Climate Change Security:

An Analysis of Cross-Sector Climate Adaptation in Papua New Guinea

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Any views expressed in this report are the authors' own and do not necessarily represent those of the CFE-DM or SIPA.

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Acronyms

ADB	Asian Development Bank
AIFFP	Australian Infrastructure Financing Facility for the Pacific
CCA	Climate Change Adaptation
CCDA	Climate Change Development Authority
CCI	Climate Change Impact
CCMA	Climate Change Management Act
CEPA	Conservation and Environment Protection Authority
CFE-DM	Center for Excellence in Disaster Management and Humanitarian Assistance
CHARM	Comprehensive Hazards and Risk Management
CIF	Climate Investment Funds
CSO	Civil Society Organization
DEC	Department of Environment and Conservation
DoD	United States Department of Defense
EOC	Emergency Operations Center
EWS	Early Warning System
FAO	Food and Agriculture Organization
FDNY	New York City Fire Department
IDP	Internally Displaced Person
ILO	International Labour Organization
INFORM	Index for Risk Management
IOM	International Organization for Migration
ITU	International Telecommunication Union
GCF	Green Climate Fund
GDP	Gross Domestic Product

GEF	Global Environment Facility
GFA	Global Fragility Act
MoU	Memorandum of Understanding
MP	Member of Parliament
NAP	National Adaptation Plan (2023)
NGO	Non-governmental Organization
NDC	Enhanced Nationally Determined Contribution (2020)
NWS	National Weather Service
OCCD	Office of Climate Change and Development
OCCES	Office of Climate Change and Environmental Sustainability
PNG	Papua New Guinea
PPCR	Pilot Program for Climate Resilience
SCF	Strategic Climate Fund
SDG	Sustainable Development Goal
SIPA	School of International and Public Affairs
UN	United Nations
UNCDF	United Nations Capital Development Fund
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
USINDOPACOM	United States Indo-Pacific Command
USNS	United States Naval Ship
WASH	Water Sanitation and Hygiene

Executive Summary

The primary objective of this Capstone project is to expand the body of knowledge around climate security on behalf of the US Department of Defense (DoD), Center for Excellence in Disaster Management and Humanitarian Assistance (CFE-DM). This report is shaped around the question: What are Papua New Guinea's (PNG) climate security challenges and adaptation needs, and how can the DoD build on its growing relationship with PNG government entities while enhancing PNG's climate adaptation capacity?

This report is part of the CFE-DM's Climate Security and Climate Change Adaptation (CCA) Research Series, which looks at Pacific Island countries and maps regional perspectives and cases of climate security. The report brings to the series a perspective on challenges in climate-induced emergencies and potential mitigation and adaptation actions that can build resilience in the case of Papua New Guinea specifically.

The main goal of this report is to provide increased understanding of the regional threat environment in PNG created by climate change. This report maps the state's existing CCA plans and policies as well as opportunities for the DoD to offer strategic and collaborative solutions.

The research takes an inductive approach centering on semi-structured interviews with US government officials, PNG government officials, and regional and climate experts. Additionally, the report analyzes the role of partnerships with multilateral and international actors in mitigating the climate security risks of PNG.

Finally, this report develops population-centric pathways to building climate safety structures and mitigating the growing negative impacts of climate change through US-PNG government partnerships.

1.0 Introduction: Climate Change, Global Security, and Papua New Guinea

"Climate change is the single greatest threat to our existence as we know it. Weather patterns grow more erratic and there are more climate change-induced natural disasters. Food production is growingly affected and disrupted. Community resilience and livelihoods are constantly threatened…it is not the natural environment anymore that shapes the planet and how we live, but it is us humans who shape and impact the planet."

- *Mr. Dirk Wagener, UNDP Resident Representative in Papua New Guinea, PNG National Adaptation Plan Launch, April 5th, 2023.*[1]

Climate Theme Spotlight:

Climate Safety & Climate Security

Climate safety refers to the need to prevent harm and ensure the safety of individuals and communities affected by climate change. It is a bottom-up issue that requires local and community-driven efforts. Conflict resolution is important to climate safety, as disputes over resources or other climate-related issues can lead to violence and harm. Sustainability is also crucial to ensuring climate safety, as it involves balancing the needs of the environment, society, and economy to create a long-term solution. The DoD can take an internal response that prioritizes the needs of affected communities in PNG and empower them to take action to ensure climate safety.

Climate security refers to the threat posed by climate change to the stability and security of societies, both at the national and global level. It is a top-down issue that requires international cooperation and collaboration to mitigate its impact. Climate change can lead to conflicts and resource competition. However, the DoD can take an effective mitigation response through international aid, which can also be critical in promoting climate security.

Example: Climate change poses security - and safety - risks to communities by increasing extreme weather events, leading to conflicts, poverty, and inequality. In Papua New Guinea, this can lead to resource disputes and conflict, as displaced communities and different tribes may compete for scarce resources.

Implications: To address the underlying causes of insecurity and instability, the DoD must prioritize climate safety, requiring a coordinated response from several sectors with a focus on how to lead the actions on the ground, prevent human-related risks and prioritize livelihoods.

Papua New Guinea (PNG) is one of the most vulnerable countries in the world to climate change.[2] The adverse impacts of climate change will continue to hinder development and intensify over time. The local community—especially in rural, coastal, and underdeveloped areas—will face the greatest challenges from increased climate-related calamities. As the magnitude of climate change impact increases, traditional coping mechanisms will no longer be sufficient to protect the community across all sectors of development and livelihood. Global and community security, therefore, become a priority area in the collective effort to scale up climate action with and for the community.

Climate change and global and community security present a focal point to advance collaborative engagement on climate action in Papua New Guinea. The intersection of climate and human security brings forward the central theme of this report: **climate safety.**[1]

1.1 Context: Climate Change as a Threat to Global Security

With the increasing awareness of climate change and its potential impacts on natural disasters and national stability, it is critical to gain a better collective understanding of the security and safety aspects of climate. Papua New Guinea, one of the Pacific Island countries in the scope of the United States Indo-Pacific Command (USINDOPACOM), is especially vulnerable to the risks of climate change and its potential security consequences.

1.2 Papua New Guinea as a Vulnerable Country for Climate Security

The 2019 US Global Fragility Act[3] identified Papua New Guinea as one of the countries affected by fragility and conflict that should be a priority for prevention and peacebuilding. As a Pacific Island nation, Papua New Guinea faces frequent climate and non-climate-related hazards, including landslides, flooding, tsunamis, earthquakes, and others.[4] These hazards exacerbate development challenges across the country and increase threats to the ecosystem, including threats to agriculture, infrastructure, transport, and health, which jeopardizes the livelihood and safety of the population.[5] These negative impacts hinder the country's growth trajectory and socio-economic opportunities on an individual, community-based and country-wide scale.[6]

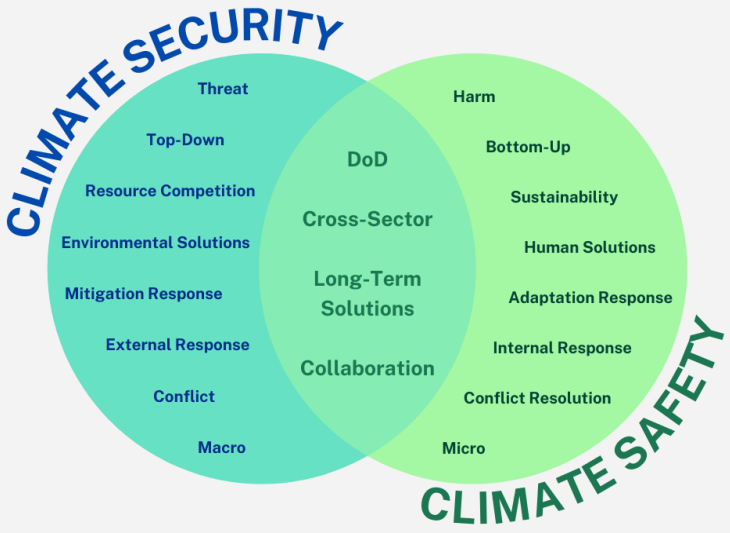


Figure 1: Distinguishing Climate Security from Climate Safety

Climate Theme Spotlight:

Disaster Risk

Disaster Risk refers to the likelihood of a natural disaster occurring and the potential impact of such a disaster. It considers a given population or region's exposure, hazard, and vulnerability metrics. Understanding disaster risk is crucial for effective disaster management. (Dale, 2022, Endnote 160)

Example: Papua New Guinea is highly vulnerable to earthquakes, volcanic eruptions, landslides, seasonal floods, and droughts.

Implications: Given the potential impact of natural disasters on military readiness and operations, the DoD has a significant stake in mitigating disaster risk. The DoD can develop strategies to reduce risk and enhance resilience by investing in research and analysis to better understand the effects of natural disasters.

We would like to credit our project advisor, Adjunct Associate Professor Joseph Pfeifer, for his contributions to the conceptualization and development of this key term.

Pfeifer, Joseph. "Crisis Leadership: The Art of Adapting to Extreme Events." Harvard Kennedy School's Program on Crisis Leadership Discussion Paper Series, (https://www.hks.harvard.edu/centers/research-initiatives/crisisleadership/about-us/people/joseph-pfeifer), Cambridge, MA. 2013.

Advancing climate change resilience in PNG is critical to mitigating the impacts of natural disasters. The Climate Change and Development Authority (CCDA), alongside varied government bodies and community leaders, emphasizes the advancement of climate action as essential to alleviating the security risks associated with climate change and these evolving threats.[7] [8] Major disasters across PNG's various ecosystems directly impact strained and vulnerable development efforts, biodiversity, and human health. Advancement of resilience structures and stability in the community become intrinsically linked as priorities.

As the central body for the Climate Agenda in PNG, it is important to underscore the CCDA's role as the coordination agency and hub for advancing climate actions, programs, implementation, and partnerships across the community and internationally. **The framework of this report builds around this central hub for climate-resilient actions and the three objectives of the 2023 National Adaptation Plan established in PNG:**

1. Strengthen institutional capacities and the ability to mainstream climate change adaptation and disaster risk reduction effectively.
2. Build resilience at the national, subnational, and sectoral levels through information and awareness-raising, education, and capacity building, as well as providing early warning systems.
3. Facilitate resource mobilization and foster public and private investment in climate change adaptation priority areas.

1.3 Report Objectives

The central discussion of the report surrounds climate security and adaptation with a focus on both state and human security lenses. The goal is to identify primary perceived climate threats to the country that could lead to climate disasters, and based on this information, determine potential contributions through which the DoD can support the country's climate security infrastructure using mitigation and adaptation measures.

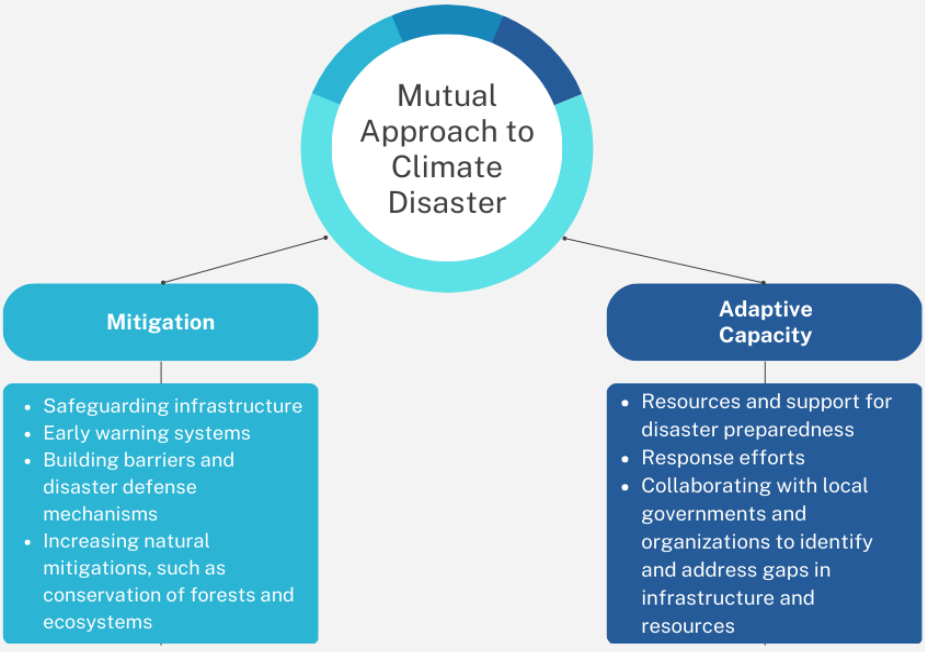


Figure 2: Mutual Approach to Climate Disaster

Mitigation measures aim to reduce the intensity and effects of natural disasters. These measures focus on the processes and infrastructure needed to diminish disaster effects. The local ability to effectively use mitigation techniques and respond to climate events is their adaptive capacity (the ability to adapt and respond to changing conditions).

To find potential avenues for mitigation and adaptation, this report deep-dives into climate trends, local policies, and local perspectives. The scope of this analysis is structured in three main areas: climate definitions and implications, adaptation and mitigation priorities, and potential areas for support (Figure 3).

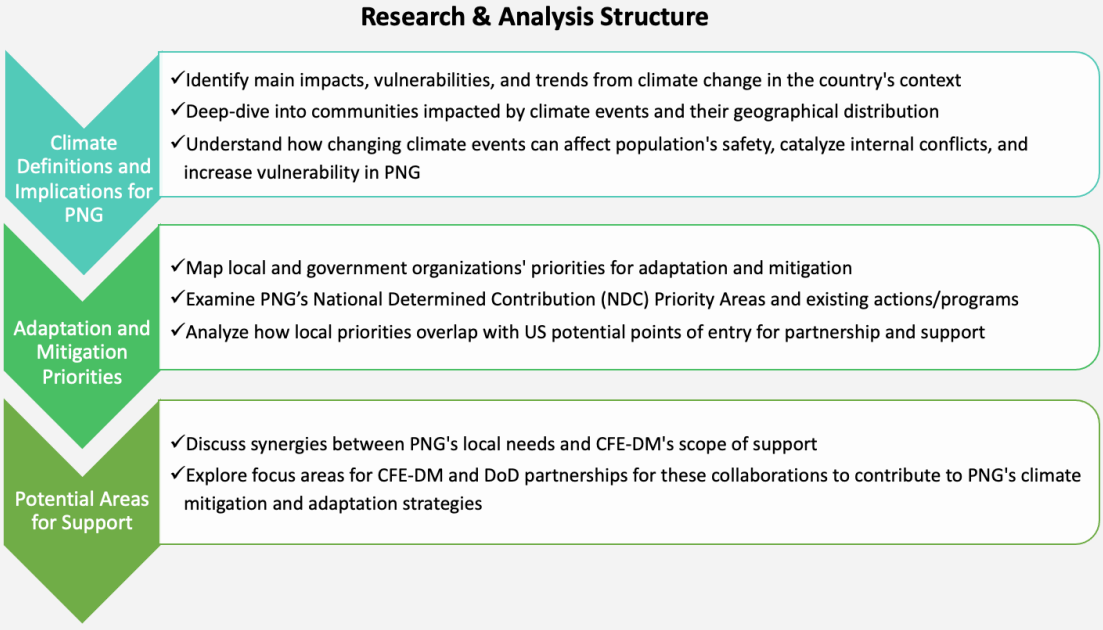


Figure 3: Three-Pronged Research and Analysis Framework

2.0 Papua New Guinea and Climate Change

To understand Papua New Guinea's climate security landscape and possible mitigation and adaptation strategies, it is necessary to consider the country's specific challenges: the "what, who, and how" of national climate security threats. The "what" are the disaster threats that the country might face, the "who" are the affected people and communities, and the "how" are the means and strategies that the government, international organizations, and partners are applying to act against climate change.

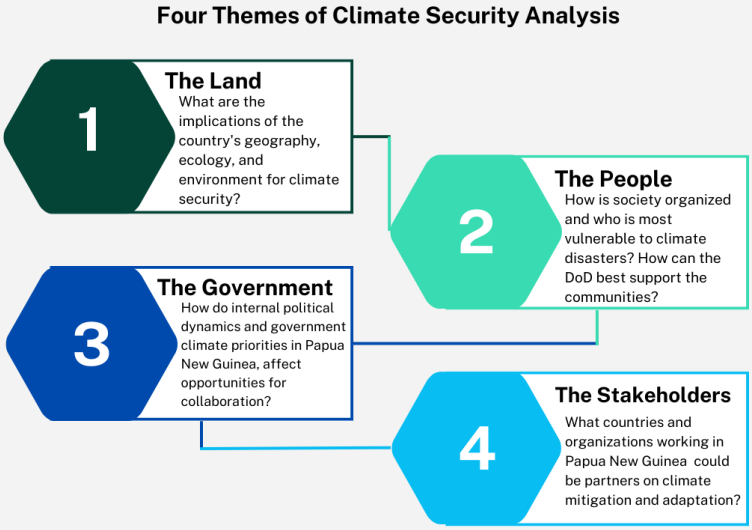


Figure 4: Four Themes of Climate Security Analysis

2.1 The Land

Papua New Guinea (PNG) is an island nation in the Pacific Ocean. PNG is one of the world's most culturally and linguistically diverse countries and is known for its stark geographical features, including rainforests, wetlands, and volcanoes. It is also highly biodiverse, home to more than 7% of the world's biodiversity.[9] PNG is extremely prone to natural disasters and hazards, and its high vulnerability and low resilience capabilities make such events particularly concerning, especially as the world climate continues to shift.[10]

Figure 5: Political Map of Papua New Guinea—sourced from worldometers.info/maps/papua-new-guinea-maps/

Overview of Climate-Related Risks to the Land

In the following section, this report analyzes Papua New Guinea's climate security profile by examining the interactions between PNG's projected climate trends, existing security landscape, and new or exacerbated issues that these interactions might produce.

Papua New Guinea's climate is generally described as "hot tropical humidity year round."[11] PNG's climate has a wet season from December to March and a dry season from June to September. There is very high humidity in the country, which usually ranges from 70-90%. According to the European Commission's INFORM Risk Index, Papua New Guinea is at a "high risk" for natural disasters due to both exposure and a lack of coping capacity.[12] Natural disasters in PNG include earthquakes, tsunamis, volcanic activity, cyclones, flooding, landslides, and droughts. The country experiences an average of two to three disasters per year. Changes in the climate compound the negative impacts of all of these natural disasters.

Figure 6 below shows the various consequences of climate change and their level of urgency in PNG on a scale from 0–5.

One of the most critical climate trends is the mean **sea level rise** surrounding Papua New Guinea. One-fifth of the land in PNG is already subject to inundation.[13] The country faces more than double the

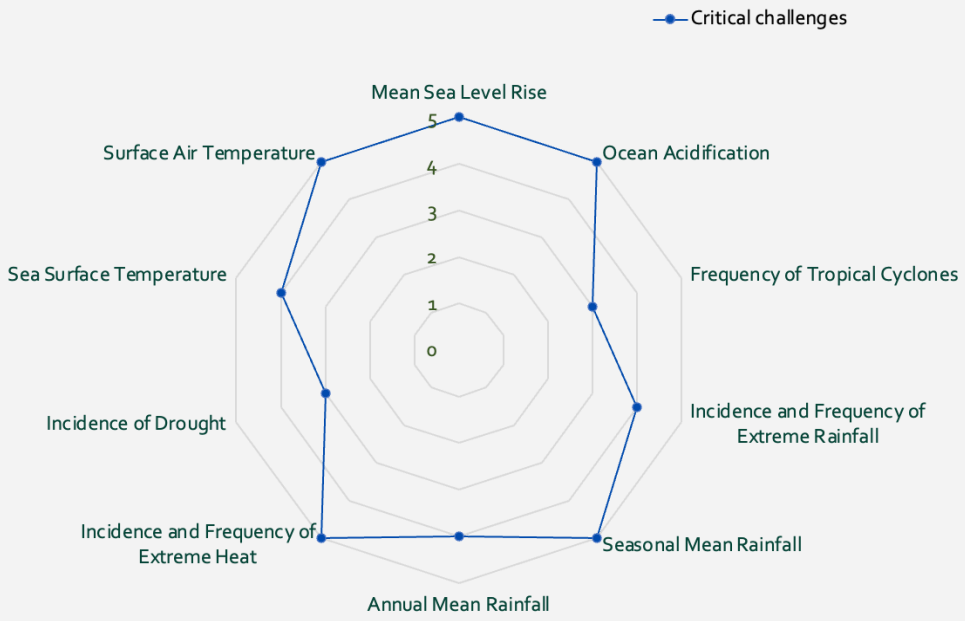


Figure 6: PNG's Most Concerning Climate Trends

global average of annual sea level rise. This trend will cause multiple security risks for the country, such as a lack of access to fresh water, displaced persons, food insecurity, and increased violence. Sea level rise, when combined with other factors such as an increase in the frequency of extreme rainfall, can lead to a rise in flooding country-wide. This includes **flash floods, coastal flooding, and river flooding,** all of which present significant security risks to the country. Furthermore, the population affected by river flooding is projected to double by 2030, underscoring the intensity and severity of these natural disasters.[14] Flooding will also lead to economic insecurity. This will present even greater challenges to the government of PNG, which requires more infrastructure to address these issues properly.

Example: Climate Change Increasing Natural Disaster Occurrence

In July 1998, a 7.0 magnitude earthquake triggered a series of three tsunamis that struck and devastated Papua New Guinea's northern coast. At least 2,500 people were killed and thousands more were displaced. In the months following, domestic violence, substance abuse, and diet-related health problems related to the disaster were increasing. However, one year after the disaster, critical aid promised by the government still had not arrived. Today, due to the effects of climate change and rising sea levels, Papua New Guinea is facing growing risks of natural disasters such as tsunamis, but it still lacks the infrastructure, governance, and technology to respond effectively and efficiently.

Another climate trend is the increased danger of **volcanic activity**. Papua New Guinea currently ranks highest in the world for population exposed to volcanic risk; the country has a total of 56 volcanoes, with 16 currently active and six considered "high risk.'[15] This volcanic activity is already a risk to 17% of PNG's population since more than one million individuals live within 30 kilometers of an active volcano.[16] Volcanic activity has serious implications for the security landscape; destruction of the land around volcanoes will lead to displaced persons, reduction of usable land for farming, health risks from resulting pollution, destruction of freshwater sources, and a deterioration of infrastructure. Research suggests that volcanic activity and climate change can create a negative feedback loop of increased intensity and spread of chemical aerosols from the resulting volcanic plumes.[17] Therefore, it is essential that volcanic activity is included in discussions on climate trends and their effects on the country's security landscape.

Landslides and earthquakes both present additional climate security threats. Papua New Guinea has an increased landslide risk due to its frequent seismic activity, steep mountain ranges, and high annual rainfall. Landslides are most common in the Highlands and other mountainous regions. Moreover, PNG is ranked sixth in the Asia-Pacific region for highest percentage of the population exposed to earthquakes.[18] Both potential disasters can lead to displaced populations, loss of livelihoods, lack of access to healthcare and clean water, and food insecurity.

Recommendations for the DoD: The Land

1 **Conduct scenario training**

2 **Support infrastructure and logistics**

3 **Support risk assessments & monitoring**

See recommendations section for more details

2.2 The People

The total population of Papua New Guinea was believed to be about 9.5 million until 2022, when a UN Population Fund study estimated that this number was closer to 17 million. Most of the population is concentrated in the mountainous Highlands and the eastern coastal regions, with less than 15% living in urban areas. With over 800 languages spoken within its borders (about 12% of the world's total languages), PNG is the most linguistically diverse country in the world. However, it has three official languages: Tok Pisin, English, and Hiri Motu. PNG is among the world's most culturally diverse nations, with thousands of individual tribes and communities interspersed across the island.

PAPUA NEW GUINEA KEY FACTS:

Estimated Population (2023): ≈ 9.8 million[19]

- Note: PNG has not recently held a comprehensive census that can provide a definitive population estimate.[20]

Social/Cultural Overview

- Over 850 languages spoken[21]
- High social and cultural diversity[22]
- Tribal/clan social structures
  - Deeply ingrained tribal divisions and histories of conflict[23]

Map sourced from worldometers.info/maps/papua-new-guinea-maps/

Geography & Environment

- 7% of the world's biodiversity[24]
  - Majority is endemic to New Guinea[25]
- Geography: heavily mountainous with coastal lowlands[26]
  - Also features rainforests, grasslands, mangrove forests, freshwater swamp forests, savannas, and one of the last tropical glaciers on Earth[27]

Economy

- Primary exports
  - Petroleum gas, gold, copper ore, wood, crude petroleum[28]
- Major industries
  - Minerals/energy extraction, agriculture, forestry, fishing[29]

Papua New Guinea possesses a wealth of natural resources, including minerals, oil, natural gas, timber, and fish, but its economy has suffered due to decades of exploitation.[30] Nonetheless, most of the country's top exports—petroleum gas, gold, copper ore, wood, and crude petroleum— are derived from the mineral and energy extraction industries, contributing to a large part of the national GDP.[31] [32] Subsistence agriculture also accounts for a significant portion of the national economy, especially in rural areas, and provides the vast majority of the country's food supply.[33] The agricultural, forestry, and fishing sectors offer most of PNG's employment opportunities.

Papua New Guinea ranked 160 out of 161 countries in the United Nations Development Programme's 2021 Gender Inequality Index due to its extremely high levels of gender-based violence against women and girls, minimal political participation opportunities for women, and other discriminatory practices.[34] Women, youths, and disabled people, particularly those living in rural areas, are the most vulnerable to the effects of climate change, insecurity, and violence.[35]

Climate Theme Spotlight:

Resilience

Resilience refers to the ability of individuals, communities, or systems to recover from the impacts of climate change and other disasters. More resilient communities can better absorb the effects of a natural disaster and return to normalcy more quickly than less resilient communities. Building resilience involves developing measures to minimize the impacts of disasters, such as strengthening infrastructure and promoting social cohesion. (Dale, 2022, Endnote 160)

Example: In Papua New Guinea, building resilience is critical for communities to recover from natural disasters. This could involve investing in disaster recovery and reconstruction efforts or promoting local-level preparedness and response strategies.

Implications: The DoD can support disaster recovery and reconstruction by providing resources and collaborating with local governments and organizations to promote long-term sustainability and economic development. 3

Security Challenges and Climate as a Threat Multiplier

Papua New Guinea faces a number of serious security issues, including widespread tribal violence, food insecurity, water insecurity, sexual and gender-based violence, and gang activity and crime. In the coming decades, the climate trends described above are very likely to compound pre-existing security challenges in addition to creating new ones.

Some of Papua New Guinea's most urgent climate-compounded threats include:

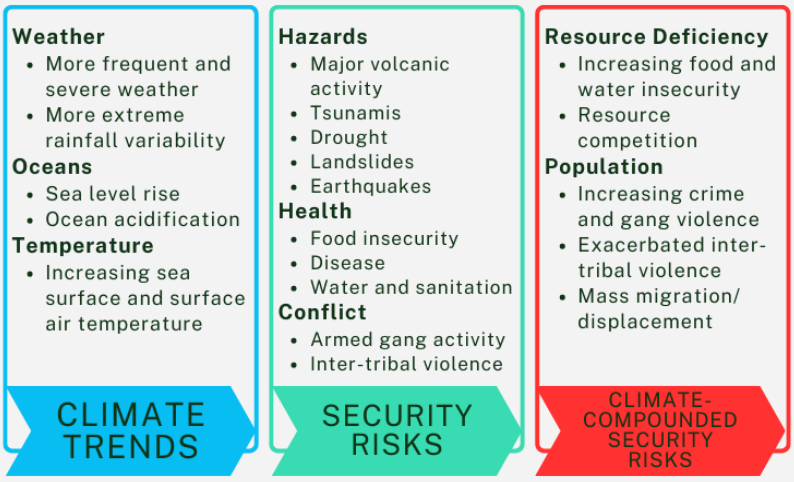


Figure 7: Climate Trends Act as a Risk Multiplier upon Existing Security Threats to Create New and Increased Risks.

1. Famine

Food insecurity is already a serious concern in Papua New Guinea, and as seen following the July 1998 tsunami in PNG, this problem worsens dramatically when diet staples are wiped out by disaster.[36] PNG's nationwide dependence on subsistence farming for food is highly concerning given the country's limited arable land, which is threatened by soil degradation accelerated by unsustainable farming practices and deforestation as well as more frequent and severe flooding and landslides.[37] Residents will thus face decreased farming capacity as well as reduced fish and ocean-sourced food supply due to ocean acidification and harmful fishing practices.[38]

2. Water crisis

Only 40% of the Papua New Guinean population has access to safe drinking water. Water quality is often compromised due to unsustainable logging practices and large-scale mining projects, which discharge heavy metals and harmful chemicals into rivers.[39] Existing drinking water sources are threatened with seawater contamination due to rising sea levels. Furthermore, changing rainfall patterns and increased risk of severe drought may inhibit residents' access to water.

3. Violence and crime

Inter-tribal violence is already prevalent across Papua New Guinea, with tribal and clan divisions carved over tens of thousands of years along familial, linguistic, and regional lines.[40] Violent crime is also a serious problem, particularly in cities. Competition over a diminishing supply of resources, including food, water, energy, and land, is likely to increase tribal and armed gang violence, especially when people are forced to search for resources in another group's territory.

The agricultural, water resources, ecosystems, and health sectors are predicted to be the economic sectors most affected by climate change, which will seriously reduce employment opportunities for most of the population.[41] This loss of livelihood and the inability to access sufficient resources may drive residents, especially young men, to join armed groups or engage in criminal activity. Armed groups may also forcibly seize control of resources and use restricted access to these resources as a coercion mechanism against local populations. It is important to note that women and children will likely experience the effects of increased violence.

4. Mass migration and internal displacement

Rapid sea level rise has led to a shrinking landmass in Papua New Guinea, especially among its smaller islands. Reduced land and living space will likely lead to the increased internal displacement of these islands' residents to the mainland or other islands. Increased frequency and strength of natural disasters, as well as resource scarcity and resulting conflict, are also likely to be major forces for displacement.

An influx of internally displaced persons (IDPs) across the country to urban centers and IDP camps may overwhelm the infrastructure and resources available in these areas. The possibility for violence is likely to increase when displaced members of different communities with histories of conflict are forced together, and sexual violence risks are often heightened in IDP camps.

Climate Safety

Climate safety describes how climate change has made natural disasters more severe and offers people a concrete strategy to follow in such situations. The end goal of understanding the climate crisis is to protect the population and provide them with confidence that they are safe from disaster threats.

Climate Safety in Three Steps:

1) *Know Your Risks:* The first step to climate safety is understanding the threats of climate change and natural catastrophes in your area. This includes researching local weather patterns, most frequently occurring natural disasters, and recommended emergency preparations.

2) *Plan a Strategy:* The second step is to develop a crisis management strategy. This includes planning evacuation routes, collecting emergency supplies, and planning communication strategies with friends and family.
3) *Take Action:* The third step is to take action to prepare for the effects of natural disasters. For example, modifying your home to withstand earthquakes or flooding, planting drought-resistant crops, or reducing one's carbon footprint can all help reduce the impacts caused by climate change.

Figure 8: Three Steps to Climate Safety

"Know, Plan, Act": This approach encourages individuals to take proactive steps to protect themselves and their communities from the impacts of natural disasters.

The Know, Plan, Act strategy is vital to connecting all of Papua New Guinea by sharing information.

Climate Theme Spotlight:

HEV: Hazard, Exposure, and Vulnerability

HEV or Hazard, Exposure, and Vulnerability are the three components of disaster risk. Hazard refers to the potential threat or danger posed by a disaster, such as a hurricane or a flood. Exposure refers to the physical or social presence of people, assets, or infrastructure in an area at risk of a disaster. Finally, vulnerability refers to the susceptibility of people, assets, or infrastructure to damage or harm from a disaster based on socioeconomic status, age, or health. (Dale, 2022, Endnote 160)

Example: The HEV framework is particularly relevant in Papua New Guinea, where many communities are located in rural areas. Hazard is high due to the country's location on the Pacific Ring of Fire, which makes it prone to earthquakes and volcanic eruptions. Exposure to natural disasters is also elevated, particularly for communities living in coastal or mountainous regions. Vulnerability is significant given the country's limited infrastructure, limited healthcare systems, and ongoing social and political conflicts.

Implications: HEV is relevant to the DoD, particularly in understanding the vulnerability of military installations and personnel. One significant area of concern is the Highlands as there are no roads and many people travel by river. Identifying these areas of exposure and susceptibility is essential to successful disaster response. Additionally, once on the ground, the DoD should develop strategies to protect military personnel and infrastructure from the impacts of natural disasters.

Information Sharing

Early Warning System

The first essential tool for information sharing is an Early Warning System (EWS), which provides advance notice of potential hazards, such as natural disasters or disease outbreaks, to communities and authorities. EWSs allow for timely preparation and response, which can significantly reduce the impact of disasters.[42] In addition, exchanging information is essential for connecting to the community and relaying information back to the DoD. Figure 9 addresses the four priorities for an Integrated EWS.[43]

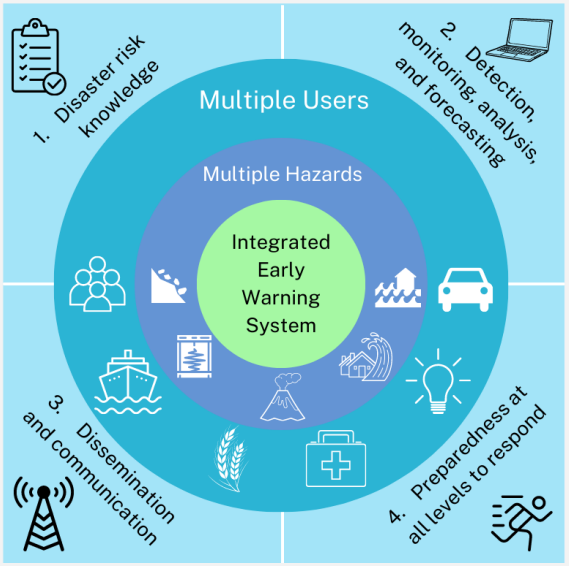


Figure 9: Graphic Adapted from Cumiskey, Lydia. Integration Challenges EWS, 2019

Currently, in Papua New Guinea, the National Weather Service operates an Early Warning System to provide advance notice of potential natural hazards, such as floods. The system uses a network of weather monitoring stations throughout the country to collect data on weather patterns and issue warnings to the public through radio, TV, and other means. It needs a disaster-focused system that is attuned to all of the major catastrophes that can occur. [44]

The current Early Warning System capacity in PNG is under the National Weather Service (NWS), which operates within the Department of Transportation. The NWS can notify the public about cyclones, strong winds, and droughts. The system operates in eight out of twenty-two provinces and utilizes national airport radar systems. The EWS could expand to include the most likely hazards across all twenty-two provinces: [45]

- ➔ Flooding
- ➔ Volcanic Eruptions
- ➔ Earthquakes
- ➔ Landslides
- ➔ Tsunamis

There is a difference between disasters caused by climate change and environmental disasters. Climate and environment are strongly intertwined in terms of developing disaster conditions. Climate-based disasters include the impacts of sea level rise, coastal and inland flooding, wildfires, and droughts. In comparison, environment-based disasters include volcanic eruptions, earthquakes, and tsunamis.

These five hazards were selected as the top priority for Papua New Guinea, as the country is most at risk of experiencing one of these disasters.

Cell Sites

Cell sites, also known as cell towers or base stations, enable wireless communication by transmitting and receiving signals between mobile devices and the cell network. In low-income countries, cell sites may provide mobile phone coverage to remote areas where wired telecommunications infrastructure is unavailable.

Digicel and Bmobile-Vodafone are the main mobile network operators in Papua New Guinea.[46] They have deployed a network of cell sites nationwide to provide mobile phone coverage to remote areas. For example, Digicel has deployed cell sites in the Southern Highlands Province to provide mobile phone coverage to previously isolated communities due to rugged terrain and lack of infrastructure. When a disaster strikes, the DoD can bring in new cell sites to impacted regions.

Portable Chargers

Portable chargers, or power banks, can charge mobile devices like smartphones and tablets. They are valuable tools for connecting communities and accessing information. Portable chargers are a popular tool for staying connected in Papua New Guinea, where access to electricity can be limited or unreliable. For example, the Australian government has provided solar-powered portable chargers to communities in Papua New Guinea, which allow people to charge their mobile phones and other devices using renewable energy.

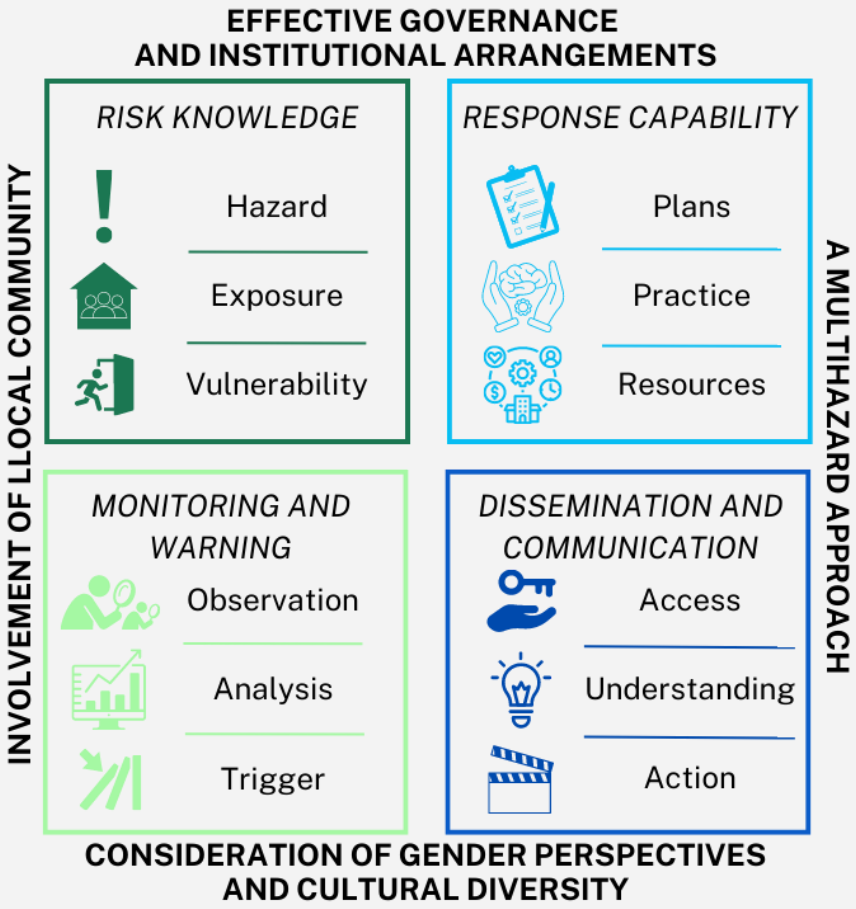


Figure 10: This diagram was adapted from the World Meteorological Organization. Budimir, Mirianna. How do you build an effective early warning system? 12 Mar. 2021, https://www.preventionweb.net/news/how-do-you-build-effective-early-warning-system .

Emergency Operations Center

An Emergency Operations Center (EOC) is essential to overseeing the operations of EWS and the deployment of cell sites and portable chargers during disasters. An EOC is a facility that coordinates emergency response activities during disasters, such as natural disasters or disease outbreaks. EOCs may serve as a central command center through which emergency personnel and resources are managed and deployed.[47]

In Papua New Guinea, the National Disaster Center is the country's Emergency Operations Center, coordinating response efforts during natural disasters and other emergencies. The center is located in Port Moresby and is separated from the EWS, run by the national weather service.[48] The DoD can build off of this center to expand the EWS system and the search and rescue training program. Training a young group to work under the government as a means of helping the broader community would provide jobs for youths as well as community-building opportunities. Building an effective Emergency Operations Center means taking a holistic, people-centered approach. [49]

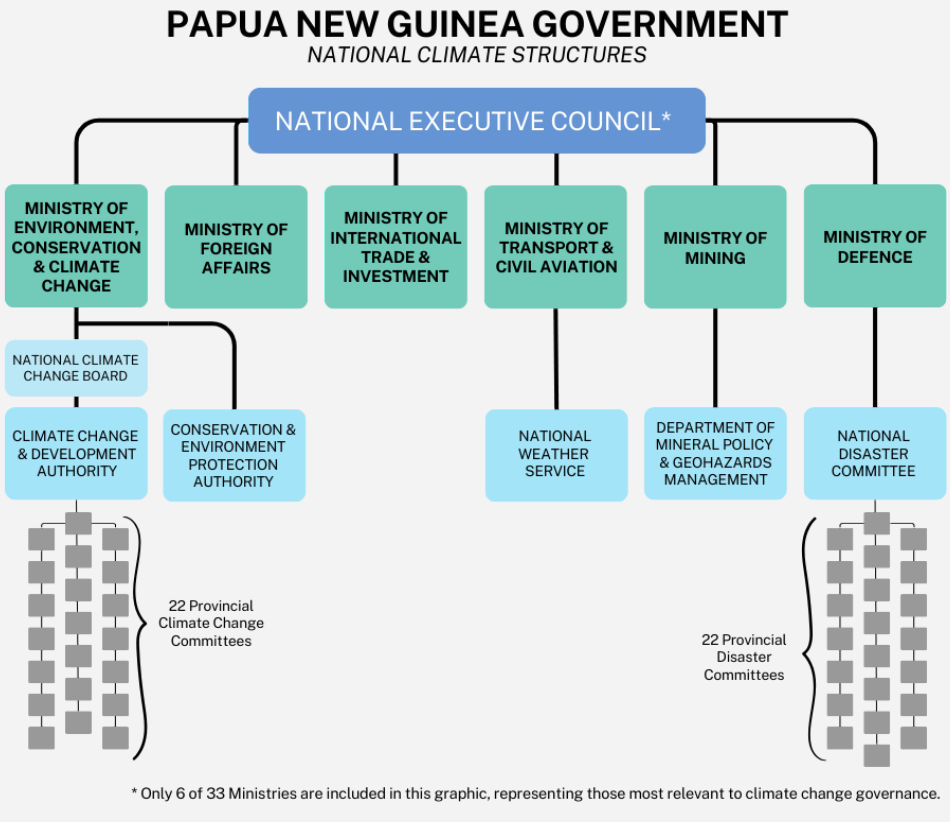
This EOC would be the center for creating conditions for proper coordination. Figure 10 to the right addresses the four main areas to develop an efficient EOC: risk knowledge, response capability, monitoring and warning, and dissemination and communication.

Know: The three critical pieces of technology to provide Papua New Guinea before, during, and after a disaster are an Early Warning System (EWS), cell sites, and portable chargers.

Plan: The technology should all be housed under an Emergency Operations Center (EOC), which can continuously relay information to the DoD.

Act: Implement a training program focused on search and rescue that can be located within the EOC.

2.3 The Government



Sources: [50,51,52,53,54,55]

Figure 11: National Climate Structures within the Papua New Guinea Government

The **Ministry of Environment, Conservation, and Climate Change** houses the entities most central to Papua New Guinea's climate governance. The minister, informed by reports from agencies in its portfolio, directs PNG's climate-related policy, represents the country in international climate-related events, and engages in issues surrounding the Climate Change Action Plan and the Climate Change Adaptation Plan.[56,57] The existence of this ministry, and its steady position within the National Executive Council throughout each new government, represents the consistent prioritization of climate and the commitment to ensuring climate is well represented in national strategies.[58]

The **Climate Change and Development Authority** (**CCDA)**, established in 2010, is the coordinating body for all climate change-related policies and actions in the country, as well as the focal point for all climate-related documents.[59] [60] It is also the designated National Authority under the United Nations Framework Convention on Climate Change (UNFCCC), making it the first and primary point of contact for all multinational donors and partners.[61] The CCDA serves as an intermediary, assessing which provinces have the most pressing needs and which agencies may be best positioned to support them. The CCDA replaced the former Office of Climate Change and Environmental Sustainability (OCCES) when it was founded and replaced the Office Of Climate Change and Development (OCCD) in 2016 when it was officially designated an Authority.[62] The Climate Change (Management) Act of 2015 mandated the CCDA and imbued it with the responsibility to contribute towards global efforts in mitigating greenhouse gas emissions through low-carbon development that fosters economic growth and social welfare for the people's well-being and prosperity.[63] According to Part II (Division 1) (10) of the Climate Change (Management) Act of 2015, "The purpose of the Authority is to -

(a) promote and manage the compatible climate development through climate change mitigation and adaptation activities; and

(b) implement any relevant obligations of the State under applicable rules of international law and international agreements and to give effect to national commitments of Papua New Guinea, voluntarily or otherwise, under the UNFCCC and the Kyoto Protocol together with such amendments or any new agreement that may supersede the Kyoto Protocol to which Papua New Guinea has acceded; and

(c) be Papua New Guinea's Designated National Authority or equivalent entity or complementary or superseding entity and any relevant entity under the UNFCCC for the purposes of the Kyoto Protocol and any subsequent arrangement or agreement under the UNFCCC that may supersede Kyoto Protocol made thereto; and

(d) administer compensation or incentive funds, grants, donor money and other funding derived from national and international sources under the direction of the Board to assist in the development of climate compatible economic endeavors and climate adaptation and mitigation programs in Papua New Guinea."[64]

See Appendix A for a full list of the Authority's functions and powers.

The Climate Change (Management) Act of 2015 further provides the authority and legal means to ensure that sectors and stakeholders comply with national climate-related regulations. Compliance by ten named regulated sectors of the national economy requires the annual provision of strategies and action plans to the CCDA. These ten sectors[65] include:

(a) agriculture and livestock;

(b) electricity generation;

(c) transportation of persons and goods by road, sea, and air;

(d) building materials for manufacturing, construction, and infrastructure development;

(e) forestry including land use and land use change and forestry;

(f) petroleum, energy and natural gas production, refining, and distribution;

(g) minerals exploration, extraction, production and refining;

(h) fishing and maritime resources include fishing shore-based facilities or factories;

(i) waste management, industrial processing and disposal; and

(j) any other sector which may be determined by the Minister and published in the National Gazette.

Climate Theme Spotlight:

Climate Risk Management (CRM)

Climate Risk Management (CRM) refers to a step in the adaptive policy-making process that connects real-time risk assessment with short-term and responsive management changes. (Dale, 2022, Endnote 160)

Example: A CRM framework in place allows for knowledge on the real-time impact of earthquakes that lead to landslides in each region and the crisis response system to be in place for rapid emergency services deployment.

Implications: Assessments and fast response mechanisms are essential during natural disasters, including resource mobilization, rapid emergency response team deployment, and communication structures across government agencies. Implementing a CRM framework into all climate programs and activities leads to a better supported community before, during, and after disaster.

The **National Climate Change Board** was also established by the Climate Change (Management) Act. The Board's primary function is to provide general control and guidance over exercising the functions and powers of the CCDA (see Appendix B for full functions and powers of the board)[66]. They deal

predominantly with administrative issues and manage contract procurement for projects budgeted at $500,000 or above.[67] Technical divisions report directly to the board, responsible for making recommendations before the Ministry of Environment, Conservation, and Climate Change.[68]

The **Conservation and Environment Protection Authority (CEPA)**, previously known as the Department of Environment and Conservation (DEC), was established in 1985.[69] The Authority is tasked with ensuring CEPA natural and physical resources are managed to sustain environmental quality and human well-being.[70] CEPA will lead the implementation of climate initiatives supporting conservation, diversity, and other climate issues, and the CCDA will provide a bridge for climate support.[71] CEPA's predominate responsibilities include:

(a) Environment management policy development

(b) Biodiversity protection policy development

(c) Pollution control and the regulation of hazardous substances

(d) Management of water resources

(e) Environmental impact assessments of major projects, including infrastructure, forestry, agriculture, mining, and petroleum proposals

(f) Biodiversity assessment and data management

(g) Hydrological investigation, data collection, and analysis

(h) Coordination of donor-funded programs

(i) Education and awareness

The **Ministries of Foreign Affairs** and **International Trade & Investment** are relevant to climate governance because they are the first line of contact for foreign governments engaging with PNG.[72] All bilateral partnerships must complete a Memorandum of Understanding (MoU) or sign a contract through these departments before being referred to the CCDA.[73] Once referred, the CCDA will serve as the nexus point for communication, engagement, and coordination for all bilateral and multilateral partners on climate-related issues.

The **National Weather Service** falls within the **Ministry of Transport & Civil Aviation** and is critical to climate governance because it is responsible for national early warning systems.[74] Eight provinces currently possess the infrastructure to receive and disseminate information via these systems.[75] In these provinces, the National Weather Service updates meteorological hazards related to drought, flooding, frost, hail, heavy rain, landslides, tropical cyclones, tsunamis, and wind.[76] While extremely useful where infrastructure enables it, the National Weather Service faces severe challenges with funding and capacity. Historically, funding flowing into the Ministry of Transport & Civil Aviation is allocated predominantly to the maritime sector and roads. Insufficient funding for the National Weather Service inhibits its ability to hire sufficient staff; only six people currently work for the service.[77] This resource deficit is particularly dangerous for the atolls, as they face some of the greatest climate-related risks and only receive disaster warnings through the National Weather Service.

The **Department of Mineral Policy & Geohazards Management** sits within the **Ministry of Mining** and is notable because it is responsible for geophysical hazards. Earthquakes and volcanoes are not considered climate-related hazards but natural disasters requiring a disaster management response. PNG currently only has one functional 'lookout' to monitor these hazards and is interested in increasing their prevalence.[78]

The **National Disaster Committee** now falls under the portfolio of the **Ministry of Defence** but includes ministers of Police, Finance, Works, Health, and Foreign Affairs as well.[79] [80] The committee was established by the Disaster Management Act (1984) as the entity set to supervise the national state of preparedness for emergencies and to report to the National Executive Council.[81] The committee is also positioned to assign various national departments responsibilities for disaster-related activities. In the event of a disaster, the committee coordinates relief efforts. The DoD can find a detailed explanation of PNG's Organizational Structure for Disaster Management in the CFE-DM's Disaster Management Reference Handbook for PNG.

The Importance of the Parliamentary System and Provincial Governments

CCDA coordination between national and provincial governments has seen notable growth in recent years. The CCDA worked with each province to establish a **Provincial Climate Change Committee** responsible for managing climate communication and action between the nation and the provinces, as well as aiding district-level engagement.[82] Access restraints make it exceedingly difficult for national authorities to visit provinces directly; thus, building provincial capacity is essential to ensuring the impact of national strategy and ensuring that national funds reach the broader population. The CCDA also manages all donor funds for climate-related development, but cannot adequately dispense these funds or develop projects without clear communication of provincial priorities. Infrastructure is a key priority across regions, but specific infrastructure gaps vary by province. Only after needs are assessed and prioritized can the CCDA allocate funds appropriately; thus, the bulk of responsibility rests on leaders via the Climate Change Committee mechanism to ensure funds are spent intentionally and efficiently.[83]

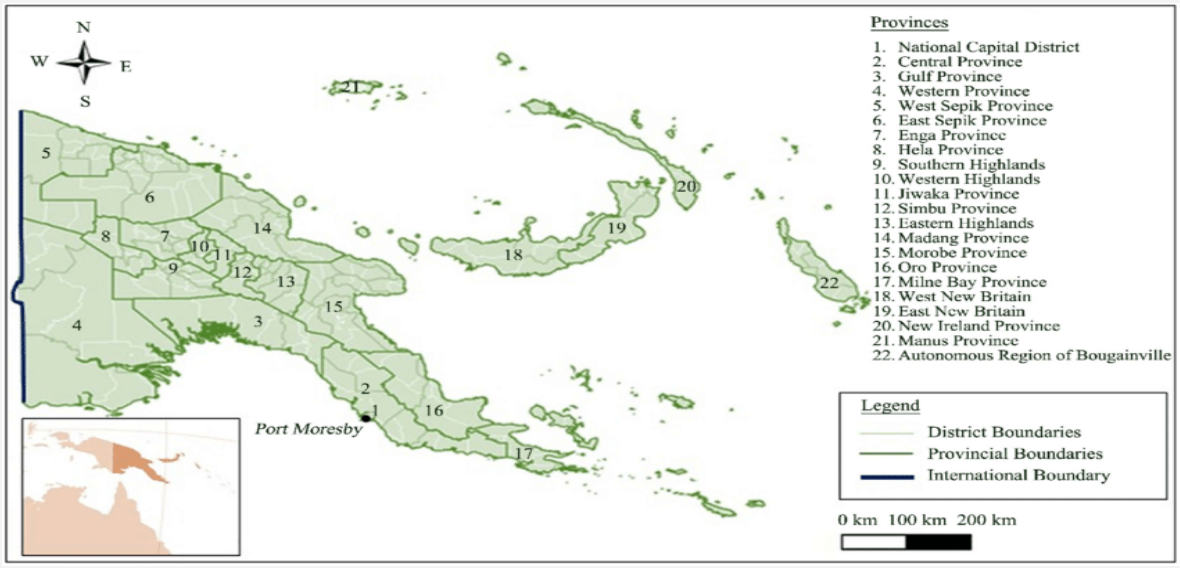


Figure 12: Map of PNG's 22 Provinces

Unfortunately, just and efficient financial management has long been a critique of PNG's provincial leadership. The national government includes a 111-member parliament, with 89 members elected from open electorates and the other 22 elected within each province.[84] [85] These 22 provincially elected Members of Parliament (MPs) also serve as provincial governors. These national legislators thereby hold significant power at the provincial level, ever increased by the large sums of money they are able to spend with limited oversight.[86] [87] These funds are generally spent in line with the priorities of those individuals and the communities who elected them. Any alignment between these priorities and those of the broader province is often coincidental.

CCDA funds allocated through the Provincial Climate Change Committees have some level of regulation as to how they can be spent. Still, the CCDA expands its power through MoUs.[88] These MoUs provide an avenue through which the CCDA can leverage its power as an authority to ensure that PMs align their provincial budgets with national climate priorities. The process requires provinces to provide a signed plan for funding allocations and their intended impacts, then report on progress regularly.

The National Disaster Committee also engages **Provincial Disaster Committees** to bridge the planning and implementation of disaster response across national, provincial, and district levels. These committees were created by the Disaster Management Act in 1984. Today, only some provinces have well-developed committees with established Provincial Disaster Centres, but most at least have a disaster coordinator.[89]

Provincial leadership is more essential to PNG than most other nations because of the marked diversity between provinces. Terrain, language, risks, and strengths vary widely across regions, and each necessitates tailored engagement. Structures are in place to meet this need but may lack the stability and capacity to fully address it. In either case, most funds contributing to local, tangible impact must flow through provincial leadership. Their role cannot be understated.

Key Informal Structures

The organization of PNG's government is comparable to the US, making international collaboration between corresponding structures a logical choice. However, despite their similarities, many structures in PNG lack the power and enforcement capacity they hold in the US. Instead, much of that power rests in the informal yet indispensable structures outside of the well-defined 'government.' These informal structures may not align with US understandings of governance but are nevertheless essential to the functioning of PNG and are not to be overlooked in bilateral engagement.

Central to the culture of many Papuans is the idea of Melanesian personhood - that people only exist in relation to other people.[90] The role of families, clans, language groups, and regional groups are therefore highly valued in PNG. Social networks predominantly exist in churches, and the trust, unity, and bond of these networks are far superior to anything that may exist in a political space. Politics are not governed by ideology but by personal connection; thus, understanding and engaging with social networks is essential to political progress. Further, the centrality of *local* connection renders community buy-in for national mechanisms decidedly low. Government-to-government engagement is unlikely to garner the support of many Papuans, but community-to-community engagement, which prioritizes connection over transaction, will prove fruitful in time.

Understanding and utilizing social networks is also essential for the delivery of services. Churches provide half the nation's healthcare services and are the first place community members will go in times of need or crisis.[91] Community-based organizations, providing a range of other benefits, are also tied to church communities. Given the patriarchal nature of formal structures, these social networks are often the only places the voices of women and children are heard and are central to ensure they receive aid and support.

Climate Theme Spotlight:

Ecosystems Services

Ecosystems services refers to the benefits that healthy ecosystems deliver to human societies usually free of charge. These benefits include provisioning, regulating, cultural, and support services, which are critical for managing climate-related impacts. (Dale, 2022, Endnote 160)

Example: Established regulation on the marine ecosystem allows for coastal cities to reduce damage from the mining and waste sectors, improving standards for health, food, and livelihoods.

Implications: Provisioning and regulating services are critical for managing climate related impacts. Papua New Guinea's agriculture and health sectors benefit from advanced ecosystem services to manage food insecurity, water sanitation, climate-adaptive crops, and warning systems.

Papua New Guinea Government National Climate Change Actions and Policies

Papua New Guinea signed the UNFCCC in 1992 and ratified the Paris Agreement in 2016. As the coordinating body for all climate-change related policies and actions, the CCDA builds a regulatory framework and climate strategy roadmap in alignment with the UNFCCC and the national long-term strategic plan. This extensive framework details the strategy and targets, emphasizing the funded and non-funded components for the nine priority areas described in the sections below.

The CCDA is set to be highly decentralized with a distribution of key stakeholders for development across the regional and local levels, including government, private sector, NGO, and regional development partners. A partnership model with lead organizations is utilized for adaptation and mitigation efforts across individual sectors such as energy and land use.

PNG National Adaptation Plan 2023

The National Adaptation Plan (NAP) 2023 functions as the strategic high-level action plan for adaptation produced to build upon existing policy addressing climate adaptation, resiliency, and mitigation.[92] The NAP was formally launched on April 5, 2023, making it the first National Climate Change Adaptation Plan for PNG and placing PNG among one of the few countries in the region to formally introduce the NAP framework. The plan includes an open, inclusive, gender-responsive, and transparent process for

addressing priority areas, identifying adaptation gaps, determining climate financing, and establishing methods for monitoring and impact-outcome effectiveness.

The PNG NAP serves as the primary framework of the CCDA Climate Response. This framework underscores priority areas to be addressed in partnership with agencies from all sectors, academic institutions, and development partners through a five-year strategic plan.[93] It operates alongside the Nationally Determined Contributions 2020 for cohesion in long-term adaptation strategy. **It is the essential strategic plan for collaborative engagement with the CCDA on climate action in PNG.** The four sectors and nine climate-related priorities are outlined in the section below.

PNG Enhanced Nationally Determined Contribution 2020

The Enhanced Nationally Determined Contributions (NDC) 2020 aligns with the national strategies of PNG for sectoral policies, plans, and stakeholder engagement areas to build climate action programs.[94] This framework aligns with the PNG NAP 2023, outlining key pathways towards sustainable economic development through climate-resilience and mitigation.

The NDC takes into account important international commitments to address the impacts of climate change. These commitments include outlining long-term national strategies, including the NAP 2023 and SDG 13 Climate Action Roadmap, and taking gender-responsive and human rights-based approaches in all planning, programming, and implementation.[95]

Adaptation - Papua New Guinea NDC Nine Priority Areas

PNG has highlighted nine priority areas linked to national government policies. These priority areas are included across PNG governing frameworks, including the National Determined Contribution, the Climate Change Management Act of 2015, the National Communications, the Green Climate Fund (GCF) Readiness Support for NAP Project for PNG, the CCDA Climate Change Corporate Plan, and the GCF PNG Country Programme. All areas drive adaptation actions and provide key opportunities for engagement.

The CCDA identifies these nine priority areas in Papua New Guinea to address the country's most urgent climate change impacts. The charts below describe current adaptation actions. All information comes from the National Determined Contribution 2020[96] and the National Adaptation Plan 2023,[97] where funding and the extent of program advancement in each priority area vary. The Adaptation Gaps represent areas of need and opportunity that will influence the success of adaptation projects in PNG. Capacity building, infrastructure advancement, and resource mobilization to scale-up current and new initiatives are highlighted themes for future actions in the PNG government and within DoD support.

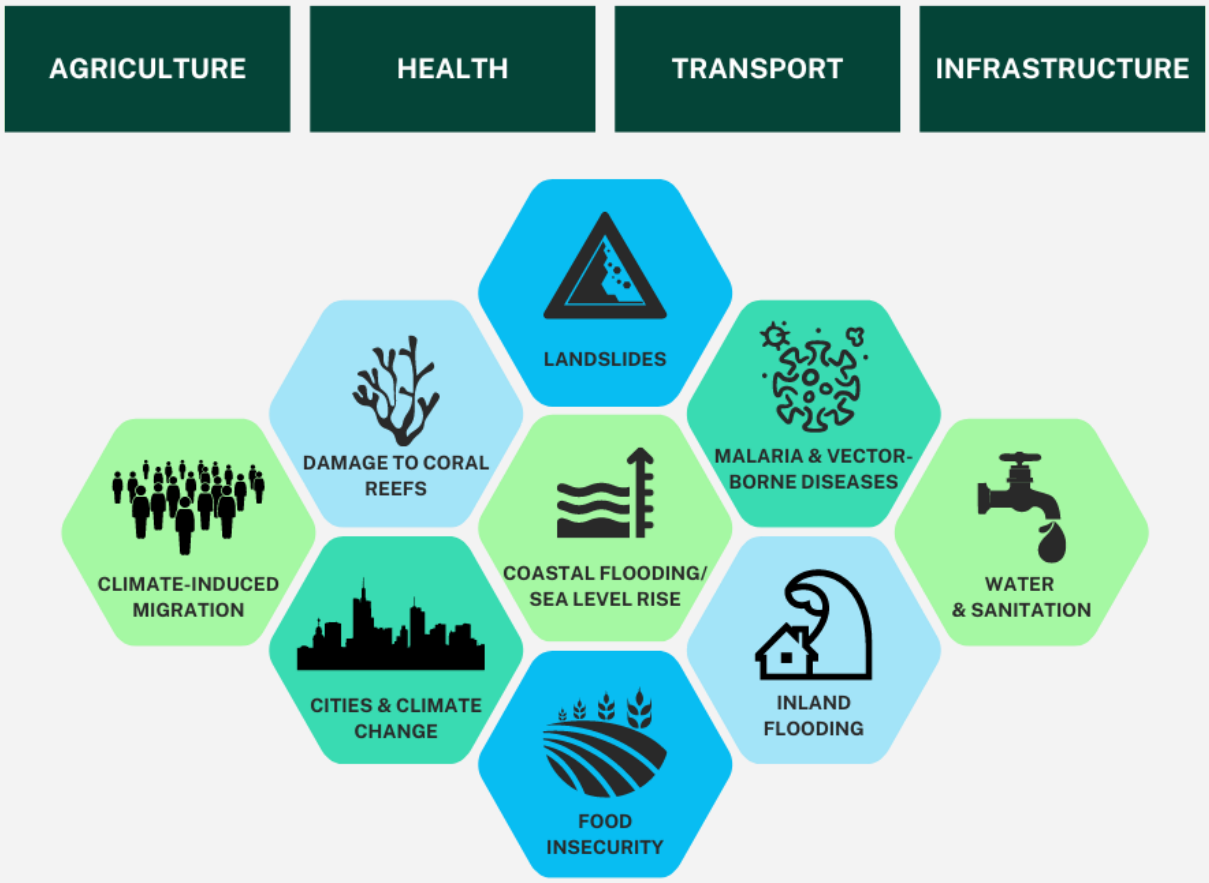


Figure 13: PNG National Action Priority Areas

1. Coastal Flooding and Sea-level Rise	***Rationale:*** The risk of flooding in coastal regions is the greatest climate risk in PNG. This risk is expected to increase, particularly in the country's northern regions, impacting lowland areas, mangroves, estuaries, coral reefs, and agricultural production. This priority area is linked to nearly all sectors of government. ***Adaptation Actions:*** - *Supported:* Mangrove planting, coastal defense structures, rehabilitation and relocation, climate risk and vulnerability assessments across five provinces (New Ireland, Oro, Madang, East Sepik, and Morobe) - *Unsupported:* Scaling-up and replication of successful measures across coastlines, climate-resilient physical planning standards and codes, climate-resilient infrastructure

	Adaptation Gaps: While climate monitoring has been added from the Comprehensive Hazards and Risk Management (CHARM) Framework, minimal tide gauges exist in maritime provinces, and there is inconsistent scale-up of soft and hard defense structures to reduce coastal floating.
2. Inland Flooding	***Rationale:*** Heavy, irregular rainfalls affect valleys and wetlands across PNG which experience flooding during the monsoon season. The agriculture sector is highly affected, with over 18% of PNG landmass experiencing seasonal flooding. Steep geographical inclines and deforestation have compounded the effects of flooding. ***Adaptation Actions:*** - *Supported:* Climate risk, hazard, and vulnerability assessments, community-based flood simulation exercises, and early warning system integration - *Unsupported:* Scaling-up and replication, hazard mapping, soil stabilization, climate-resilient standards, infrastructure, and asset management plans ***Adaptation Gaps:*** Current infrastructure and financing limit access to monitoring tools, mapping technology, and mitigation planning.
3. Food Insecurity	***Rationale:*** The agriculture sector is highly linked to the livelihood of Papua New Guineans. Climate conditions impact agricultural yields and the need for the farming community to find alternatives to meet community and work needs. ***Adaptation Actions:*** - *Supported:* Socially inclusive climate-smart agriculture policy, food security policy - *Unsupported:* Scaling-up and replication of technology, training, and information management to enhance safety, security, and nutrition for vulnerable farmers, access to grant funding for farmers ***Adaptation Gaps:*** Early warning, risk management data, and forecasting for agricultural sectors is limited. Advanced research into climate-adaptive crops and further warning systems to mitigate loss or risk from climate is also needed.
4. Cities and Climate Change	***Rationale:*** The impacts of flooding and other disasters on agriculture are driving major climate-induced rural-to-urban migration. Climate change exacerbates the existing development challenges in PNG, including poor health, inadequate housing, and lack of infrastructure and financial safety nets for the community. Major cities along the coastlines have higher vulnerabilities with the combined impacts of coastal flooding. ***Adaptation Actions:*** - *Supported:* National Energy Policy, advancement of climate-resilient transport sector - *Unsupported:* Action on low-emission transport options, the connection of farmers to markets with infrastructure, infrastructure for coastal defenses, green urban development plans, stormwater, and waste management systems

	Adaptation Gaps: City profiling and policy application is limited to three cities (2020); capacity building on climate change impacts/planning and improved water and waste management infrastructure is needed.
5. Climate Induced Migration	***Rationale:*** Urbanization is increasing due to climate change where communities rely heavily on natural resources. Internal migration rates are increasing as people seek access to employment, education, health services, clean water, and sanitation. Migration to urban communities challenges resources, sustainability, and appropriate services and infrastructure availability. ***Adaptation Actions:*** - *Supported:* Indirect support from IOM study on the evidence base for action - *Unsupported:* Relocation and resettlement assessments, strategies, and activities for relocation with local-level government planning and infrastructure ***Adaptation Gaps:*** Planning, infrastructure, and evaluation is required to reduce the drivers of climate migration, but there is an overall lack of data to inform strategy-building in these areas.
6. Damage to Coral Reefs	***Rationale:*** Increased ocean acidification will continue to impact the marine ecosystems of PNG. Fifteen coastal provinces rely on coral reefs and coastal ecosystems for food, shelter, and livelihood security. ***Adaptation Actions:*** - *Supported:* Mangrove planting, coral rehabilitation, marine protected areas, marine awareness programs - *Unsupported:* Establishment of marine protected areas, planting of seagrass, replanting of coral coordination, response measures, ecosystem-based adaptation approaches ***Adaptation Gaps:*** Scaling of programs, resources, and adaptation approaches across coastal cities is currently lacking, as are regulation and community engagement on mining and waste sector policy to reduce damage from these sectors.
7. Malaria and Vector- Borne Diseases	***Rationale:*** Malaria is a top five health priority in PNG, with 60% of the population living in high-risk malaria regions. Rising temperatures from climate change paired with poor waste, water, and sanitation management have increased the risk of malaria parasites. ***Adaptation Actions:*** - *Supported:* Destruction and reduction of malaria-vector breeding, environmental health management under consideration, Climate Change Health Impact Policy in draft - *Unsupported:* Improvement of environmental health services, improved technology, research on impacts and responses, access to safe drinking water and

	basic sanitation, WASH policy with 30 facilities across PNG, WASH Program Management Unit ***Adaptation Gaps:*** Monitoring and resource mobilization for incidences of malaria and vector-borne diseases is limited, presenting an opportunity to collaborate on facilities and program management implementation.
8. Water and Sanitation	***Rationale:*** Access to safe water supply in PNG is among the worst in the world. Climate change decreases levels of uncontaminated drinking water, with significant impacts on health. ***Adaptation Actions:*** - *Supported:* Establishment of WASH policy, planning with development partners for the implementation of policies - *Unsupported:* Increased access to safe drinking water and basic sanitation, technology improvements, desalination processes, development of renewable energy initiatives, and activities under WASH program to be replicated and expanded ***Adaptation Gaps:*** Programs supporting technology, infrastructure for large water reservoirs, and supply for country-wide treatment are not comprehensive enough.
9. Landslides	***Rationale:*** According to the World Bank, PNG ranks first in the world for its global landslide hazard. Increased rainfall and land use in mountainous rural areas impact infrastructure, homes, and agriculture in these regions. Due to limited infrastructure and pathways to rural communities, landslides present a high risk of blocking access to communities for business, health, and water sanitation. ***Adaptation Actions:*** - *Supported:* Identified landslide risks using technology, advisory support to engineer-design and infrastructure projects with development partners - *Unsupported:* Improvements to engineer designs, geo-hazard assessments, stormwater drainage improvements, reforestation, and soil stabilization ***Adaptation Gaps:*** Seismographs located around the country continuously measure seismic activity, but there are still significant gaps in data and strategies for managing landslides and support systems for at-risk areas.

National Action Plan Priority Areas - Implications

The priority areas of the National Action Plan 2023 center around the four development sectors expected to bear the highest impact: agriculture, health, transport, and infrastructure. Climate change will exacerbate existing risk conditions such that high levels of vulnerability will continue to increase. These nine climate priority areas illustrate the projected impacts of climate change as well as opportunities to improve conditions for the community. While the 2023 NAP and 2020 NDC provide a

framework for these efforts, it is the partnership investments that will lead to progress in addressing climate change risks.

The CCDA prioritizes these nine areas while also understanding there are different needs, implications, and challenges across each of the 22 provinces of PNG. A lack of infrastructure to advance and scale all areas of climate adaptation presents the most significant gap in PNG's climate resilience planning.[98] The 2023 National Adaptation Plan targets the creation of infrastructure necessary to build resilience, such as roads to reach provincial communities during emergencies, expanded communication and warning systems, and seawalls in the coastal communities. While support for capacity building exists through current partnerships, there remains a significant need for long-term capacity building paired with technical support and capital infrastructure to effectively protect communities.[99]

Recommendations for the DoD: The Government

1. **Partner with Papua New Guinea CCDA**

2. **Support infrastructure and logistics**

3. **Support risks assessments & monitoring**

4. **Support expansion of an early warning system and emergency operations center**

See recommendations section for more details

2.4 The Stakeholders

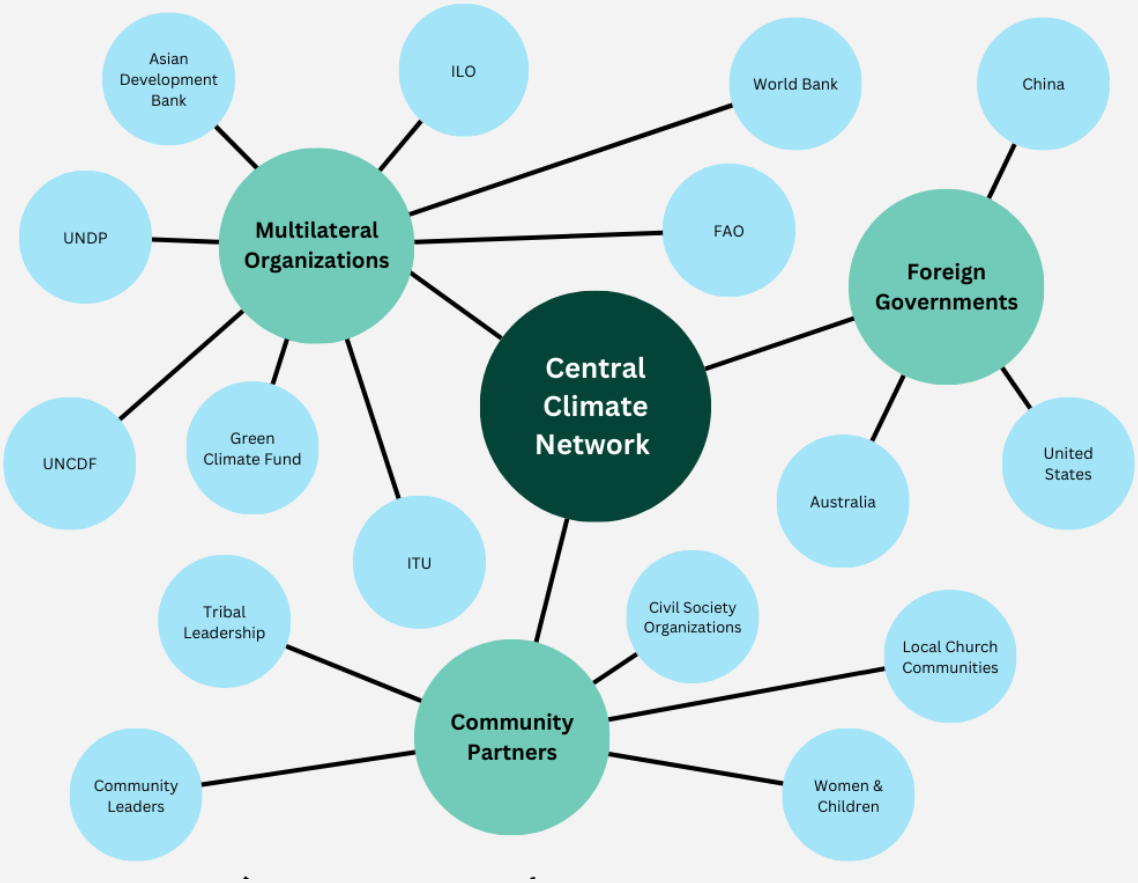


Figure 14: Map of CCDA Coordination Stakeholders

Multilateral Engagement

The CCDA is the designated National Authority of the UNFCCC. They coordinate all climate-related engagement to ensure these partnerships serve the broader national strategy within the four development sectors (agriculture, health, transport, and infrastructure). The United Nations Development Programme (UNDP) has been a prominent implementation partner in climate-related adaptation. The UNDP Papua New Guinea Climate Action portfolio is comprised of four primary projects which address resilience, adaptation, energy, and economic development.[100] Funding and implementation support for this portfolio are provided by international organizations such as the Food and Agriculture Organization (FAO), the International Labour Organization (ILO), the International Telecommunication Union (ITU), the United Nations Capital Development Fund (UNCDF), the World Bank, the Asian Development Bank (ADB), and the Green Climate Fund, among others. The United Nations Environmental Program (UNEP) is also a relevant multilateral stakeholder, but works more directly with the CEPA.[101] The Global Environment Facility (GEF) is a lead funding partner for UNEP as it is a financial mechanism for the UNFCCC, as well as four other international environmental conventions.[102]

Papua New Guinea was selected as one of the countries to participate in the Pilot Program for Climate Resilience (PPCR) in 2012.[103] The PPCR is part of the Strategic Climate Fund (SCF), a multi-donor trust fund within the Climate Investment Funds (CIF). Its goal is to help countries conform to a climate-resilient development path consistent with national poverty reduction and sustainable development goals.[104] The government of PNG obtained a SCF-PPCR grant from the ADB to implement one of the four projects of UNDP PNG Climate Action portfolio: Building Resilience to Climate Change.[105] The project sought to mainstream climate change in development through capacity building in islands/atoll communities, government agencies, and Civil Society Organizations (CSOs).

The Humanitarian Advisory Team Project, implemented by UNDP, is a critical development as well. The project brings together humanitarian agencies to ensure a coordinated response to emergencies.[106] It aims to strengthen national and international humanitarian coordination and provide direct support to the government, United Nations agencies, the Resident Coordinator in their Humanitarian Coordinator function, the Disaster Management Team, non-governmental organizations, faith-based organizations, and other partners in Papua New Guinea. Final result documentation is not yet available, but the project hopes to achieve enhanced readiness of the Disaster Management Team and the National Disaster Centre as well as a potential update of the National Disaster Management Act.[107]

Multilateral support for PNG is substantial and consistent, but not without complexity. Three general areas present the opportunity for improvement: local inclusion in planning, local recognition, and sustained engagement. Local inclusion is requisite for most involved partners, but varied definitions and understandings of 'local' can result in the exclusion of large sections of the population. UNDP is committed to collaborating with governments and implementing climate action in partnership with them. Their collaboration with the CCDA, provincial leadership, and others should be replicated, but further inquiry into the groups and communities in PNG that these entities represent is also essential.[3] As aforementioned, informal structures of power may more authentically represent local voices; their inclusion from the onset must be prioritized. Despite the consultative and collaborative nature of the NAP, there remains concern that PNG's national climate strategy is intended to acquire and direct external investment more than it is intended to meet locally determined needs.

Local recognition and sustained engagement are intertwined. The involvement of multilateral actors is invaluable in acquiring funds. Each agency has access to various funding streams as well as to an international reputation which elevates the profile of the projects in which they are involved. The benefits are significant, but there are also some real consequences. Community leaders are active across PNG, providing resources and services, and developing community responses to the challenges they experience.[108] When such leaders are identified and organizations collaborate with them—usually providing funds and the capacity for scaling up—these entrepreneurial minds can be subsumed by the organizations supporting them.[109] A project is no longer considered a local leader's community initiative, but a multilateral organization's local partnership project. Leaders themselves are unlikely to critique this reframe, as the needs which prompted their leadership are now being met tenfold, but sustainability of the initiative is hampered. The project is now one of UNDP or World Vision, tangential to local structures and requiring transitional processes if the program is to be maintained. Financial support will likely leave with the multilateral organization and, without significant planning, a resource or service gap will return.

[3] UNDP is implementing in the highlands, even when the government is not - Michael Main and John Cox, 2023, April 17th

Bilateral Engagement

The Climate Change and Development Authority (CCDA) is the focal point for Papua New Guinea's climate-related bilateral coordination, including development support. However, the Ministry of Foreign Affairs manages general bilateral engagements and international trade. High-level bilateral engagements are conducted through the National Executive Council, with the Prime Minister serving as chairman.

For geographic and historical reasons, Australia represents Papua New Guinea's most significant bilateral relationship regarding development, trade, and security. The Papua New Guinea–Australia Defence Cooperation Program represents the largest defense cooperation program in both countries.[110] Recent security initiatives signed include cooperation in cybersecurity,[111] policing,[112] aviation,[113] and maritime security. The Australian Defense Force has also conducted several operations to support Papua New Guinea in recent years, including Operation PNG Assist 21-1 and Operation KIMBA. These missions involved providing a range of support to Papua New Guinea, including airlifting medical personnel during the COVID-19 pandemic and providing transportation and logistics support for Papua New Guinea's national elections.[114] At the time of writing, mainstream reports suggest that Australia and Papua New Guinea are additionally set to agree on a comprehensive Bilateral Security Treaty in the coming months involving climate change, cybersecurity, troop training, and joint operations.[115]

In 2018, the governments of Australia and Papua New Guinea signed the Papua New Guinea–Australia Climate Change Action Plan, a cooperative initiative focused on addressing climate change. The action plan includes an annual bilateral climate change dialogue between relevant departments in each country, enhancing access to climate finance opportunities, cooperation on climate change action programs, developing clean energy markets, and climate-smart infrastructure. In addition, the agreement includes plans to develop the capacity of national, provincial, and local governments to address the impacts of climate change through a partnership between Papua New Guinea's Climate Change and Development Authority (CCDA) and Australia's Foreign Affairs and Environment and Energy departments.[116]

In addition, Australia is Papua New Guinea's largest economic partner, with bilateral trade totaling over $6 billion in 2020 and Australian investment in the country totaling around $24.8 billion in 2021.[117] Climate-specific development support from Australia includes the Papua New Guinea–Australia Transport Sector Support Program and potential cooperation between the Australian Bureau of Meteorology and the PNG National Weather Service.[118] Australia also supports climate-resilient infrastructure development in the country through the Australian Infrastructure Financing Facility for the Pacific (AIFFP) program. AIFFP investments in Papua New Guinea include electricity access, sustainable maritime infrastructure, roads, and solar power.[119]

China represents another significant bilateral relationship for the country. China and Papua New Guinea have maintained diplomatic relations since 1976 when PNG gained independence from Australia. In recent years, China has sought to increase its economic and diplomatic engagement with PNG, particularly in the context of its strategic interests in the Pacific. China is a significant source of trade, infrastructure, and aid for PNG. However, bilateral relations have, at times, generated controversy. In August 2019, Papua New Guinea ordered a Chinese-owned nickel processing facility to close after a nickel spill contaminated Basamuk Bay.[120] In addition, the 23-story Noble Center, built by a Chinese state-owned company to be the tallest building in the country, remains empty after over 70 threats and safety defects were identified.[121] Furthermore, despite plans announced in 2017 for the state-owned

China Railway Group to fund upgrades to PNG's road and highway network, progress remains negligible.[122] Nonetheless, the PNG government will likely prioritize the maintenance of a strategic and productive relationship with China.

China is also seeking to enhance its military cooperation with PNG. Chinese security engagements in PNG include police training and cooperation as well as constructing a new military hospital at police barracks in Port Moresby.[123] Reports have also been circulated suggesting that China is concerned about potential security pacts between PNG and Australia, and PNG and the US.[124]

Recommendations for the DoD: The Stakeholders

1 **Support community leaders**

2 **Prioritize long-term efforts**

See recommendations section for more details

3.0 Recommendations for Further US Security Cooperation to Support CCA

To engage locally with Papua New Guinea and fill the gaps to achieve climate safety, we recommend that the DoD follow a three-pillared strategy: **Connect, Collaborate and Coordinate.**[4]

Figure 15: Expanding on the *Connect, Collaborate, Coordinate* Strategy

3.1 Recommendations for DoD Initiatives

We have proposed eight specific initiatives inside these pillars. In following them, the DoD should be able to effectively help Papua New Guinea promote long-term climate safety, achieve their NDCs, and execute their National Plans for mitigation and adaptation from the CCDA.

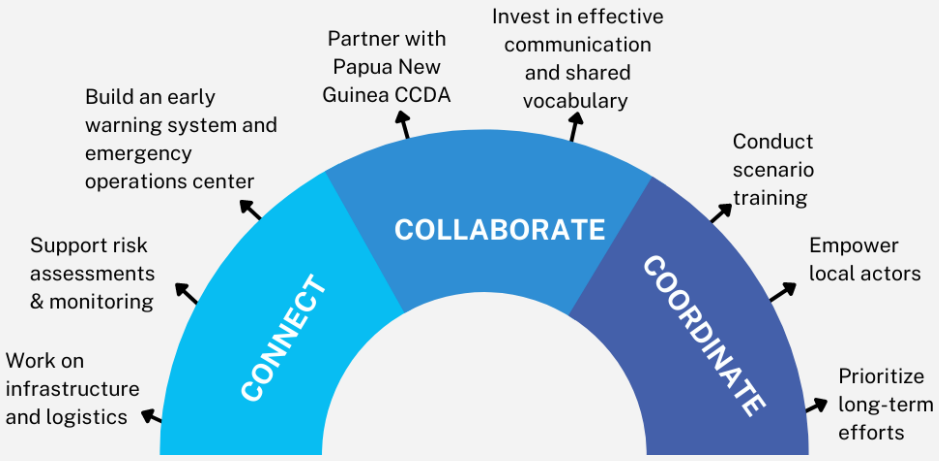


Figure 16: Recommendations for the DoD based on the *Connect, Collaborate, Coordinate* Framework

[4] We would like to credit our project advisor, Adjunct Associate Professor Joseph Pfeifer, for providing this framework.

CONNECT

1. Augment infrastructure and logistics

The DoD can aid in analyzing **plans to respond to climate-related disasters**. This involves creating, enhancing, and expanding response plans and investing in locally determined and directed infrastructure developments. Provincial and regional leaders should be at the forefront of systems development to properly address a wide range of regionally specific climate-security risks in an extremely culturally and geographically diverse country.

The first gap to be addressed is **infrastructure and cohesion**. Papua New Guinea suffers from an extreme lack of connectivity within the country, making it difficult to provide support, aid, and resources when climate-related disasters occur. The DoD can help to develop infrastructure in the country by connecting regions to resource centers and providing a network for emergency response. Moreover, with the DoD's assistance, PNG can work to create cohesion across all sectors and aid organizations to ensure proper coverage—with limited overlap—for climate security needs.

The DoD can also support efforts to **build adaptive capacity in vulnerable communities** in PNG. This could involve providing resource support for disaster preparedness and response efforts as well as collaboration with local governments and organizations to identify and address gaps in infrastructure and resources. Engaging with the relevant Provincial Disaster Committees and MPs will be critical.

The DoD can **invest in mitigation efforts** to reduce the impact of natural disasters on communities in PNG. This could involve developing strategies to protect critical infrastructure, such as military bases and installations, and supporting local communities to develop early warning systems and emergency response plans (to be discussed further below).

The DoD can also **collaborate with PNG forces on hardware and design**, especially concerning naval and air operations. The DoD can provide logistical support and equipment to the Papua New Guinea military and state police. This equipment, listed in detail in Appendix C, is intended to be strategically deployed within PNG during various disasters to help support rescue, recovery, and resettlement efforts. There is currently a major lack of state-owned disaster response infrastructure and materials. PNG has limited capital infrastructure and resource mobilization necessary for the expansion of climate adaptation programs including advancing telecommunications, roads and access points to communities, expansion of PNG's early warning system, and higher expense infrastructure to pair with their capacity building efforts.[125] A detailed aid package from the Department of Defense would help provide necessary material, including tentage, utilities, heavy equipment, food, and clean water. Such a package could be offered in tandem with military training to increase the efficiency of PNG forces.

Additionally, in a natural disaster, the DoD can **provide PNG with immediate disaster response and relief support**. This includes deploying personnel, supplies, and equipment to affected areas. Other forms of aid relief could include medical assistance and search and rescue operations.

Task Force Engineers is a Marine and Navy deployment of logisticians and engineers.[126] This team of US military specialists deploys to regions with a general mission of planning and building necessary

infrastructure. This unit can be dispatched to Papua New Guinea to help design and construct structures to prevent further degradation due to rising sea levels. This includes structures that can assist in evacuation efforts and command sites for support.

Part of the logistical support can be delivered as **Aid from the Sea.** The US military branches most likely to deploy and provide immediate support to Papua New Guinea during a natural disaster would be the Navy and Marine Corps teams.

The Navy's ability to operate continuously around the globe is made possible through the geographic combatant commanders USINDOPACOM's employment of numbered fleets (3rd & 7th) through their respective component commanders within Command Pacific Fleet. These numbered fleets direct operations, including Strike Group movements, deployments of Marines, search and rescue, humanitarian aid efforts, and a slew of additional complex mission sets. The primary employment elements at the tactical level are the Carrier Strike Group and Expeditionary Strike Group. These units are each composed of separate sets of various naval vessels. A Strike Group carries roughly 8,000 active military personnel and an air wing of up to 70 aircraft, including helicopters, to be used in transporting troops, equipment, aid, and potential modes of evacuating civilians.

During significant disasters, the United States and other allies of Papua New Guinea can quickly provide seaborne support by positioning forward-deployed Naval fleets to PNG's territorial waters. Strategic collaboration and communication with PNG's Emergency Operations Center would allow the DoD to rapidly deploy security forces, personnel, medical supplies, heavy equipment, food, water, fuel, and various support teams to aid PNG in disaster relief efforts.[127]

The **strategic deployment of military personnel** can support PNG forces in creating command and control centers, satellite and communication sites, temporary housing, temporary hospitals, aid stations, helicopter landing sites, and fuel depots. The DoD can simultaneously provide power generation, non-combative drone technology for reconnaissance in search and rescue operations, and a slew of technological platforms that can assist in rescue efforts.

In addition to the current capabilities of baseline forward deployed assets within the Seventh Fleet, the US Navy also has two massive hospital ships: the USNS Mercy (T-AH-19) and the USNS Comfort (T-AH-20). Both ships have a capacity of 1,000 beds and carry state-of-the-art medical facilities. USNS Mercy is stationed in the Pacific and docked at Naval Base San Diego. If PNG experiences a disaster, USNS Mercy can be activated and deployed to PNG waters in varying time frames depending on the mission and operational cycle. Upon request by the PNG government and after approval by USINDOPACOM, the US Navy's Seventh Fleet can also provide support to PNG to assist in disaster relief efforts.

2. Support Risk Assessment and Monitoring

The National Weather Service and the Department of Mineral Policy & Geohazards Management provide PNG with consistent monitoring of meteorological hazards, earthquakes, and volcanoes. However, a lack of infrastructure prevents monitoring systems from covering all 22 provinces. As mentioned in the previous recommendation, physical infrastructure support is necessary in 14 provinces to ensure that meteorological updates are eventually accessible to the entire population. Investment is particularly important for PNG's islands and atolls, which face the greatest threats, yet remain under-informed.

Infrastructure in the form of lookouts would benefit geohazard monitoring as well. Earthquakes and volcanoes are currently monitored with a single lookout; the government needs more.

Of additional concern is the National Weather Service's human capacity, which sits at just six staff members. **Sustained funding support** is necessary to increase and maintain capacity of this institution. Provision of salaries may be appropriate for a predetermined period of time. DoD can then support in developing internal funding structures that allow for financial stability and full PNG ownership.

Additionally, there is shared government interest in **expanding risk monitoring** to include king tides and sea level rise within the National Weather Service. Building out this capacity would likely require the development and/or adaptation of new technologies and prolonged support while new models are being integrated into existing systems. The DoD's technical capacities position them to lead in this expansion, creating a lasting impact in line with nationally determined needs.

3. Build an Emergency Operations Center and Support Expansion of the Early Warning System

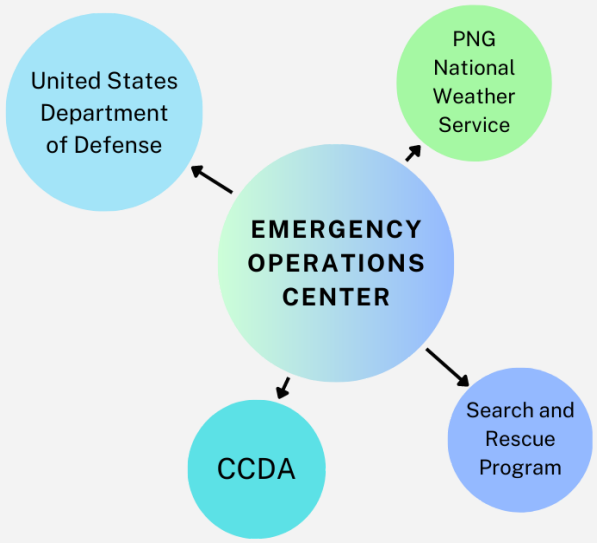


Figure 17: Branches of Communication in the Emergency Operations Center

There is a **growing need for an EWS** in several vulnerable regions within PNG. Expanding on the current crisis communications systems in PNG would help warn populations of incoming disasters and allow them greater evacuation and preparation time. The warning system should be able to send messages before, during, and after the crisis. It should provide situational awareness or a two-way communication system until connectivity is lost during a disaster.[128] The focus will be on transmitting information and the ability to gather information back.

The **EWS should expand the national weather service's current warning system** in Port Moresby to include more provinces and disasters. This operation will require an overarching emergency operations center (EOC) for management. Please see Figure 17 for more details regarding the communication channels that would flow through the EOC.[129] The EOC should also be located in Port Moresby, close to the National Weather Service. The main focus should be gathering and pushing information out to the public.[130] To survey the land, the EOC should have access to the PNG government's drones.

In addition to drones, the **DoD can supply cell sites or first responder network towers** that can be airlifted and dropped in safe zones to provide the public with ongoing information during emergencies. The DoD could also include small portable generators in case of power loss. This program should be brought to PNG initially by the DoD but should eventually be led by the PNG government.

COLLABORATE

4. Partner with CCDA

The CCDA is the nucleus of PNG's climate governance structure and an essential partner in US DoD-PNG engagement. First and foremost, **initial and consistent contact with the CCDA** ensures that any actions by the DoD fit within the broader national strategy and align to locally determined priorities. As the CCDA is the national coordinating agency for climate-related partners and implementing actors, partnering with the CCDA places the DoD in a position to collaborate with all actors seeking to invest in similar projects. Depending on the situation and entities' competitive advantages, it might be appropriate for DoD to **partner with international donors, UN organizations, or other multilateral entities**. The primary goal, however, should be to leverage CCDA contacts to increase connections with local partners.

Climate related MoUs, for instance, provide an excellent opportunity for collaboration with MPs/Provincial Governors to support hazard mitigating measures mandated by the CCDA. The DoD can **supplement provincial budgets** to achieve greater impact and allow investments for sustained future climate-committed allocations of provincial budgets. The DoD can then build from MP relationships to engage tribal leaders who often work with provincial MPs. **Developing connections with tribal leadership** will communicate respect for social networks and may be key to establishing trust in the region. Eventually, establishing direct relationships with local churches should be central to long-term investment. Churches and linked organizations are presumed to be best suited for just resource allocation in times of crisis. They are also natural meeting points for local populations and should thus be included in crisis management strategies.

The US DoD can fill in a **coordination gap within CCA action**. PNG is a decentralized nation, so the DoD has an opportunity to help coordinate local, regional, and national governmental climate security measures. The DoD can also help improve transportation. Overcoming barriers to transportation and road efficacy presents an important point of collaboration with the PNG government. The DoD can facilitate and foster partnerships between community leaders, NGOs, and the government itself.

5. Invest in effective communication and shared vocabulary

The DoD should apply more vocabulary words in the Climate Disaster Management Field. A unified terminology around crisis management is crucial for many reasons, including effective communication, coordination, clarity, and education.

Improving communication effectiveness lowers the potential for confusion. Coordinating across various organizations and sectors is simpler when everyone in disaster management speaks the same language. This is crucial in large-scale disasters since many agencies and groups may contribute to the response. Ensuring that key terms and concepts are consistently used and clearly defined helps avoid confusion or misunderstandings and ensures that everyone involved in disaster management understands key concepts and strategies. Supporting education and training efforts to use a common language around disaster management keeps materials consistent and accessible to everyone, regardless of their background or experience.

The DoD can utilize their current research projects to share new and useful information regarding climate security. This information would be communicated to local authorities to create a network for climate-related research and disaster development. Continued knowledge sharing and learning in scenario training exercises would enhance PNG forces' capacity to work under disaster conditions. These exercises could vary from military operations to disaster management to humanitarian operations.

This information sharing should also be leveraged to increase international cooperation among all parties interested in addressing climate-security risks in Papua New Guinea.

COORDINATE

6. Conduct scenario training

Scenario training is one of the most critical recommendations for the DoD to aid in PNG's climate-security efforts. Joint training operations would allow the US to engage the PNG military and regional actors in military and aid exercises. Through top-down training emphasizing non-combative disaster operations, the US DoD can design new trainings within the scope of intense disaster conditions. This report recommends that these trainings be done in collaboration with the PNG military and state police forces. The design of training exercises for common and extreme disaster scenarios should improve actions taken under real conditions. These trainings should have both academic components for leadership and practical application scenarios for ground deployment aspects.

Well-designed scenario training will have conditions, parameters, capabilities, limitations, and more. Such training should also include an evaluation and grading system to assess unit readiness. Scenario training would also contain an incident management process.

There is potential for the DoD to **push for creating new industries and jobs within PNG related to the development of scenario training programs**. This new sector could provide employment opportunities for both trainers and trainees and would help the DoD and PNG officers execute proper disaster management training.[131]

Scenario training also presents an opportunity for **positive and apolitical collaboration with China**, specifically in regional disaster management efforts. Climate-related disasters are not discriminatory and should be viewed by all regional and global powers as a threat requiring collaborative solutions.

7. Empower local leaders

One important aspect of promoting Papua New Guinea's autonomy and internal capacity to deal with climate disasters is **recognizing and supporting the authority of local leaders.** Local leadership in the emergency process ensures the long-term permanence of actions, provides a sense of responsibility and ownership to local leaders and organizations, and achieves higher legitimacy since the communities tend to have higher trust in known local organizations. The DoD can perform three actions to support this empowerment of locals:

1) **Train the experts:** During its training programs on disaster management and climate crises, the DoD should have modules and guidelines for participants to train others on disaster management. This can create a local network of people prepared to respond to a crisis and ready to help in case of a climate or disaster event (read recommendations by crisis section below). Search and rescue training is of high value, and DoD programs on search and rescue operations would help locals develop knowledge of appropriate emergency reactions, procedures, leadership, and tools. The training programs could start with local officials such as firefighters, police officers, and community leaders, who could replicate the training for a larger number of participants throughout the country and develop the capacity to scale up the program.

2) **Award best practices:** DoD should recognize best practices and partners in the country to encourage people to engage in climate disasters and be proactive on solutions for crisis management. The DoD can partner and publish research with locals, providing them credit and recognition, and also select those who perform well in training, conducting research, or other programs to participate in the other CCI and CFE training programs.

3) **Invite local leaders to trainings:** The DoD should ensure that trainings include representation from different communities. When building local capacity and emergency preparedness, it is critical to engage people from rural areas and communities. The goal is to have everyone ready to provide emergency help in their areas and bring their communities' perspectives and specific needs.

Furthermore, the DoD can use these recommendations to **collaborate with PNG on efforts to improve gender equality and youth inclusion**. Papua New Guinea scored second lowest globally in women's political empowerment because there are no women in parliament and ministerial positions.[132] The DoD can encourage the inclusion of women at all levels of CCA implementation and promote women's voices at the decision-making table. Since women are particularly vulnerable to climate-related security risks, encouraging women's participation in CCA will increase the sustainability and efficacy of all climate-security solutions. Encouraging youth participation in CCA measures will ensure that the policies developed will last for several generations and that the solutions created apply to all citizens affected by climate-related disasters.

8. Prioritize long-term efforts

Climate safety is a long-term goal; it involves lives and land. Developing countries and conflict areas such as Papua New Guinea have issues with pilot programs that are often discontinued, have short-term views, and are built from external sources that do not consider the local government's goals and necessities. For the DoD to truly support PNG, the focus should be on **acting in tandem with PNG leadership to establish long-term cooperation and planning, working with locals in all programs and trainings, and developing internal capacity within Papua New Guinea to maintain and operate efforts**.

Supporting nations sometimes fear **prolonged investment** based on concerns about creating structures of dependency. This does not mean that the DoD should be cautious with investments, because dependence is created by repeated short-term investments. Substantial, intentional, and sustained investment, which prioritizes the transfer of skills as well as funds, should be the goal.

From day one, engagement with CCDA should focus on multi-year planning that begins with substantial, consistent support toward building climate response capacity and establishing relevant systems and procedures. Long-term investment also means taking the time to bring all relevant stakeholders to the table, maximize buy-in, and divide roles and responsibilities between the DoD, the government, and all other stakeholders involved.

3.2 High Priority Choices

As mentioned above, to achieve a comprehensive approach to the CCDA and build long-term results in promoting climate safety, this report recommends taking the detailed approach above. However, if the DoD needs to prioritize its focus and select crucial initiatives, three priority recommendations are listed below from each pillar.

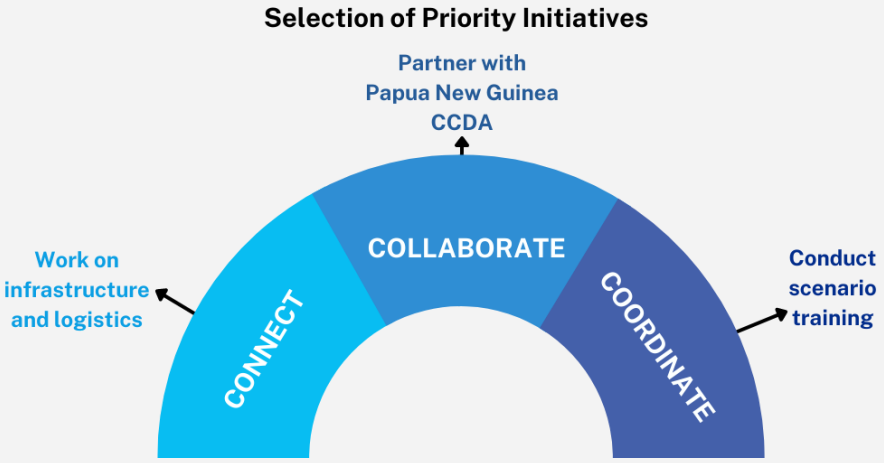


Figure 18: Priority Initiatives for the DoD

Through these priorities, the DoD would be able to begin tackling the large gap in climate-related infrastructure in Papua New Guinea. These actions will lead to an increased response capacity in case of emergency.

3.3 Recommendations by Crisis

The geography of Papua New Guinea and its poor response capabilities make the country highly vulnerable to frequent natural disasters and extreme weather events.[133] The DoD should prepare to respond to several crises driven by climate-affected disasters, particularly storms, flooding, and landslides. Papua New Guinea is situated at the convergence of the Pacific and Australian tectonic plates, so the country experiences high levels of tectonic activity, resulting in frequent and sometimes powerful earthquakes.[134] These earthquakes have been known to trigger tsunamis and thus may lead to severe flooding.[135] Volcanic eruptions are also extremely dangerous and frequent in Papua New Guinea and may trigger other severe disasters, including earthquakes and tsunamis.[136]

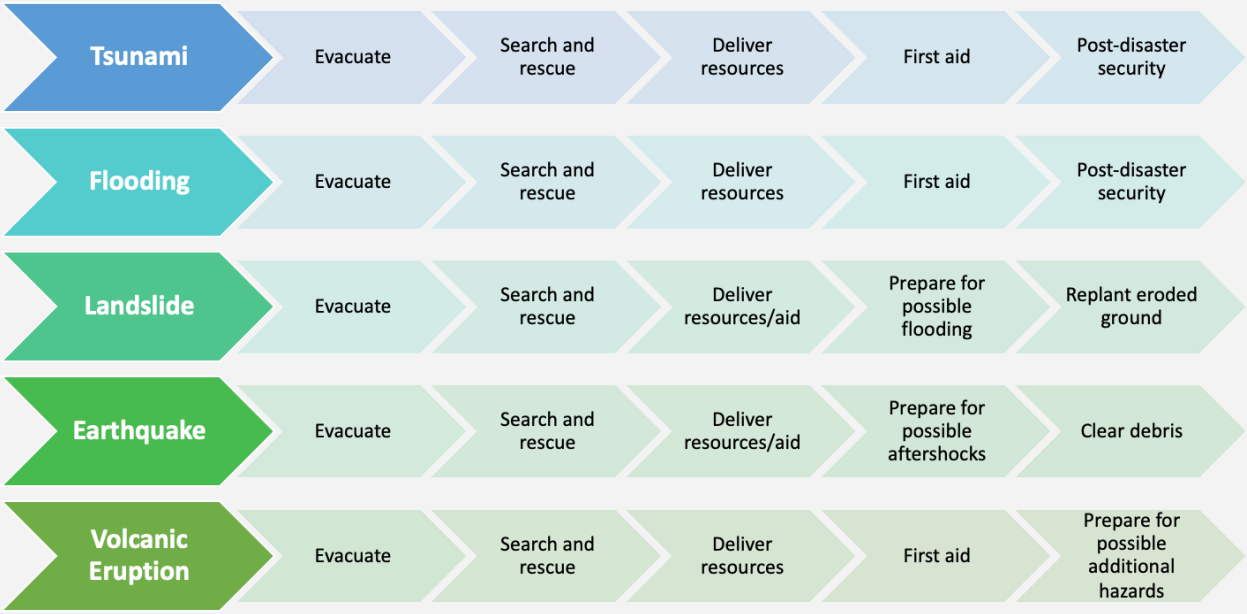


Figure 19: Disaster Relief Response Steps for Primary PNG Hazards

As shown in Figure 19, to minimize casualties, it is important to evacuate urban centers whenever possible.[137] The DoD should work with local leadership to deliver warnings and help relocate people away from dangerous areas. In all of these hazard scenarios, it is necessary to dispatch personnel to conduct search and rescue operations and escort people to safety.[138] The DoD should provide food, water, medical equipment, sanitation supplies, and other resources to survivors through any accessible means, including airlifts, ships, or land vehicles, depending on the location of the disaster.

DoD personnel should also support and facilitate the equitable distribution of aid and resources to the affected population and prepare for any potential hazards that might follow the initial disaster (for example, aftershocks or tsunamis).[139] This would involve close collaboration with regional healthcare networks, humanitarian actors, NGOs, religious centers, and community leaders. The DoD should also provide security in and around relief sites while aid and assistance are delivered.

4.0 Conclusion

Promoting climate safety goes beyond traditional security approaches. It is critical for the DoD to understand local beliefs, perceptions, systems, and challenges. Building trust in the long term is critical to success. Through climate safety and security initiatives in Papua New Guinea, the US needs to consider the specific characteristics and objectives of the country's land, people, government, and stakeholders.

Local authorities are taking action to put climate adaptation plans in place. However, challenges such as the lack of resources, the difficulty of coordination, and low scaling capacity pose obstacles to the execution of these plans. The DoD has an opportunity to help address these challenges in cooperation with central and community authorities, providing support for them to respond to emergencies locally.

The pillars **Connect, Collaborate, and Coordinate** provide a comprehensive framework for engaging with Papua New Guinea. As its immediate priorities, the DoD should focus on supporting the development of critical infrastructure to build climate resilience, engaging early with the CCDA, and building response capacity with scenario training programs, which can be a first step to generating real impact at scale.

In conclusion, this report emphasizes the importance of long-term initiatives and cooperation. Short-term or intermittent projects can be counterproductive, while capacity building and long-term structured approaches can empower locals and enhance impact. When the DoD approaches climate safety and security, it is critical to think about shared vocabulary and positioning. Sharing terms that focus on understanding and empathy can help build powerful trust and openness to collaboration. Finally, climate disasters pose serious threats to life and livelihood in PNG. Therefore, understanding communities and providing them with climate and security-related jobs and knowledge to deal with emergencies offers the most promising path to achieving climate safety.

Appendix

Appendix A - Functions and Power of the CCDA

FUNCTIONS AND POWERS OF THE AUTHORITY.

(1) In the discharge of its purpose, the Authority has the following functions:

(a) to develop, periodically update, publish and make available to the Conference of the Parties, in accordance with the UNFCCC, the national inventory of anthropogenic emissions by sources and removals by sinks of all targeted greenhouse gases in accordance with international reporting practice; and

(b) to formulate, implement, publish and regularly update national and regional measures

to mitigate climate change by addressing anthropogenic emissions by sources and removals by sinks of all targeted greenhouse gases and measures to facilitate adequate • adaptation to climate change; and

(c) to promote and cooperate in the development, application and diffusion, including transfer of technologies, practices and processes that control, reduce or prevent anthropogenic emissions of targeted greenhouse gases in all relevant regulated sectors; and

(d) to promote sustainable management and cooperation in the conservation and enhancement, as appropriate, of sinks and reservoirs of all targeted greenhouse gases, including in biomass, forests and oceans; and (e) to cooperate with relevant bodies or persons in preparing and implementing plans and activities for adaptation to the impacts of climate change; and

(f) to establish administrative offices, agents or consultants in Papua New Guinea and overseas or climate change attaches; and

(g) to promote and cooperate in scientific, technological, technical, socio-economic and other research, systematic observation and development of data archives related to the climate system as a precautionary measure to reduce the uncertainties regarding the causes, effects, magnitude and timing of climate change; and

(h) to promote and cooperate in the full, open and prompt exchange of relevant scientific, technological, technical, socio-economic and legal information related to the climate system and climate change; and

(i) to promote and cooperate in education, training and public awareness related to climate change and encourage wide participation from individuals, groups, statutory bodies, donors and other relevant institutions; and

(j) to confer powers to establish trading schemes for the purpose of limiting greenhouse gas emissions or encouraging activities that reduce such emissions or remove greenhouse gas from the atmosphere; and

(k) to establish, coordinate and manage any trading schemes for the purpose of limiting greenhouse gas emissions or encourage activities that reduce such emissions or remove greenhouse gas from the atmosphere; and

(l) to strengthen climate observation and support research towards improved understanding, modeling and prediction of the climate system and climate impacts; and

(m) to carry out climate risk assessments and study human systems to identify options to adapt to minimize the effects of climate change; and

(n) to coordinate planning efforts on climate change adaptation initiatives to address loss

and damage associated with climate change; and

(o) to monitor, evaluate and revise adaptation projects, policies and programs, including their effectiveness, efficiency and overall utility; and

(p) to monitor and review climate change related activities annually to strengthen coordination, accountability, drive innovation, enforce compliance and ensure implementation; and

(q) to promote and enforce the rights of the landholders by encouraging equitable participation in the climate change related programs that affect their customary land coastal sea area, and to perform any other or further functions or roles imposed on the Authority by this Act or any other law.[140]

Appendix B - Functions and Powers of the National Climate Change Board

FUNCTIONS AND POWERS OF THE BOARD.

(1) The primary function of the Board is to provide general control and guidance over the exercise of the functions and powers of the Authority.

(2) Without limiting the generality of Subsection (1), the functions of the Board are to -

(a) determine the policies of the Authority; and

(b) oversee the performance of the Managing Director and implementation and delivery of policy directives of the Government under this Act; and

(c) ensure the proper national regulation by way of Regulations made under this Act for all matters reasonably requiring regulation including the establishment, coordination and management of any trading schemes under the UNFCCC and the Kyoto Protocol together with such amendments or any new agreement that may supersede Kyoto Protocol to which Papua New Guinea has acceded for the purpose of limiting greenhouse gas emissions as defined in this Act; and

(d) administer the implementation of adaptation programs for the purposes of ensuring Papua New Guinea adapts to the effect of climate change and builds resilience to the adverse impacts of climate change; and

(e) administer the receipt of donor funding (such as results-based finance) from REDD and REDD+ activities and other national or international climate compatible development programs; and

(f) determine eligibility criteria in accordance with standard procedures for the implementation of REDD and REDD+ activities based on national circumstances and international best practices; and

(g) monitor the performance and reporting of participants in REDD and REDD+ activities and other national or international climate compatible development programs; and

(h) provide endorsement and ratification of proponents and projects applying to participate in the CDM, REDD and REDD+ and other national or international climate compatible development programs and activities.[141]

Appendix C - Physical Materials for DoD Capacity Building

Tentage:

- 305 Tents- Command tents
- GP tents - General Purpose tents
- CAPSET III/IV (Division/Battalion Command tents)

Utilities:

- Generators
- A/C units
- Shower units
- Laundry units
- LWPS (Lightweight Water purification system) - purifies for company sized element
- EWDS (Expeditionary water distribution system) - Transports water
- TWPS (Tactical Water Purification system) - purifies for company plus sized element
- Amphibious Assault Fuel System (AAFS) 1.12 million gallon capability
- Tactical Airfield Fuel Dispensing System (TAFDS) 320,000 gallon capability; employment: https://www.dvidshub.net/news/120420/mwss-171-fuels-set-up-tafds-thailand

Heavy Equipment:

- Forklifts
- Extended boom forklift (used for offloading from helicopters)
- KALMAR (used for ISO containers)

MWSS Specific Capabilities:

- Airfield Damage Repair (ADR) kit - the equipment & material (used to supplement the transport of the thousands of tons of concrete needed to repair airfield)
- P19-R fire truck
- Fire Suppression system (FSS)
- AM2 Matting (for temporary airfields)

Learn more about MWSS and what they do:
https://mca-marines.org/wp-content/uploads/Utilization-of-the-MWSS.pdf

Appendix D - Research Methodology

This research piece analyzed Papua New Guinea's climate security and adaptation by collecting information from multiple literature and expert sources.

Desk research: The team has conducted analysis on academic publications related to the topics of the paper. First, the team has analyzed the terminology and literature to build a solid comprehension of climate change impacts and the existing mitigation and adaptation strategies. An important step was to set definitions that were being applied on the paper and their implications and the meaning of climate security, safety and adaptation used in this paper.

Secondly, the team has deep-dived in the specific content about Papua New Guinea. The research focused on understanding the country's population profile and geographical distribution. It also mapped the existing disaster risks and natural disaster history. Then, the team analyzed the impacts of climate change on new disasters and increasing the occurrences of the existing natural disaster threats. For this part, the team complemented the literature and published studies with also the analysis of public and private databases that monitor climate events and trends.

Finally, the team has also studied government documents, commitments and strategies to understand the local priorities and areas of focus from the country's national and regional authorities.

Expert interviews: The team has complemented the research by interviewing experts from academia and government in order to get a deeper perspective about the climate issues and local context, challenges, and capabilities. Main topics of focus with experts have been:

- Existing definitions of climate change, climate security, adaptation, and mitigation
- Papua New Guinea's internal power dynamics
- Main actors working in climate change and mitigation and adaptation
- Programs being implemented in the country and challenges faced during execution
- Climate issues and readiness to respond
- DFE scope and capabilities for support
- Specific sectoral understanding, as extractive industries and public sector
- Populational and conflict issues in Papua New Guinea

Glossary of Terms

1. **ADAPTATION:** The adjustment process to actual or expected climate change and its effects. In human systems, adaptation seeks to moderate or avoid harm or to maximize beneficial opportunities.
2. **ADAPTIVE CAPACITY:** The ability of a (human) system to adjust to climate change, moderate potential damages, take advantage of opportunities, or cope with the consequences.
3. **BASIS RISK:** The misalignment between insurance claims and losses; it can be positive when a payout is triggered even though the disaster has not led to correlated losses or negative when losses are extreme but payouts are insufficient.
4. **CELL CITES:** Cell sites, also known as cell towers or base stations, enable wireless communication by transmitting and receiving signals between mobile devices and the network. In low-income countries, cell sites may provide mobile phone coverage to remote areas where wired telecommunications infrastructure is unavailable.
5. **CLIMATE CHANGE:** refers to long-term shifts in temperatures and weather patterns. These shifts may be natural, but since the 1800s, human activities have been the main driver of climate change, primarily due to burning fossil fuels (like coal, oil, and gas), which produce heat-trapping gases.
6. **CLIMATE RESILIENCY:** This is about successfully coping with and managing the impacts of climate change while preventing those impacts from worsening. A climate-resilient society would be low-carbon and equipped to deal with the realities of a warmer world. [142]
7. **CLIMATE RISK:** is the potential for climate change to create adverse consequences for human or ecological systems. This includes impacts on lives, livelihoods, health and wellbeing, economic, social, and cultural assets and investments, infrastructure, services provision, ecosystems, and species.[143]
8. **CLIMATE RISK MANAGEMENT (CRM):** A step in the adaptive policy-making process that connects real-time risk assessment with short-term and responsive management changes.
9. **CLIMATE SAFETY:** refers to the need to prevent harm and ensure the safety of individuals and communities affected by climate change. It is a bottom-up issue that requires local and community-driven efforts. Conflict resolution is important to climate safety, as disputes over resources or other climate-related issues can lead to violence and harm. Sustainability is also crucial to ensuring climate safety, as it involves balancing the needs of the environment, society, and economy to create a long-term solution. The DoD can take an internal response that prioritizes the needs of affected communities in PNG and empowers them to take action to ensure climate safety.
10. **CLIMATE SECURITY:** Refers to the threat posed by climate change to the stability and security of societies at the national and global levels. It is a top-down issue that requires international cooperation and collaboration to mitigate its impact. Climate change can lead to conflicts and resource competition. However, the DoD can take an effective mitigation response through international aid, which can also be critical in promoting climate security.
11. **CLIMATE SERVICES:** A Climate Service provides climate information to assist decision-making. The service must respond to user needs, be based on scientifically credible information and expertise, and require appropriate engagement between the users and providers.[144]

12. **COASTAL FLOODING:** Coastal Flooding is when water inundates or normally covers dry coastal land due to high or rising tides or storm surges.[145]
13. **CO-BENEFITS:** The results realized when a single action benefits both climate mitigation and adaptation goals.
14. **COMMON BUT DIFFERENTIATED RESPONSIBILITY PRINCIPLE:** All states have common responsibilities to protect the environment and promote sustainable development, but because of different social, economic, and ecological situations, countries must shoulder different responsibilities.[146]
15. **CORRESPONDENCE PRINCIPLE:** A tenet of economics positing that beneficiaries of a good should be the same economic actors who bear the costs of managing that good and who have the authority to make decisions regarding its equitable allocation.
16. **DISASTER RISK:** The potential loss of life, injury, or destroyed or damaged assets that could occur to a system, society, or a community in a specific period of time, determined probabilistically as a function of hazard, exposure, vulnerability, and capacity.[147]
17. **DISTRIBUTIVE JUSTICE:** Environmental costs and benefits should be allocated across time and space so that people who benefit from access to a resource also shoulder the costs associated with its management and use.
18. **EARLY WARNING SYSTEM:** Early warning system is an adaptive measure for climate change, using integrated communication systems to help communities prepare for hazardous climate-related events. A successful EWS saves lives, jobs, land, and infrastructures and supports long-term sustainability. Early warning systems will assist public officials and administrators in their planning, saving money in the long run and protecting economies.[148]
19. **EARTHQUAKES:** An earthquake is a sudden, rapid shaking of the ground caused by shifting rocks deep underneath the earth's surface. Earthquakes can cause fires, tsunamis, landslides, or avalanches.[149]
20. **ECOSYSTEM SERVICES:** The benefits that healthy ecosystems deliver to human societies, usually free of charge, including provisioning, regulating, cultural and support services.
21. **EMERGENCY OPERATIONS CENTER (EOC):** This is a specially designated centralized facility where officials meet face-to-face to coordinate a jurisdiction's overall disaster response and recovery efforts in support of field operations. Every US state, most cities, counties, tribes, major employers, military installations, and healthcare facilities have an EOC. While the size, complexity, and types of EOCs vary by organization, they all perform the same basic functions.[150]
22. **EXPOSURE:** The presence of people, livelihoods, species, ecosystems, environmental functions, services, resources, infrastructure, or economic, social, or cultural assets in places and settings that could be adversely affected by hazards.
23. **FLASH FLOODS:** Flooding that begins within 6 hours, and often within 3 hours, of the heavy rainfall. Several things can cause flash Floods but is most often due to extremely heavy rainfall from thunderstorms. [151]
24. **FOOD SECURITY:** Is when all people, at all times, have physical and economic access to sufficient safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life. The four main dimensions of food security are the physical availability of food, economic and physical access to food, food utilization, and stability. All four dimensions must be fulfilled simultaneously for food security objectives to be realized.[152]
25. **GOVERNANCE:** The processes involved in managing a social system or modifying its members' behaviors, including actions by governments, civil society, and the private sector

26. **HAZARD:** A natural or human-induced physical event, trend, or physical impact that may cause loss of life, injury, or other health impacts as well as damage to property, infrastructure, livelihoods, service provision, ecosystems, and environmental resources.
27. **INSTITUTIONS:** These can refer to government agencies, formalized organizations, or established practices and customs.
28. **LANDSLIDES:** A landslide is the movement of a mass of rock, debris, or earth down a slope. Landslides are a type of "mass wasting," which denotes any down-slope movement of soil and rock under the direct influence of gravity. The term "landslide" encompasses five modes of slope movement: falls, topples, slides, spreads, and flows. These are further subdivided by the type of geologic material (bedrock, debris, or earth).[153]
29. **MAINSTREAMING:** Mainstreaming ensures that environmental management, protection, and conservation are integrated into sustainable development planning and management.[154]
30. **MALADAPTATION:** This is when climate change adaptation actions backfire and have the opposite of the intended effect – increasing vulnerability rather than decreasing it.[155]
31. **MITIGATION:** Refers to efforts to reduce or prevent the emission of greenhouse gases. Mitigation can mean using new technologies and renewable energies, making older equipment more energy efficient, or changing management practices or consumer behavior.[156]
32. **POLLUTER PAYS PRINCIPLE:** States should take the actions necessary to ensure that polluters and users of natural resources bear the full environmental and social cost of their activities. The principle is designed to ensure that polluters and users of natural resources bear the full environmental and social costs of their activities. [157]
33. **PORTABLE CHARGERS:** Portable chargers, or power banks, can charge mobile devices like smartphones and tablets. They are valuable tools for connecting communities and accessing information. Portable chargers are a popular tool for staying connected in Papua New Guinea, where access to electricity can be limited or unreliable.
34. **PRECAUTIONARY PRINCIPLE:** Addresses how environmental decisions are made in the face of scientific uncertainty. The principal is concerned with taking anticipatory actions to avoid environmental harm before it occurs. [158]
35. **RECOGNITION JUSTICE:** Decision-making should explicitly acknowledge the legitimacy of all groups of stakeholders, particularly those that have been rendered invisible to date.
36. **RESILIENCE:** The capacity of social, economic, and environmental systems to cope with a hazardous event, trend, or disturbance by responding or reorganizing in ways that maintain their essential function, identity, and structure while also building the capacity for adaptation, learning, and transformation.
37. **RISK:** A function of dynamic interactions among hazard, exposure, and vulnerability to climate change impacts.
38. **RIVER FLOODING:** River Flooding is when streams and rivers exceed the capacity of their natural or constructed channels to accommodate water flow, and water overflows the banks, spilling out into adjacent low-lying, dry land. [159]
39. **SUBSIDIARITY PRINCIPLE:** A tenet of economics positing that decisions should be made by the decision unit or layer of government at the lowest level of aggregation possible.
40. **VULNERABILITY:** The propensity or predisposition to be adversely affected; it encompasses a variety of concepts and elements, including sensitivity or susceptibility to harm and lack of capacity to cope and adapt.[160]

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