprik–Angoram area, and areas on the Eastern Highlands and Madang Provinces. While only 13 droughts have struck PNG over the past 13 years¹⁹, the occurrence of prolonged droughts, particularly in the lowlands of the Central Province, is rising likely due to the ENSO effect. The 1997/98 drought—coined “the most serious drought of the century”—has been widely linked to El Niño.
- ➔ **Landslides** are a common occurrence in the high mountainous regions of PNG and frequently damage vital infrastructure, upland forests, and the homes and gardens of thousands of residents. According to a World Bank Hotspot study²⁰, PNG ranks first in terms of landslide hazard profiles due to its steep mountain ranges, high seismicity, and high annual rainfall. Between 1997 and 2002, landslides affected 19,707 people, killed 128 people, and cost the government 1,090,000 PNGK (approximately \$USD 420200). Climate variability, together with intensified land use due to increasing population, promises to increase the threat of future landslides²¹.

¹⁴ “Reducing the Risk of Disasters and Climate Variability in the Pacific Islands: PAPUA NEW GUINEA Country Assessment.” World Bank, Global Disaster Risk Reduction Facility and South Pacific Applied Geoscience Commission.

¹⁵ Water Papua.

¹⁶ Papua New Guinea Initial National Communication under the United Nations Convention on Climate Change, 2000.

¹⁷ National Integrated Water Resource Management Diagnostic Report Papua New Guinea. GEF, UNDP, SOPAC, UNEP, 2007.

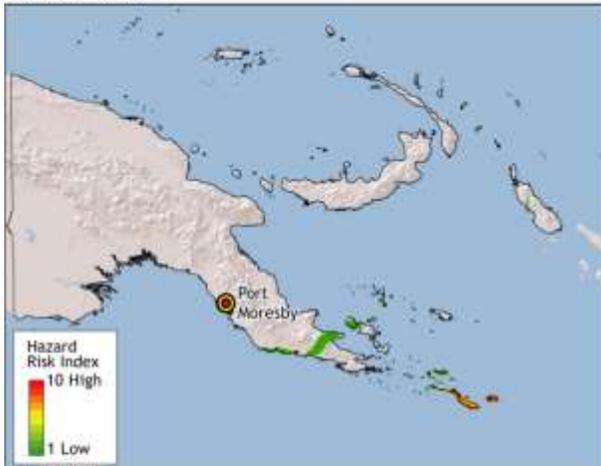
¹⁸ Ibid note 16

¹⁹ Pacific Adaptation to Climate Change Papua New Guinea Report of In-Country Consultations. GEF, UNDP, SPREP.

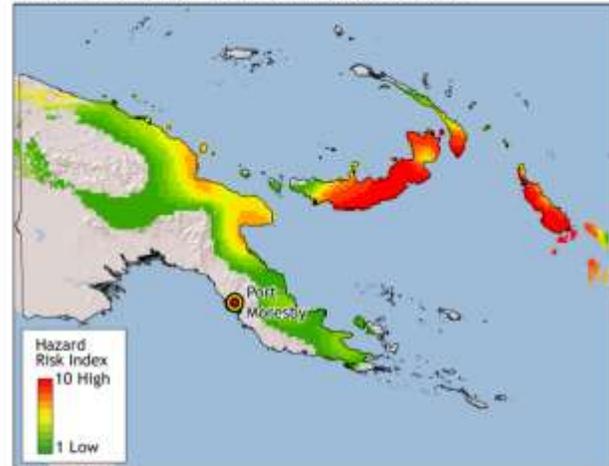
²⁰ Natural Disaster Hotspots: A Global Risk Analysis. World Bank. 2006.

²¹ Ibid note 14

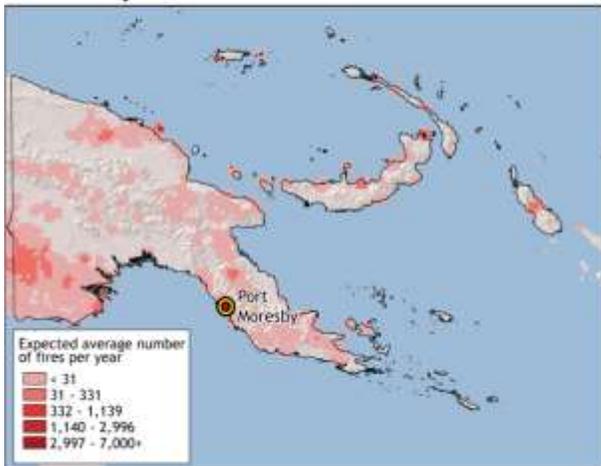
Cyclone Risk



Earthquake Risk- Peak Ground Acceleration



Fire Density

Figure 2: Exposure to climate-related hazards across Papua New Guinea²²

- ➔ **Sea-level rise** is strongly influenced by ENSO as rainfall patterns shift and sea surface temperatures rise. The effects of sea-level rise are already apparent in the Katarets Island and the Motlocks, near the Solomon Islands, where much land is now underwater²³. Sea-level rise will result in inundation of coastal wetlands, coral bleaching, loss of wetlands, and eventually may displace communities with consequences for social cohesion. Similarly, saltwater intrusion is observed to be destroying freshwater trees along the Binaturi River in the Western Province and limiting access to freshwater in general. This floodplain suffered from saltwater intrusion in 1992 when saltwater was found to have inundated a forest 15 km inland²⁴.

²² Preliminary risk maps from WHO e-atlas of disaster risk for Eastern Mediterranean Region, 2008; population density map from LandScan™ Global Population Database (2006). Oak Ridge National Laboratory: <http://www.ornl.gov/landscan/> in: Disaster Risk Management Programs for Priority Countries.

²³ GEF, UNDP, SOPAC, UNEP, 2007. National Integrated Water Resource Management Diagnostic Report Papua New Guinea.

²⁴ Ibid.

Implications for Disaster Risk Management

- ➔ As the rural population of PNG continues to grow (at 2.8 percent per year), the frequency, intensity, and magnitude of extreme weather events will rise.
- ➔ Climate change is likely to place water resources under additional stress in years to come.
- ➔ PNG is ill-equipped to identify and manage climate risks due to low recognition of hazard and weak monitoring systems.

SECTORAL CLIMATE RISK REDUCTION RECOMMENDATIONS

Climate variability and change has and will continue to affect Papua New Guinea. Vulnerability is a key factor that needs to be considered in identifying the differential impacts of climate. The poor have limited access to services necessary to make them resilient to adverse climate effects, and their living conditions are often affected by laws, policies, and economic forces over which they have little or no control. While it is by no means clear whether vulnerable groups, with their pressures to survive, or affluent groups, with their pressures to consume, ultimately lead to the impacts that continue to drive vulnerability, it does seem clear that poor people will not, indeed, cannot, adapt if this requires looking beyond their immediate needs. The most profound impacts of climate variability and change in the Papua New Guinea Islands will be felt in the sectors discussed below.

AGRICULTURE

The agriculture sector employs 85% of Papua New Guinea's population and accounts for approximately 30% of the national GDP²⁵. As the majority of PNG receives more than 2500 mm of rainfall annually, both subsistence and commercial farming is rainfed. Primary cultivated crops include sweet potatoes, taro, yam, cassava, banana, breadfruit, sugarcane, and aibika, while a diverse range of vegetables are produced for local consumption, including pumpkins, corn, carrots, peppers, beans, and tomatoes. The main cash crops are coffee, copra, cocoa, tea, rubber, and oil palm²⁶. Higher temperatures resulting from climate change will result in more heat stress and increased humidity with negative consequences for agricultural production. Rising temperatures could lead to faster rates of crop deterioration after harvesting, with significant implications for food security. Increased temperatures and humidity will facilitate the spread of pests and vector-borne diseases, and time for crops to mature will shorten with dire consequences on overall yield²⁷. Increased incidences of landslides and floods can cause loss of soil fertility, thereby affecting agricultural yields, while an increased incidence of drought could mean increased evapotranspiration and water stress on crops. Salt-water intrusion into agricultural lands can also affect food production. All of these impacts can increase the country's reliance on (often unhealthy) imported goods, and income generated from agricultural production will be lost with significant implications for millions of households²⁸. Appropriate adaptation options include:

- ➔ promoting research into new plant varieties, crop rotation, use of irrigation, altered nutrient levels, and plantation of forestry alternatives;
- ➔ promoting sustainable natural forest management;
- ➔ capacity-building initiatives focused on piloting innovative extension systems;
- ➔ improving and integrating farming technologies;
- ➔ strengthening agricultural data collection; and
- ➔ planning and expanding micro credit and small business training facilities^{29,30}.

²⁵ Pacific Adaptation to Climate Change Papua New Guinea Report of In-Country Consultations. GEF, UNDP, SPREP.

²⁶ Ibid note 23.

²⁷ Ibid note 25

²⁸ Asian Development Bank, 2009. Mainstreaming Climate Change in ADB's Operations Pacific Regional Department Climate Change Implementation Plan Pacific Islands Region (2009 – 2015).

²⁹ Ibid.

WATER RESOURCES

PNG is one of the wettest places in the world. Average rainfall is 3000 mm per year with some parts—especially in the Western Province—commonly experiencing over 4000 mm per year. PNG’s capital, Port Moresby, receives rain only between October or November and March or April. As such, PNG enjoys abundant water resources that have great potential for development. The country is home to a vast network of springs, streams, creeks, rivers, and lakes. Principal rivers include the Fly, the Sepik, the Markham, the Purari and the Kikori. Most Papua New Guineans depend on surface water to meet their needs. Groundwater is also heavily relied on to meet the demands of local populations of major provincial towns like Lae, Vanimo, Rabaul, and Kavieng. Relatively little surface water is available in the coastal areas. Freshwater resources are used for domestic consumption, industrial purposes, transport, and the generation of hydropower. However, these resources are being gradually degraded and misused largely due to rapid industrial and resources development, population pressure, and forestry and agriculture expansion³¹. Projected increases in future temperatures, coupled with increasingly shifting rainfall patterns, will require the establishment of an efficient water management system in order to secure access to reliable water sources. PNG could greatly benefit from expanding its irrigation system and introducing new water-saving technologies to the local populations. This includes recycling of water resources. Adaptation options for building resilience of the water sector include:

- ➔ investment in and promotion of new water technologies, particularly for recycled water;
- ➔ incorporating climate change into water management legislation;
- ➔ strengthening capability and capacity building for water quality monitoring;
- ➔ assisting in the acquisition of upgraded resources to enhance national technologies;
- ➔ information collection and data transfer on water resource management methodology;
- ➔ water hazard warning and forecasting and improvement of analysis techniques;
- ➔ developing alternative water sources, such as rainfall catchment devices as well as saltwater and brackish water desalination plants;
- ➔ water conservation measures, including leakage control³².

HUMAN HEALTH

Papua New Guinea has the lowest life expectancy rate in the South Pacific region. Most Papua New Guineans live to on average 56 years of age, and foremost amongst causes of death for all people are pneumonia, prenatal problems, malaria, meningitis, tuberculosis, and diarrhea. As only about 20% of rural dwellers have access to clean water and sanitation services, these populations, and in particular the elderly, women, and children, are extremely vulnerable to cholera outbreaks. Climate variability and change are expected to increase the incidence of these vector- and water-borne diseases. Both human safety and access to health centers are directly affected by landslides and floods, by blocking major communications and transportation arteries. Increasingly intense storms as well as accompanying landslides can destroy public infrastructure such as hospitals and roads, preventing delivery of health services to vulnerable populations. Milne Bay province and parts of the Northern and Central Provinces have already suffered this type of damage due to cyclone activity. Climate change will also adversely impact food security, heightening risk of malnutrition in areas where reliance on subsistence crops and fish stocks is particularly high. Rising temperatures will facilitate the spread of vector-borne diseases. For example, malaria generally thrives at temperatures of 22°C at an altitude of 670 meters above sea level. If temperatures continue to rise, malaria is likely to spread into areas without previous experience or capacity to manage this disease. The Kikori and Sepik plains, together with the Star Mountains and parts of New Britain, are vulnerable to rising temperatures. Adaptation measures to manage climate-related illnesses in PNG include:

³⁰ Ibid note 16.

³¹ Ibid note 23.

³² Ibid note 16.

- ➔ Infrastructure improvement, including adoption and enforcement of more stringent building codes, and improving quarantine services.
- ➔ Eradication of artificial breeding sites (i.e. litter, solid waste, water containers) for vector-borne diseases.
- ➔ Improved sanitation, reliability, and safety of water supply.
- ➔ Development of emergency response systems to cope with floods and droughts.
- ➔ Improved provision of primary health care.

ADAPTATION

Lowering PNG's vulnerability to climate change requires the implementation of a number of integrated measures aimed at strengthening agricultural production and water resource management. Many efforts are currently underway to support these activities. Some exemplary initiatives are listed below.

Ongoing Efforts—At a Glance

Vulnerability Reduction

Sustainable Management through Reduced Risk from Disasters and Climate	/ World Bank (2008 – present)
Pacific Islands Climate Prediction Project	/ AUSAID and the Australian Bureau of Meteorology (2004 – present)
South Pacific Sea Level and Climate Monitoring Project	Sets up high-resolution monitoring stations in eleven island countries to measure the relative motions of land and sea. These data will assist in the long-term calibration of satellite altimetry and radio astronomy and provide a measure of regional vertical control, and exchange information and data with national, regional, and international climate change centers to help the understanding of the complex problem of measuring changes in sea levels. The project holds two-week training courses on the use of oceanographic, atmospheric, and climate data in social and economic decision making.
Pacific Meteorological Services Needs Assessment Programme	Designed to identify the assistance required by the Meteorological Services of 20 PDMCs, including capacity building to meet the growing public demand for improved weather and climate services and products.
Regional Partnerships for Climate Change Adaptation and Disaster Preparedness –	Designed to improve availability of geophysical information for supporting greater resilience to climate impacts and shocks through improved decision making on minimizing hazard exposure and risk. It also includes an assessment of the feasibility of a regional pooled catastrophe insurance scheme and its subsequent development.
National Action Plan Implementation Facility	Implemented by SOPAC between 2008 and 2011—designed to enhance the sustainable development of Pacific countries through the implementation of measures identified in their National Action Plans.
Climate Data Rescue in the Pacific	Project aimed at developing an inventory of digitized and un-digitized climate records, to recommend action for the preservation of the records, and where appropriate, to enact immediate action to secure important paper climate records at risk of becoming lost.
Climate Change and the Southern Hemisphere Tropical Cyclones Project	Project designed to conduct further analysis of the climatology of tropical cyclone variability and to develop a tropical cyclone forecasting scheme, linking with activities in PI-CPP.

GFDRR Interventions

Develop a Coordinated Hazard Policy and Integrated Spatial Hazard Risk Information and Mapping System for PNG (National Scale) (2009-2011).

Conduct Hazard Maps, Digitizing, and Spatial Information on Drought, Frost, Coastal Erosion, Plus Awareness in view of Predicted Mega Drought in 2012 (2009-2011).

EXISTING ADAPTATION FRAMEWORK/STRATEGY/POLICY AND INSTITUTIONAL SETUP**AT A GLANCE**

PNG is highly prone to large-scale natural disasters such as earthquakes, tsunamis, volcanic activity, floods, landslides, sea-level rise, and droughts. Population growth, poverty, environmental degradation, inadequate infrastructure, and a traditional land tenure system, whereby 97% of land is owned by clan-based structures, can contribute to and exacerbate the vulnerability of PNG. While the current land tenure system promotes a close relationship with the land among local populations, some landowners' desire for quick cash needs leads them to sell precious timber resources and contributes to natural resource degradation³³. Moreover, this system makes it difficult for the State to manage environmental problems and implement projects with the potential to boost agricultural production, develop public infrastructure, and promote commercial activities to spur development. Additionally, changes in soil quality and shifting rainfall patterns have already jeopardized the livelihood activities of farmers and fishermen. For example, regions hit hard by dry seasons have resorted more and more to trading as an adaptation mechanism. In the Central Province coast in particular, people living in the mountains trade pots for sago from the Gulf of Papua, which does not have a dry season but does enjoy a large soil-water surplus. Similarly, islanders from Milne Bay travel far distances by canoe to trade for food with residents of larger islands and on the mainland³⁴. Thus, while autonomous adaptation mechanisms are already being successfully implemented, much more is needed. The following government departments are active in climate change and adaptation-related issues in PNG:

- ➔ Office of Environment and Conservation
- ➔ Department of Energy and Petroleum
- ➔ University of Papua New Guinea and University of Technology
- ➔ National Forestry Institute (PNGFRI)
- ➔ Transport Department
- ➔ PNG National Forest Authority
- ➔ National Agriculture Research Institute, National Fisheries Authority and National Weather Service

INSTITUTIONAL AND POLICY GAPS

- ➔ Strengthening institutions to support agriculture and fishing by enhancing the skills and knowledge of male and female farmers and fishermen will yield significant returns.
- ➔ Lack of coordination and cooperation between government agencies is common; this problem is exacerbated by the lack of strong information systems³⁵. This is also the case with donors, where coordination is desperately needed, particularly on gender issues.

³³ Ibid note 16.

³⁴ Ibid note 25.

³⁵ Ibid note 25.

RESEARCH, DATA, AND INFORMATION GAPS

Papua New Guinea's status as a developing country dependent mainly on agriculture and susceptible to a wide variety of natural disasters makes it particularly susceptible to the effects of climate change. Added to this is the fact that like most other developing countries, PNG lacks the requisite monitoring systems to understand the dynamics of the climate systems with which it must contend, thus making the task of developing short-term response or disaster mitigation strategies extremely difficult. The following are some activities that will enable the country to address climate change risks in a proactive fashion.

RESEARCH GAPS

- ➔ An improved understanding of traditional mechanisms for coping with climate hazards, coupled with effectively designed strategies for dissemination of endogenous knowledge, is required to support vulnerability reduction to the country's population. Vulnerability studies in key areas of the country could provide this information.
- ➔ Collecting detailed accounts of local strategies to adapting to climate change are desperately needed to serve as a starting point for knowledge exchange on successful practices among vulnerable populations and to support rational policymaking in vulnerable areas.
- ➔ Technology access and income diversification activities need to be explored and piloted, particularly in areas most vulnerable to climate risks.
- ➔ Research on the impacts of warm phase ENSO events is needed across the country's economic sectors in order to develop context and culturally relevant adaptation portfolios for the areas most at risk.

DATA AND INFORMATION GAPS

- ➔ Although historic data on hazards exists for PNG, this information is not easily accessible. Lack of technology and experience with analytical tools also hinder efforts to establish recent trends³⁶. Ongoing efforts such as the Climate Change Data Rescue project, the Pacific Meteorological Services Needs Assessment Programme, and the Climate Change and the Southern Hemisphere Tropical Cyclones Project (listed in the adaptation section above) are set to provide critical information, but these efforts will need to be augmented for other hazards in the region. Resource deficiencies (i.e. human, financial) need to be addressed, particularly at the local level, as they limit the exchange of knowledge and information on climate change and adaptation and complicates efforts to mainstream these issues into national development plans³⁷.
- ➔ A better understanding of the local dimensions of vulnerability is essential to develop appropriate adaptation measures that will mitigate these adverse consequences. This requires detailed vulnerability assessments to be conducted in the most vulnerable flood- and drought-prone areas.
- ➔ Better information is needed on water resources management and drainage systems, particularly those feeding growing urban areas.
- ➔ Developing sound early warning systems, including flood forecasting, is essential.

³⁶ "Reducing the Risk of Disasters and Climate Variability in the Pacific Islands: PAPUA NEW GUINEA Country Assessment." World Bank, Global Disaster Risk Reduction Facility and South Pacific Applied Geoscience Commission.

³⁷ Global Environmental Facility, UNDP, SPREP. Pacific Adaptation to Climate Change Papua New Guinea Report of In-Country Consultations.

