Climate Centre

Country-level | Climate fact sheet

Papua New Guinea

The following climate factsheet summarizes available information on the climate of Papua New Guinea climate change and impacts of these changes on humanitarian activities in country. Each of the factsheets were written as a compilation of information from peer-reviewed academic papers, government publications, and INGO documentation.

1. Climate overview

Average annual temperature: 24-26°C (with seasonal variations between 15°C-34°C)

Average annual rainfall: 200-300 millimetres

Main driver of climate variability: 1. El Nino Southern Oscillation (ENSO) 2. West Pacific Monsoon 3. South Pacific Convergence Zone (SPCZ) 4. Intertropical Convergence Zone (ITCZ)

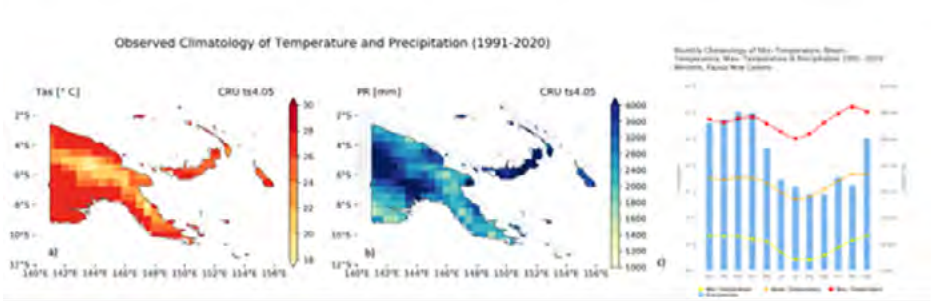

Figure 1: Observed Climatology of mean Temperature (a), annual mean total precipitation (b) and monthly climatology (c) over 1991-2020. (Adapted from World Bank, 2022).

2022

Short overview

Papua New Guinea (PNG) is predominantly made up of a tropical rainforest climate with small areas in the south-west comprising tropical monsoon and tropical savannah climates. Topography is an important factor shaping climate in PNG with locations in the central highlands experiencing near freezing night-time temperatures on occasion. Annual mean temperature varies between 18°C in highlands regions and above 26°C in most of the country (Figure 2a). PNG is one of the wettest countries in the world, with annual rainfall exceeding 4000 mm in highlands and New Britain (Figure 2b). The climate is predominantly hot, humid, and tropical year-round, with two distinct seasons differentiating the wet (December to March) and dry (June to September) periods (PNG, 2020).

1.2 Climate change in PNG

Historical Climate	Projected climate
Temperature	
▪ Mean annual temperature over PNG have increased at a rate of approximately 0.2 °C/decade since 1961 to 2015 (Gutiérrez *et al.*, 2021b). ▪ The frequency and intensity of hot extremes have increased, and cold extremes have decreased (Seneviratne *et al.*, 2021a). ▪ Sea Surface Temperatures have increased between 0.6°C to 1°C since 1910, with the most significant warming observed after the 1970's (GFDR, 2011).	▪ Mean temperature over the region are projected to rise until 2050 by at least 1.5°-2°C for a high greenhouse gas concentration scenario (SSP5-85) and 1°-1.5°C for low greenhouse gas concentration scenario (SSP2-4.5) (Gutiérrez *et al.*, 2021). ▪ Maximum and minimum temperature will increase, and heat waves will intensify in duration and peak temperatures for every increase in global warming levels above the pre-industrial values. In line with rising mean annual temperatures, the annual number of very hot days (above 35 °C) is projected to rise and with high certainty (Gutiérrez *et al.*, 2021b; Ranasinghe *et al.*, 2021; Seneviratne *et al.*, 2021).
Precipitation	
▪ While overall trends in mean annual rainfall are unclear, there has been increases in rainfall observed in most regions during the wet season since 1950 (World Bank, 2022) ▪ The frequency and magnitude of extreme rainfall events has increased (Seneviratne *et al.*, 2021).	▪ Mid-century estimates (2040-2060) under both low and high emissions scenarios project precipitation increases between 10-15%. Uncertainty over future precipitation patterns for PNG remains high (Gutiérrez *et al.*, 2021b). ▪ The frequency and intensity of heavy precipitation events are projected to increase with potential effects in flooding and soil erosion (Seneviratne *et al.*, 2021).

It is essential to note that many of these hazards are interrelated and produced compound risks to the same areas and communities. In addition, risk must be understood as the interplay between hazard risk, exposure, and vulnerability which make certain communities, individuals, and sectors more impacted by the hazards. All project design should consider the risk mentioned above and the compounding risks they represent.

2. Movement priorities and climate change

2.1 Scale up climate smart DRR, early action and preparedness

Observed hazard	Projected Risk
Flooding	**Droughts and Floods**
River flooding is a threat across the country of PNG. Using a compilation of models, Lange *et al.* (2020) simulated that 0.2% of the land area and 0.14% of the population of PNG is exposed to at least one river flood per year. A recent example of river flooding was in 2021 when continuous rainfall led to flooding along the Fly and Strickland rivers which led to impacts on access to drinking water and water-borne diseases. Over 150,000 USD were needed to address immediate needs such as emergency food, water, and medical supplies (ECHO, 2021). Urban flooding poses a particular risk to densely populated areas of PNG where sanitation, access to water and diseases become a greater threat from both coastal and river flood events. The adaptation fund (2021) estimates that flooding is the most critical climate related hazard for the North Coast and Island regions of PNG, home to approximately 2.6 million people.	The combined impacts of El Niño and La Niña with the impacts of climate change could impact hazards in compounding ways (UNDRR, 2019). With increasing intensity of El Niño and La Niña events, increased precipitation could exacerbate flood risk across the country, or conversely droughts may become prolonged or more intense. The impact of compounding hazards will severely impact economic development, infrastructure and human life, as well as disrupting ecological systems and habitats (UNDRR, 2019). The Government of PNG projects that the Intensity and frequency of extreme heat events are projected to increase (Government of PNG, 2018). Extreme flood events and associated impacts have been projected to increase numbers estimating the population affected by flooding is expected to increase by be between 20% and 50% (35,000-56,000 more people impacted) by 2035-2044 (World Bank, 2021).
Droughts	
PNG often faces a threat of drought which correlates with the El Niño Southern Oscillation. Droughts have a significant impact on the population of PNG as a vast majority of the population rely on subsistence agriculture.	
Landslides	
The risk of landslides in PNG is categorized as high. An example that has been cited as the world's second largest landslide (Tanyas *et al.* 2022) occurred after the 2018 earthquake. The earthquake was thought to have triggered over 10,000 landslides in an area extending over 145 km^2.	The CCKP (2022) highlights how an increase in landslide events is projected (CCKP, 2022). CCKP CMIP6 modelling shows the potential for high intensity rainfall events and rainy days to increase leading to conditions for landslides (CCKP, 2022; World Bank, 2021). Coupled with increased land use change and deforestation, landslides could pose a major threat in the future.

Sea level rise

Coastal flooding across the vast coastline of PNG. A recent Human Rights Watch (HRW) report (2021) described how rising sea levels have led to an increase in the reach of king tides across the PNG coastline. Approximately 53,000 people were displaced because of the higher tides that were experienced across the region (HRW, 2021). In this case, the risks posed by climate change were likely exacerbated by the active La Niña phase which often leads to temporary rise in sea level. Such cumulative threats are increasingly important for the country to consider in the future.

Sea level rise (SLR) has been measured at 7 mm between 1993-2010, however, the influence of interannual variations in sea level, partly driven by ENSO, is likely to influence this figure (Kiele *et al.*, 2022). It is predicted that sea level rise will continue at an increasing rate, with estimates ranging between 40-150mm by 2030 dependant on emission scenario (Kiele *et al.*, 2022). This will have a significant impact on the low-lying island areas of PNG, causing potential for displacement, livelihood changes and need for significant adaptation.

Cyclones

Cyclones are classified as a high-level hazard. This means there is more than a 20% chance of potentially damaging winds occurring in the next 10 years (ThinkHazard!, 2022). Particularly high vulnerability areas are the areas of Northern, Central and Milne Bay which all have high hazard level attributed to them. 2014 saw Cyclone Ita hit the Southeast area of Milne Bay, causing destruction across the region which lasted for well over 9 months.

Projected increases of average tropical cyclone wind speeds and associated heavy precipitation and of the proportion of category 4-5 tropical cyclones (Seneviratne *et al.*, 2021). The UNDRR (2019) estimates that by 2100, the impacts of cyclones in PNG could lead to an increase in economic losses in the range between 14.2% in the lowest emission scenario to 66.3%. In the worst-case climate scenarios. Such losses could total on average approximately US$24 million annually my mid-century (UNDRR, 2019).

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Disaster Risk Management Strategies

TThe country faces several challenges in effectively implementing the DRR system (UNDRR, 2019). These are centred around limited funding and programme resources. For example between 2006-2012 the NDC worked with a budget of $1.3 million annually, a significant increase from the $500,000 annually that it had to work with before (UNDRR, 2019). In addition to small budgets, a number of Provincial Disaster Committees are also heavily indebted which also puts pressure and difficulties on them to function. Additionally, coordination is made more difficult by the country's varied geography and the dispersion.

UNDRR (2019) reports that as climate change increases disaster risk, there is a need to upscale the country's interventions towards a more proactive, robust and sustainable options (UNDRR, 2019). This could be made up of investment in disaster resilient infrastructure, improving recovery mechanisms and exploring long term strategies for relocating displaced populations. In addition, working on enhancing climate monitoring, forecasting capacity and dissemination of early warning mechanisms. Finally, the UNDRR (2019) report highlights that DRM in PNG is currently heavily dependent on development partners in terms of both technical assistance and financial support.

Legal and Policy Framework for DRR

- Following the Disaster Management Act 1984 the National Disaster Centre (NDC) was established to act as the national focal point for DRM.
- PNG's most current up to date DRR plan is the National Disaster Risk Reduction Framework 2017-2030. This framework is aligned with the Sendai Framework for Disaster Risk Reduction and outlines 7 nationally agreed upon targets to be achieved by 2030.

2.2 Reduce health impacts of climate change

Impacts of climate change on the health sector of PNG are linked to food and nutrition, water borne and vector borne diseases and mental health concerns resulting from forces relocalisations in hazard or sea level rise prone areas.

There are strong links between climate change, food and nutrition related non-communicable diseases in the pacific island countries and territories (Savage *et al.* 2020). Changing agricultural yields will lead to undernutrition and a potential shift away from traditional production and consumption patterns to reliance on imported foods which could be less healthy (ibid). Climate change impacts on crop yield and fisheries is likely to result in declined food and nutrition security with increased cases of undernutrition and increased risk of diet related non-communicable diseases later in life (Savage *et al.*, 2020). Forced relocation due to sea level rise could have marked impacts on mental health outcomes including stress and trauma responses (Schwerdtle *et al.*, 2018). Increased malarial prevalence has been reported across PNG and it is projected to increase in coming years (Imai *et al.*, 2016). PNG is a malaria endemic country where all four species of the Malarial vector circulate in the population with varying distribution. Climatic changes are projected to increase the incidence of malaria in highland areas (Park *et al.*, 2016). Waterborne diseases pose a major challenge to the health of people across PNG (UNICEF, 2021). Increased flooding and storm surges occurring as a result of climate change could exacerbate these challenges.

2.3 Sustainable water: resources management, infrastructure and access

Water, Sanitation and Hygiene

PNG receives significant amounts of water annually, and with the high, steep mountain ranges and abundant rainfall, most of the country benefits from the runoff rainwater. Despite this, access to safe drinking water in uneven in distribution; climate change is expected to exacerbate this challenge.

By 2070, some regions of PNG could see annual water shortages of 124mm in their water supply (Asian Development Bank (ADB), 2013). Climatic-induced droughts combined with poor water infrastructure for collection and storage will lead to increased vulnerability and difficulty in meeting household water needs in some areas of PNG (Columbia Law School, 2019). A significant proportion of the country's population, especially those living in highland areas and in the town of Porgera have limited or no access to clean water or sanitation services (Oxfam, 2022). Climate change induced water deficits could severely impact health, wellbeing of people and agricultural outputs of such communities. Finally, coastal flooding has already begun to seriously impact the availability of safe drinking water for communities across PNG, especially in the low-lying atolls (Luetz & Havea, 2018). Increasing temperatures will increase the land area and population exposed to at least one river flood per year in PNG. With a 2°C increase in global temperatures, the land area and population exposed to at least one river flood per year will increase from 0.2% to 0.31 (land area) and from 0.14% to 0.22% of the population respectively (Lange *et al.*, 2020). Sea level rise will have impacts on drinking water, sewage systems, habitability of land and marine and coastal biodiversity (Kiele *et al.*, 2022).

Infrastructure, power and electricity

PNG, as with the rest of the Pacific, is moving towards more integrated energy approaches drive by climate change and dependence on fossil fuels (Sharma *et al.*, 2021). PNG is one of the Pacific countries with lowest access to energy, only 13% of the population is connected to electricity. In PNG, nearly 40% of total installed electricity capacity was generated from hydroelectric schemes while the remainder is sourced from thermal power stations relying on diesel, gas and heavy oils. To address the low electrification development challenge, Australia, Japan, New Zealand and the USA have partnered for the PNG Electrification Partnership which aims to electrify 70% of PNGs population by 2030 (Sharma *et al.*, 2021).

2.4. Enable climate resilient livelihoods and economic security

Increased climatic impacts, population increase and land use change will affect the agricultural production and fisheries in PNG with direct consequences for food supply, incomes, and nutrition (Bourke, 2018).

Between 85%- 90% of the country's population depends on subsistence or semi-subsistence agriculture and the government has not intervened very much in the development of water and irrigation for agriculture (FAO, 2011, Bourke, 2018). Shifting climatic conditions have resulted in changes in soil fertility and arable land, especially in the low-lying island atolls of PNG (ICRC, 2019). Rising sea levels, combined increasing population will put pressure on fisheries, impacting people who depend on fish as a source of income and nutrition (Barange *et al.*, 2018). The decline in fisheries could have significant impacts on food security, health and livelihoods. CO2 emissions and changes to coral reefs and other fish habitats are likely to reduce harvests from small scale coastal fishing by up to 20% by 2050 and 50% by 2100 under a high emissions scenario in the Western and Central Pacific fisheries (Barange *et al.*, 2018). Ocean acidification and rise in sea surface temperatures will lead to coral bleaching, affecting the breeding grounds of fish, from the smaller ones to those high up in the food chain (World Bank, 2021), causing economic and livelihood challenges for PNG.

2.5 Address climate displacement and protection

Current and future displacement challenges

In 2021 climate disasters triggered twice as many displacements – 7,500 – as in 2020, with 7,2000 displacements in East Sepik due to extremely high tides in December, which destroyed thousands of coastline homes (IDMC, 2022.) The country has approximately 41,000 IDPs, 70% of whom were displaced over 5 years ago due to either violence or disasters (*ibid.*)

In the future, a total of 30,969 displacements per resulting from sudden onset hazards is projected (IDMC 2022). Of these, floods form the majority of those drivers with 23,774 people projected to be displaced for varying periods of time as a result of flooding in the future in PNG (*ibid.*).

Papua New Guinea's land ownership structure, with 97% of land customarily owned, means that adaptation strategies such as planned relocation will be difficult and may trigger conflict and disputes (World Bank 2021). It is recommended that policy measures facilitate voluntary migration for low-lying island communities through comprehensive financial support and labour migration schemes (*ibid.*)

Rural-urban migration is projected to increase due to both sudden- and slow-onset disasters which limit or destroy rural populations' subsistence farming livelihoods. Most of the country's subsistence farmers have limited ability to safeguard assets and livelihoods form climate-induced natural disasters (World Bank 2021). Increased drought is projected to increase migration (ESCAP/ILO 2014). The Highlands of country, which is among the most densely populated areas, is particu larly affected by El Niño events and experiences both drought and extreme frost, which at times significantly reduces agricultural production (ESCAP/ILO 2014) and will likely lead to further out-migration to lower elevations.

Potential needs for migrants and displaced people

Needs for migrants and displaced will be high as PNG is ranked as having the 11the lowest coping capacity to climate change (World Bank, 2021).

The projections of increased disaster displacements, couples with limited land for formal resettlement, mean that an increasing number of people per year could find themselves in situations of protracted displacement, living in makeshift shelters, vulnerable to future disasters, low access to health care and after separated from their families. Poor planned development is a key risk factor (*ibid.*).

Migration Law and Policies

- PNG has a Migration Act (1978) which has been amended over the decades.
- PNG took part in a 2020 Regional Policy Dialogue to discuss climate change, migration, and human security (IOM/ESCAP 2020), but it is unclear whether a regional approach to address these issues has been further developed.
- The DRR framework seeks to empower local authorities to support populations, including IDPs and migrants, engage in DRR at the local level and 'support policies and programmes addressing disaster-induced human mobility/displacement to strengthen the resilience of affected people' (National Disaster Centre 2017).

Climate change presents dynamic challenges for addressing the weapons contamination cycle. According to the ICRC, flooding and tsunamis might scatter mines and explosive ordinates (ICRC, 2012) or displace land surveyance markers. Weapons contamination also impacts on human, animal, and environmental health as chemical contaminants permeate the soil, water, and food supply chain. Weapons contamination can ultimately cause reductions in biodiversity, and changes to the wildlife population which not only disturb the food chain but affect several development sectors such as human health and the economy (ICRC, 2012).

2.6. Policy

Relevant information from the Nationally Determined Contribution (NDC) (2020)

GHG Emissions Reduction target: Focus on energy and land use. PNG strives to achieve carbon neutrality within the energy sector by 2030 and a 25% reduction in annual deforestation and annual degradation and will additionally take actions to improve reporting in the sector.

Area of focus on Adaptation: Agriculture, Health, infrastructure and transport

Inclusion of DRR: Yes, DRR is an explicit part of the NDC with a focus on vulnerable populations. It includes enhancement of information system, activities related to flood and cyclones, response to climate extremes, and increased resilience of food and water security, health, and well-being in PNG.

National Designated Entity: Climate Change and Development Authority

Key stakeholders: Climate Change and Development Authority in the Minister of Climate Change, NDC Partnership member

Other National Policies on Climate

- The National Vision for 2050 aims to set 'the overall direction for the country to attain our dream to be a Smart, Wise, Fair, Healthy and Happy Society by 2050', diversifying from the mining industry (Government of PNG, 2009).
- The Climate Change Management Act sees the establishment of Climate Change and Development Authority and the basis for the creation of institutions, legal frameworks, and financing to move towards a low carbon economy. This includes the National Climate Change Board, a Screening Committee and the Climate Change and Green Growth Trust Fund (Government of PNG, 2015).

Climate finance

National societies cannot directly apply for climate finance from the GCF, but they can be an implementing partner for an accredited entity (Climate Centre, 2022a).

National Societies can explore options for accessing climate funds through smaller funds, such as the GEF's Small Grants Programme or the FFEM's Small Scale Initiatives Program. Other funding from bilateral donors, national climate funds, or multilateral climate funds like Adaptation Fund, CREWS, or GCCA+ could be explored (Climate Centre, 2022a).

Engaging in national climate adaptation planning is vital for accessing climate finance.

Additional Resources

Climate Centre. (2022a). Factsheet on Climate Finance. https://www.climatecentre.org/wp-content/uploads/Fact-Sheet-on-Climate-Finance.pdf

Climate Centre. (2022b). Entry points for National Societies on Climate Finance partnerships. https://www.climatecentre.org/wp-content/uploads/Entry-Points-for-Climate-Finance-Partnerships.pdf

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