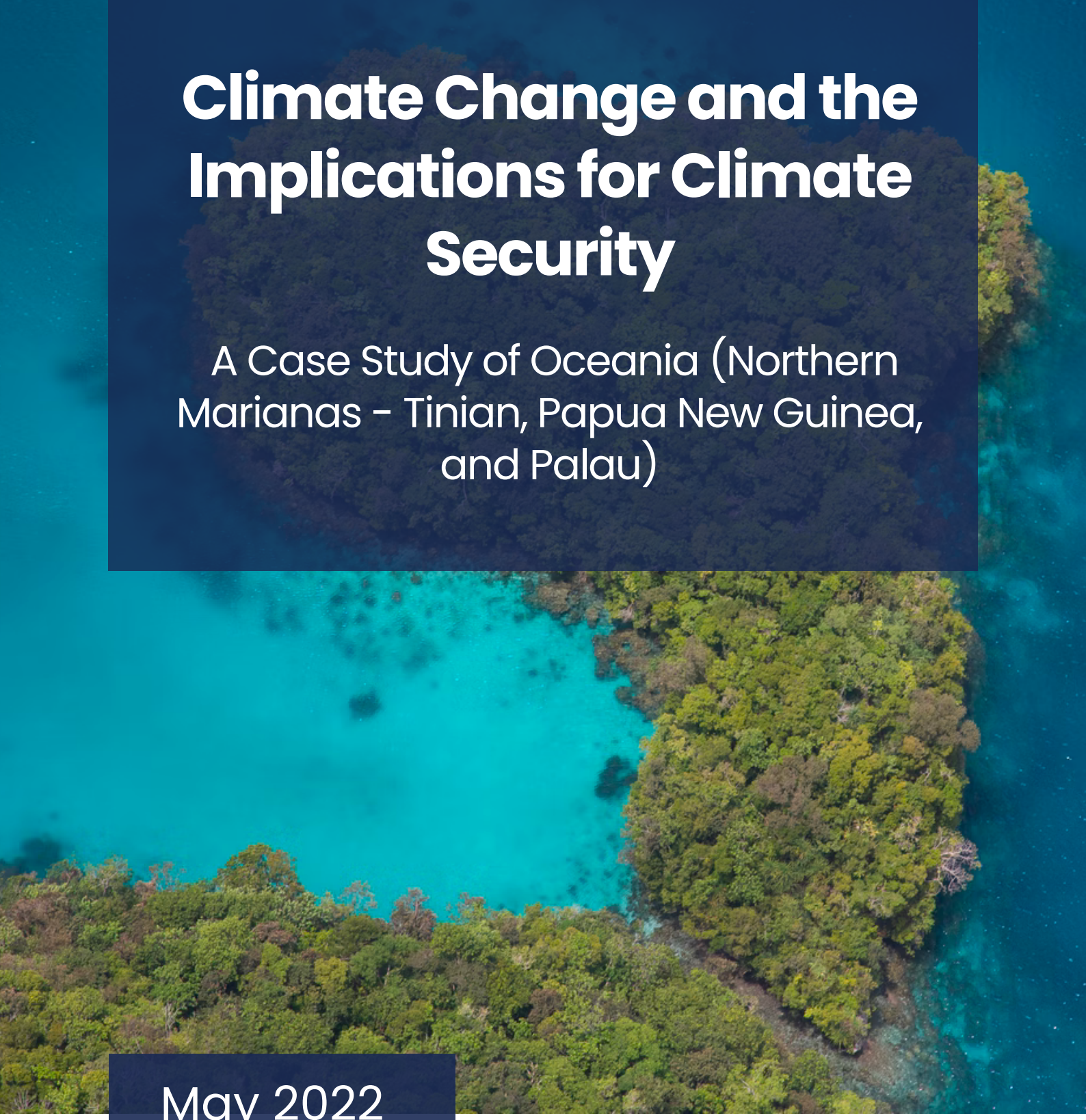
Climate Change and the Implications for Climate Security

A Case Study of Oceania (Northern Marianas - Tinian, Papua New Guinea, and Palau)



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CENTER FOR EXCELLENCE In Disaster Management & Humanitarian Assistance

COLUMBIA | SIPA
School of International and Public Affairs

Climate Change and the Implications for Climate Security: Case Study of Oceania (Palau, CNMI-Tinian, and Papua New Guinea)

Capstone Workshop Program
Columbia University, School of International and Public Affairs

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I. List of Acronyms

ADB	Asian Development Bank
CCDA	Climate Change and Development Authority (Papua New Guinea)
CCDF	Child Care and Development Fund
CEPA	Conservation and Environmental Protection Authority (Papua New Guinea)
CFE-DM	Center for Excellence in Disaster Management and Humanitarian Assistance
CJMT	Commonwealth of the Northern Mariana Islands Joint Military Training
CNMI	Commonwealth of the Northern Mariana Islands
COVID-19	Coronavirus Disease 2019
DAL	Department of Agriculture and Livestock (Papua New Guinea)
EO	Executive Order
ENSO	El Niño Southern Oscillation
FEMA	United States Federal Emergency Management Agency
GBV	Gender-Based Violence
GCF	Green Climate Fund
GDP	Gross Domestic Product
HSEM	CNMI Homeland Security and Emergency Management Office
ICRC	International Committee of the Red Cross
INDOPACOM	Indo-Pacific Command
IOM	International Organization for Migration
IPCC	Intergovernmental Panel on Climate Change
JICA	Japan International Cooperation Agency
MEOP	Municipal Emergency Operations Plan
MIRC	Mariana Island Range Complex (CNMI-Tinian)
MITT	Mariana Island Testing and Training (CNMI-Tinian)
NDC	National Disaster Centre (Papua New Guinea)
NEMO	National Emergency Management Office (Palau)
NGO	Non-Governmental Organization
NRFC	Northern Reef Fisheries Cooperative (Palau)
PICRC	Palau International Coral Reef Center
PNMS	Palau National Marine Sanctuary
PNG	Independent State of Papua New Guinea
PNGDF	Papua New Guinea National Defence Force
PPUC	Palau Public Utilities Corporation
PRCS	Palau Red Cross Society
RCDAT	Red Cross Disaster Action Teams (Palau)
SLC	Sea Level Change
TNC	The Nature Conservancy
UN	United Nations
UNDP	United Nations Development Programme
U.S.	United States of America
USAID	United States Agency for International Development
WASH	Water Sanitation and Hygiene

II. Acknowledgements

The Columbia University School of International and Public Affairs Capstone team extends gratitude to our advisors, interviewees, participants, and the U.S. Department of Defense Center for Excellence in Disaster Management and Humanitarian Assistance (CFE-DM).

We thank the individuals and organizations who graciously offered time, valuable knowledge, and professional insight into the many topics covered in this report. Their participation and expertise directly informed our findings and recommendations for reducing the threat of instability from climate change in Palau, Papua New Guinea, and the island of Tinian in the Commonwealth of the Northern Mariana Islands.

Special gratitude goes to Professor Karen L. Levin and Professor Nathalie Rothschild; we are grateful for your support and guidance throughout the Capstone project. We are also thankful to the School of International and Public Affairs Capstone Program and faculty for their support.

Lastly, we want to thank our client, CFE-DM who guided and supported us. Dr. Morales provided information and contacts, enabling us to conduct our interviews and fieldwork across the Indo-Pacific region.

1. Executive Summary

Climate change is permanently affecting human life with higher temperatures, greater rainfall volatility, and more frequent and intense natural disasters. While there is a significant body of knowledge around the anticipated physical effects of climate change, the subsequent human security impacts that contribute to instability are often complex and challenging to predict. Without an understanding of these human security impacts, it is difficult to integrate climate-related risk management into military and civilian planning processes.

As part of an ongoing collaboration with Columbia University's School of International and Public Affairs ("SIPA"), the Center for Excellence in Disaster Management and Humanitarian Assistance ("CFE-DM") requested the SIPA team to build the body of knowledge around climate security in three locations in Oceania: Palau, the island of Tinian, part of the Commonwealth of the Northern Mariana Islands ("Tinian" or "CNMI-Tinian"), and Papua New Guinea. As President Biden has recently placed climate change at the center of U.S. national security and foreign policy, the team was specifically tasked with identifying the human security impacts of climate change that contribute to instability in the locations of interest.

A mixed-methods research approach integrated qualitative interviews, an analytic survey, and extensive desk research to build findings and recommendations. The research explores perspectives from key stakeholders in all three locations of interest, including international organizations, local, national, and non-governmental organizations, national societies, and other community partners.

Across the three locations in Oceania, climate change is expected to cause threats to human security, including the degradation of freshwater sources, environmental and infrastructure destruction, and food insecurity. While similarities exist, the SIPA team found that population size and geography (among other factors) vary greatly among all three locations, resulting in significant differences in how these human security impacts arise and how they may or may not contribute to instability. Further, the SIPA team's work illustrates the multiplier effect that existing physical and social vulnerabilities within each location can have in exacerbating the human security effects of climate change.

The SIPA team's recommendations for further research and potential action by CFE-DM are themed around capacity building opportunities, partnership development opportunities, and infrastructure resilience needs in each location. This report provides CFE-DM with the information necessary for data-informed decision making in policies, plans, and programs related to disaster response and humanitarian assistance. By further integrating the human security impacts of climate change into its work, CFE-DM will be closer to achieving its mission of saving lives and alleviating human suffering before, during, and after humanitarian crises.

2. Introduction and Research Objective

Climate change is permanently changing human life with higher temperatures, sea level rise, greater rainfall volatility, and more frequent and intense natural disasters. While there is a significant body of knowledge around the anticipated physical effects of climate change, the subsequent human security impacts that contribute to instability are often complex and challenging to predict. Without an understanding of these human security impacts, it is difficult to integrate climate-related risk management into both civilian and military planning processes.

In January 2021, U.S. President Biden signed Executive Order ("EO") 14008 on Tackling the Climate Crisis at Home and Abroad. EO 14008 puts the climate crisis at the center of U.S. foreign policy and national security, signifying climate change can and will cause significant impacts to human security over the coming decades.[1] As part of this effort, the United States, through diplomatic, aid, and military relations, will work with partners throughout the world to build resilience to climate change, including in Oceania.

The U.S. Department of Defense's Center for Excellence in Disaster Management and Humanitarian Assistance ("CFE-DM") is a direct reporting unit to the U.S. Department of Defense's Indo-Pacific Command ("U.S. INDOPACOM"). CFE-DM's mission is to build crisis response capacity in U.S. and partner militaries, enhance coordination and collaboration with civilian and foreign partners, and strengthen those relationships to save lives and alleviate human suffering before, during, and after humanitarian crises.[2]

CFE-DM has asked the Columbia Capstone team to conduct research on the human security impacts of climate change and how these impacts may lead to instability in three vulnerable locations in the Indo-Pacific: Papua New Guinea, Palau, and the island of Tinian in the Commonwealth of the Northern Mariana Islands (brief background introductions to each location are included in Appendix A). This report is the culmination of that research and is intended to support data-informed decision-making for policies, plans, and programs regarding climate change and climate security within Oceania.

3. Background

3.1 Climate Change in Oceania

Islands in the Pacific Ocean such as Papua New Guinea ("PNG"), Palau, and the island of Tinian in the Commonwealth of the Northern Mariana Islands ("CNMI-Tinian" or "Tinian" hereafter) experience the impacts of climate change more immediately than many non-island locations. Sea level rise and salt water intrusion, warming ocean temperatures, ocean acidification, and coastal erosion can have detrimental impacts on fisheries, coastal agriculture, and tourism in island nations and territories. The locations analyzed in this report are further vulnerable to weather phenomena such as tropical storms, droughts, and heatwaves, all of which have the potential to become more frequent and intense as a result of changing weather patterns caused by climate change.

These climate threats can produce cascading human security impacts that lead to instability: loss of land and damage to homes and critical infrastructure, loss of livelihoods, food and water insecurity, and migration all have the potential to occur via multiple pathways as a result of impacts from climate change.

3.1.1 Sea Level Rise

Between 1993 and 2010, sea levels in the Western North Pacific rose at a rate of over .4 inches (10 millimeters) per year, over three times the rate of the global mean sea level average during the same period.[3] In Palau, sea levels are expected to rise 5 inches (127 millimeters) by 2030 and 10 inches (254 millimeters) by 2050.[4] Higher tides and stronger storm surges can contaminate water sources, while saltwater intrusion and inundation put low-lying agriculture at risk.[5]

The loss of habitable land is not a major issue in Tinian due to its coastlines' protective limestone character and its elevation.[6] However, the long-term rise in sea level will lead to a loss of freshwater, making the population more dependent on precipitation as a source of drinking and irrigation water. Additionally, in response to short-term variability due to El Niño and La Niña weather patterns, sea level change impacts salinity levels in CNMI's basal lenses, creating potential future implications for saltwater intrusion into freshwater infrastructure.[7]

The sea level surrounding PNG has risen by an average of .27 inches (7 millimeters) per year since 1993, higher than the global average.[8] Rising sea levels present significant challenges to PNG, especially among the nation's 600+ low-lying coastal islands. In research and interviews with key informants, the risk of contamination to drinking water, the degradation of coastal mangrove ecosystems that provide food, livelihoods, and storm protection, and the very real potential for community relocation are all connected to current and future sea level rise and coastal inundation.

3.1.2 Ocean Warming and Acidification

Based on climate projections for Palau, sea surface temperatures will rise about 1.44°F (0.8°C) by 2030 and 1.8°F to 3.6°F (1-2°C) by 2050, signifying an existential threat to coral reef ecosystems.[9] In addition to water temperatures impacting coral reefs, ocean acidification is having a significant impact on the ability of coral reefs to survive. Aragonite saturation rates, an important measure for reef stability, are falling and are expected to reach 3.5 by 2030. This current trend puts coral reefs at extreme risk as there is no documented evidence they can survive below a 3.0 aragonite rate.[10*]

Changes in ocean chemistry in CNMI are largely irreversible and far outlast impacts from other phenomena such as tropical cyclones. The long-term effects of changes to ocean chemistry are likely to have an impact on fisheries and tourism in Tinian, on which a majority of the island's economy depends.[11] Furthermore, extended periods of warmer-than-average sea surface temperatures cause mass coral bleaching and mortality events leading to more erosive waves.[12]

In the past several years, sea temperatures in PNG averaged between 75.2°F (24°C) and 87.2°F (30.6°C). As sea temperatures continue to rise, Papua New Guinea's coral reefs, which play a critical role in protecting coastlines from storms and land loss, will face similar mass coral bleaching and mortality similar to that seen in Tinian's reefs.

3.1.3 Changing Air Temperatures and Weather Patterns

The International Climate Change Adaptation Initiative projects a substantive increase in the number of extreme rainfall days over the course of the twenty-first century.[13] Rainfall levels are equally expected to intensify in volume in Palau with extreme events likely to increase 4% by 2050 and 8% by 2090, causing more severe flooding, affecting food security, and increasing the risk of disease.[14] Higher temperatures will also increase demand on freshwater supply for agriculture as evapotranspiration increases and for human consumption as a cooling mechanism.

Climate model outputs for the CNMI region show a range of possible future precipitation changes with some models indicating as much as a 20% rise in precipitation volume over the long-term.[15] There is more than a 25% chance that at least one period of prolonged exposure to extreme heat, resulting in heat stress, will occur in the next five years in Tinian.[16] Precipitation changes, along with their impact on freshwater supply, constitute some of the most significant climate threats to Tinian. Droughts impact the already scarce freshwater supply, while extreme rainfall can lead to increased flash flooding.[17]

In PNG, an increase in rainfall intensity drives higher instances of erosion and landslides, which can destroy infrastructure and crops, and exacerbate environmental degradation of forested land.[18] According to them International Organization for Migration ("IOM"), over 48% of the forest land in PNG is experiencing some level of degradation, with estimates that 58% of the total land is subject to erosion.

*Aragonite is a carbonite mineral that is a critical component of corals and other organic substances.

The International Climate Change Adaptation Initiative projections indicate that the annual average air temperature and sea surface temperature in and around PNG may increase by 0.7–1.8°F (.4-1°C) by 2030, significantly higher than current patterns of warming.[19] Higher temperatures will cause higher evaporation rates, leading to more frequent occurrences of droughts and a decline in soil fertility. The humid conditions caused by fluctuations in both temperature and rainfall will create conditions that favor the incubation of agricultural pests and diseases.[20]

3.1.4 Weather-Related Natural Disasters

Tropical cyclones develop over oceans with surface temperatures greater than 79.7°F (26.5°C), and evidence suggests that all three locations of interest will be at a greater risk of more frequent and intense tropical cyclones and typhoons. According to the Office of Climate Change in Palau, typhoons are currently the greatest climate threat facing the island, emphasizing that the threat is magnified by the fact that many shelters on the island are not equipped to withstand severe winds.

Tinian and PNG are likewise highly vulnerable to the effects of tropical cyclones and typhoons. In 2018, thousands of homes were damaged or destroyed in Tinian during Super Typhoon Yutu, while the United Nations warns that PNG has a greater than 50% chance of annual disaster losses exceeding U.S. $700 million in the next 50 years.[21]

3.2 Connecting Climate Change and Human Security

As a threat multiplier, climate change-related effects compound existing vulnerabilities to worsen disasters, exacerbate social tensions, and introduce conflict over resources, all of which then can create new sources of insecurity. The Intergovernmental Panel on Climate Change's ("IPCCs") Sixth Assessment Report states that concurrent and serial climate hazards increase impacts and risks to health, ecosystems, infrastructure, livelihoods, and food production. These risks overlap and interact, which introduces new sources of vulnerability or insecurity further compounding overall risk. Supply chains and key infrastructure can be disrupted by extreme weather and climate events. Food production is affected by changes in precipitation patterns, heat and drought events, and water availability.[22]

3.3 Climate Change and Adaptation Background Summary

Reducing climate risks and vulnerability by adjusting existing systems is known as adaptation.[23] Climate change adaptation can be difficult to measure–and therefore manage–because of the numerous perspectives on risk and tolerance.[24] The implementation of adaptation plans also depends on effective capacity, governance, and decision-making processes. The Department of Defense ("DoD") Climate Adaptation Plan highlights that the DoD is primarily concerned with being able to operate under changing climate conditions, preserving operational capability, and enhancing the natural and constructed systems that are essential to the Department's success.[25] However, adaptation success is hard to define because the climate is constantly evolving; what was once adaptive may become maladaptive in the face of further climate change. Flexibility, foresight, and constant analysis are necessary to keep adapting and stay effective. It is important

to recognize that local people and organizations on the ground are best prepared to identify the adaptation metrics and climate risks that impact them the most. Seeking out vulnerable or under-represented communities that are most at risk helps provide a well-rounded perspective that better addresses climate adaptation needs.[26] Additionally, understanding the causes behind these vulnerabilities can help identify the social, economic, and political opportunities for intervention that would also increase climate adaptation and human security.[27] There is a danger that adaptation efforts can reinforce or redistribute existing vulnerabilities, exacerbate existing political tensions, or introduce new risks if adaptation projects fail to understand the complexities of vulnerability, are manipulated by political forces, and/or do not consider long-term social, economic, and environmental impacts.[28] From there, long-term capacity building empowers people to develop flexible adaptation initiatives that will serve their needs now and in the future as the climate continues to change.[29]

4. Methodology

After an initial meeting with CFE-DM ("the client" hereafter) in mid-January 2022, the Columbia Capstone team ("the team" hereafter) developed a framework for data collection according to the objectives of the project, including a set of guiding questions that would inform the initial desk research. The data collection efforts were divided into three phases:

Phase one consisted of desk research to better understand the locations' underlying vulnerabilities, climate change threats, and existing climate change adaptation and disaster management plans. The second phase of data collection consisted of key informant interviews and began in mid-February. The team sent 89 emails to potential key informants, received 36 responses, and conducted a total of 28 interviews. In addition, a survey to understand climate-related risk perceptions was designed and deployed ahead of the interviews. This enabled the team to create a climate change and human security risk assessment for each of the locations. In Phase 3, a methodology to interpret the qualitative data from the interviews was developed to analyze the information the team received.

4.1 Research Team Structure

To conduct phases one and two, the team was divided into three fieldwork sub-teams one each for Palau, CNMI-Tinian, and Papua New Guinea so that each team could become knowledgeable on their location. A fieldwork coordinator was designated to provide oversight of the collection of information, while a data coordinator was designated to oversee the organization and analysis of the information collected.

4.2 Desk Research

The three fieldwork sub-teams began carrying out desk research by gathering information about their respective locations from online and printed materials. Examples include websites, online reports, and journals. Information was collected to obtain background on the following topics by location:

- Primary Climate Threats
- Pre-Existing Vulnerabilities
- Potential Human Security Impacts from Primary Climate Threats, including:
    - Housing, Infrastructure, Habitable Land, Livelihoods, Agriculture, Fisheries, Tourism, Food Insecurity, Water Insecurity, Water Salination, Communicable Disease, Migration, Conflict, and Political Instability
- Stakeholders and Existing Partnerships
- Climate Security-Related Plans
- Climate Security-Related Trainings and Exercises
- Possible Key Informants
- Other Relevant Climate Security Information as Deemed Applicable by the Researchers

The initial desk research provided the team with an overview of pre-existing vulnerabilities, climate change threats, human security impacts, and risk reduction measures. In addition, the research explored external shareholder structures, established themes, and identified key informant contacts for further field research.

4.3 Contacting Key Informants

The fieldwork portion of the research consisted of videoconference interviews or phone interviews with key informants who were identified as having expertise in their location applicable to the topics described above. Experts came from a variety of backgrounds, including the U.S. military, national governments, local, national, and international non-governmental organizations, multilateral organizations, and community partners. Key informants were initially contacted by email, with email messages created by using the templates in Appendix C and then tailoring the messages to fit the specific key informant. Key informants whose geographic area of responsibility was not specific to Palau, CNMI-Tinian, or Papua New Guinea were contacted and interviewed by the fieldwork coordinator to collect information applicable to multiple locations or the U.S. INDOPACOM area of responsibility in general.

4.4 Analytic Survey: Risk Assessment

In the body of the initial email message, most potential key informants were asked to complete the survey shown in Appendix D. The survey was used to provide a subjective risk assessment of the primary climate threats and the human security impacts in the respective location based on the opinion of the key informant. The number of survey respondents from each location and the types of sectors they represented are summarized in the table below.

Location	Survey Respondents	Sectors Represented
Palau	7	Military, multinational government, nonprofits, and research institutes.
Papua New Guinea	4	Research institutes and government agencies.
Tinian	9	Territorial government, local officials, and nonprofits.
Total	**20**	

Table 4.4: Risk Assessment Respondents by Location and Sector

After completed surveys were received, the answers were analyzed using the risk matrix below. The risk perceived by the key informant for each primary climate threat and human security impact was then characterized as one of the following risk levels: very low, low, moderate, high, very high. The team then used the risk assessments to gain an understanding of which primary climate threats and human security impacts the key informant considers to be of greatest concern.

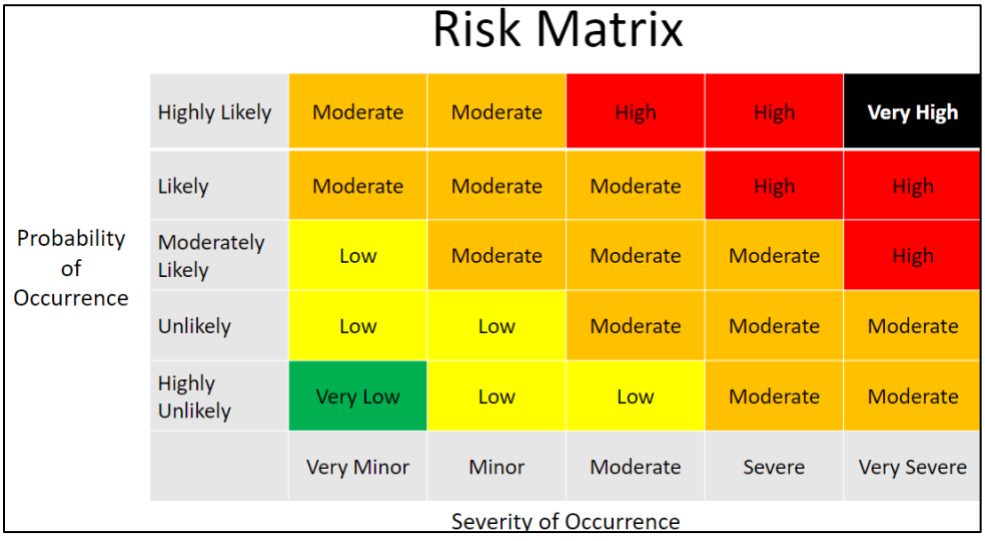

Figure 4.4: Risk Assessment Matrix

4.5 Interviews

During the semi-structured interviews with the key informants, the researchers asked questions based on their understanding from the desk research and the risk assessments, using the questionnaire template found in Appendix F to determine what types of information to collect. The interviews also provided the opportunity for open-ended discussion to capture information the key informants felt was important that was not specifically asked by the interviewer.

4.6 Analysis

The team developed a quantitative data analysis methodology to record all key informant interviews and then analyze answers and identify themes within the research. This included two primary documents, capturing information and quotes from interviewees in the first document and identifying themes across interviews in the second document (see Appendix G). The second document was divided into the three separate locations of interest, while the first document unified all interviews and created a holistic overview. Through this process, the team was able to clearly identify gaps in the research as well as find commonalities among the locations and ultimately conclude with their key findings and recommendations.

4.7 Limitations and Constraints

The deskwork portion of this research required gathering information about climate-related threats, human security impacts, pre-existing vulnerabilities, and adaptation and risk reduction measures in each of the locations under investigation. Due to the dynamic nature of the changing climate and its impacts, there may be a lag in the ability of published work to capture the current state of these factors. However, attempts were made to derive the information from the most up-to-date sources available.

There are several limitations in the survey method used to assess risk, including small sample sets for each location, the subjective nature of the surveys, and varying levels of expertise among the respondents pertaining to the questions asked. However, the results of the surveys are useful as a starting point in gauging the relative levels of risk perceived in each location.

In carrying out the fieldwork portion of the research, the teams attempted to arrange interviews with key informants having a broad range of relevant expertise in each of the locations. Some key informants were unavailable to participate.* The interviews conducted, however, span a large enough range and depth to be able to provide an informative picture of the climate-related security issues in each location. Additionally, the remote location of the target regions as well as the time difference from New York City, where the team is based, presented considerable technological and logistical challenges.

*The team attempted to contact key informants with the Australian Mission to Papua New Guinea, the Australian military, the Palau National Emergency Management Office (NEMO), and the CNMI Homeland Security and Emergency Management (HSEM) Office via multiple communication channels, however, contacts from these organizations were unable to be reached. The Australian Mission to Papua New Guinea and the Australian military both play important roles in disaster management and climate change adaptation in Papua New Guinea. NEMO is the lead national-level office for coordinating disaster management in Palau. HSEM is the territorial-level office responsible for disaster management in CNMI.

5. Findings

5.1 Human Security Impact Commonalities: Palau, CNMI-Tinian, Papua New Guinea

Palau, CNMI-Tinian, and Papua New Guinea have several commonalities among the climate change-induced human security impacts to which they are vulnerable. Broadly speaking, these include water insecurity, impacts on critical infrastructure, food insecurity, impacts on livelihoods, impacts on housing, and increased incidence of diseases. However, the size, topography, and vegetation, among other factors, vary among all three locations, resulting in significant differences in the details of how these human security impacts arise and how they are experienced.

5.2 Common Gaps and Barriers to Adaptation

Key informants from all three locations indicated a lack of local capacity to adapt to climate change and manage natural disasters, leading to dependence on external support. Accessibility to and distribution of food, supplies, and fuel by boat to outlying islands are also common challenges faced, as the boats used for transportation between the islands are small and cannot transport large quantities, and it can take a long time to get to and from the various islands. Improving coordination between different government departments and between levels of government was also identified as a need for each of the three locations.

5.3 Perceptions of Risk

Most survey respondents had “moderate” to “very high” perceptions of climate risk in their location. The charts on the following page aggregate and average survey respondent data for Palau, Tinian, and Papua New Guinea. The survey results indicate that respondents from all three locations perceived the risks of climate threats as relatively high, with the threats of sea level rise, heavy rainfall, and flooding being perceived as “high” to “very high.” The survey indicated that perceived risks to human security from climate change varied greatly from location to location. For example, the risk of climate change driven migration, conflict, and instability were perceived to be higher in Papua New Guinea than in Palau or Tinian, a finding that was also reinforced in key informant interviews. A summary of the data from the risk assessment surveys is found in Appendix E.

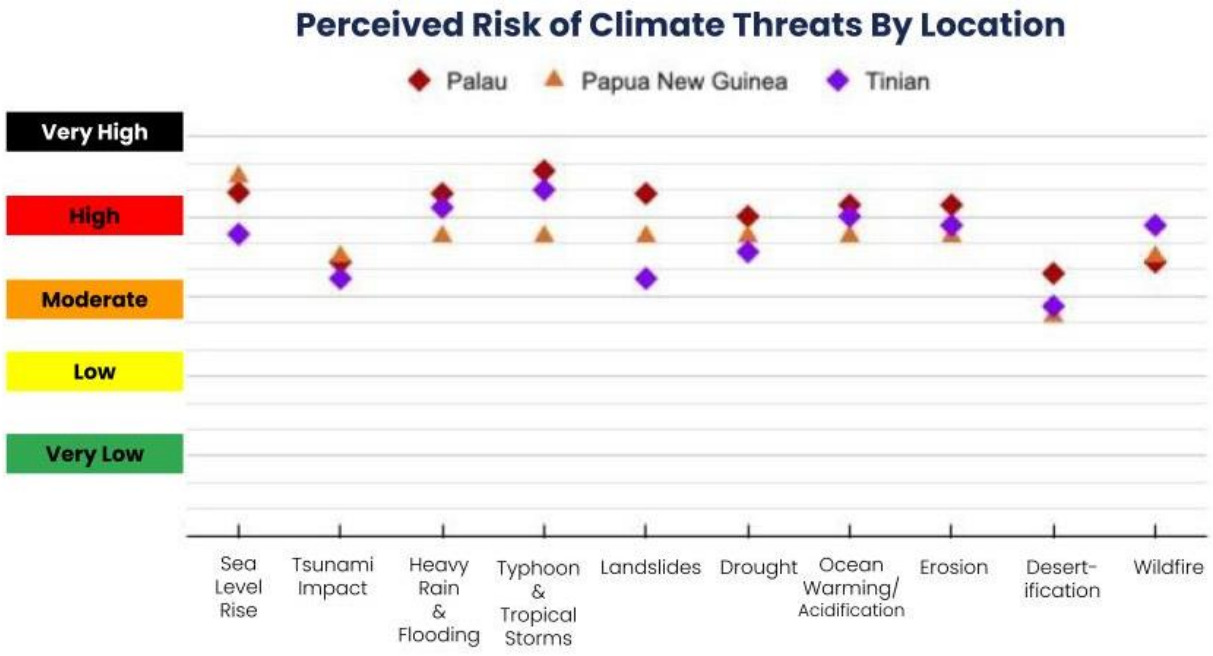

Figure 5.3.1: Average of all survey respondents' perceived risk of climate threats, by location of interest.

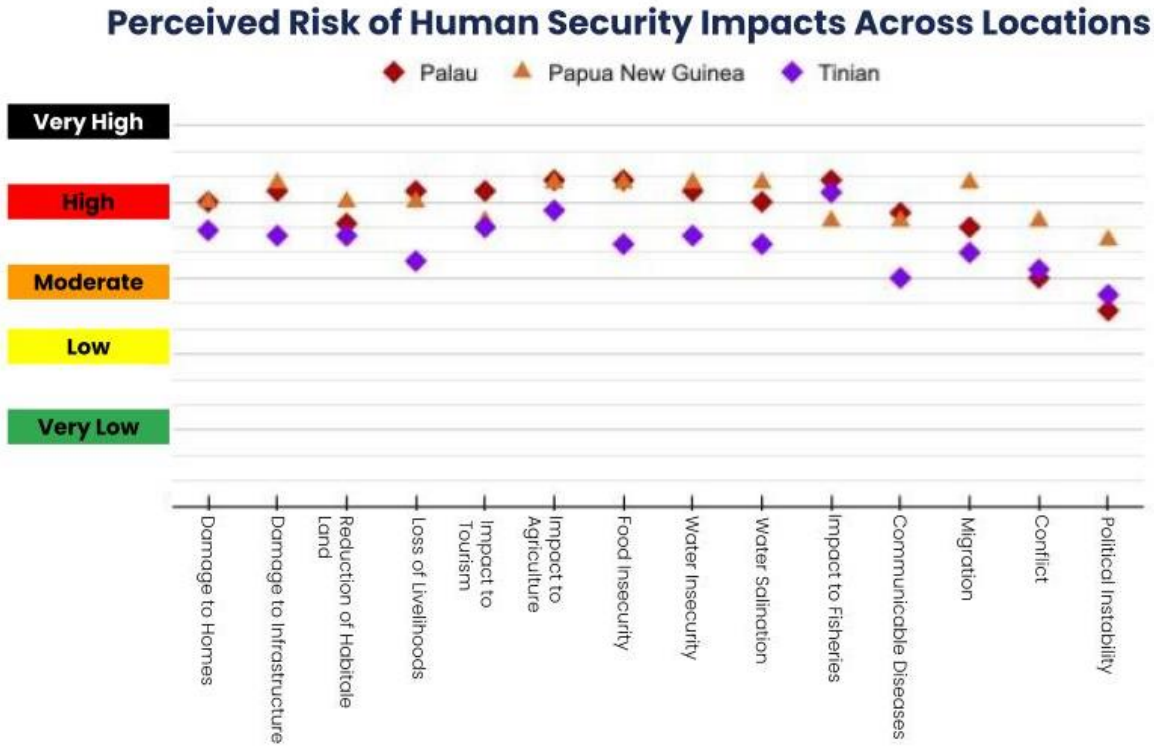

Figure 5.3.2: Average of all survey respondents' perceived risk of human security impacts, by location of interest.

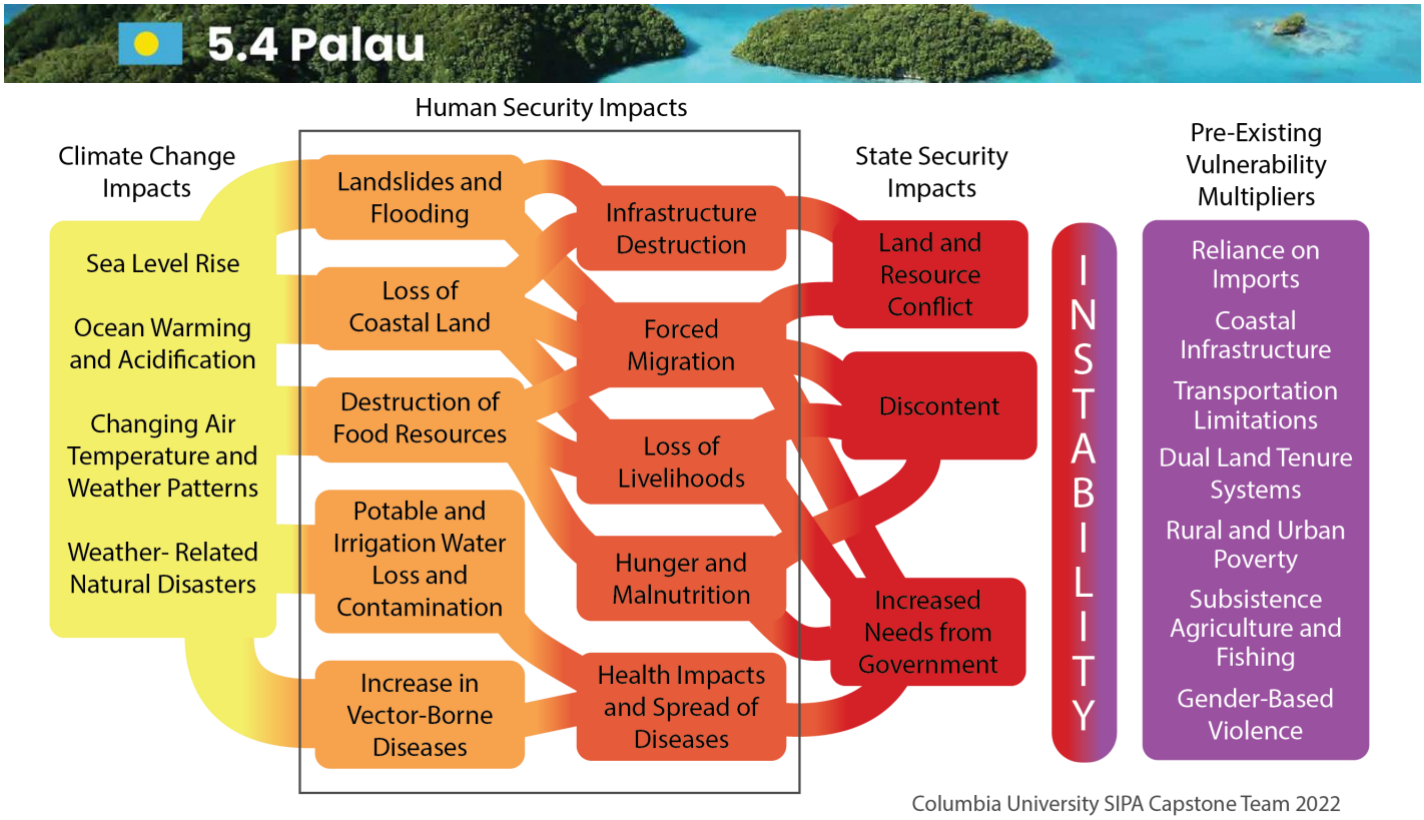

Figure 5.4: Cascading human security threats from climate change that can lead to instability in Palau and Palau's pre-existing vulnerability multipliers (non-exhaustive).

5.4.1 Human Security Impacts

Water Security

Palau's freshwater supply is threatened by drought, flooding, shifting rainfall patterns, and sea level rise due to climate change. As a home and commercial coolant, the demand for water will also increase as air temperatures rise.[30] Increasing demand for, and disruption to, Palau's water supply is also a food security issue, as it leaves less water available for agricultural production, and an economic concern, as tourism revenues rely on the ability to provide basic infrastructure, including water.[31]

From mid-2015 to 2016, water supply was constrained, usage was rationed, and there were significant sanitation and hygiene risks because of a drought due to El Nino weather patterns.[32] Flooding can also damage or destroy water system infrastructure, leading to water supply disruption. A key informant from the Palau International Coral Reef Center ("PICRC") related that a water supply pipe was raised 12 feet in order to avoid potential future floodwaters. Another key informant from the Palau Office of Climate Change shared that typhoon destruction can disrupt the energy supply to water pumps, leading to residents relying on rainwater catchment systems instead, creating breeding grounds for mosquitos, and increasing the risk of waterborne and vector-borne diseases.

Infrastructure Destruction

Palau residents face a threat to their access to healthcare facilities and communication systems as a result of sea level rise and stronger storms. According to a key informant from Palau's Office of Climate Change, most phone lines and other communication systems are located along the coast and are in urgent need of relocation to ensure functionality and reliability. The key informant estimated that most of Palau's communication infrastructure should be relocated in the next five years in order to keep it operationally relevant during a disaster.

In addition to Palau's communication system, the nation's only hospital is located only six feet (1.82 meters) above sea level and is connected to the capital via a single bridge. In 2015, the country identified the vulnerability of the building and in January of 2022, a commission was created to evaluate and plan for a new hospital.[33]

Food Security

Palau's coastal agricultural production is threatened by storm destruction, salt water inundation, and freshwater supply limitations due to climate change. Additionally, rising sea temperatures and ocean acidification negatively impact coral reefs and the size and supply of reef fish that Palauans rely on as a primary protein source.[34]* Local food production in Palau is mostly subsistence-oriented (in 2020, agriculture, forestry, and fishing accounted for 3.3% of Palau's Gross Domestic Product ("GDP"))[35], however, it makes up 15-20% of food consumed nationwide.[36] As air temperatures rise, most crops will require more water to survive. Saltwater inundation and typhoons are especially threatening to taro patch cultivation, which mainly takes place in low-lying, coastal areas. Changes in rainfall patterns will shift traditional planting and harvesting times, disrupting usual food production expectations and cultivation methods. Flooding and heavy rainfall also introduce potential threats from disease and pests that are detrimental to agriculture production.[37]

Housing Security

The increase in the frequency and intensity of typhoons directly threatens residents' lives and destroys coastal homes, decreasing housing supply availability. The aftermath of Typhoon Surigae in 2021 serves as a recent example of the threat typhoons pose to housing in Palau; over 125 families were left without homes and over 1,000 families had significant home damage.[38] According to the IOM, only one in six shelters in the outer islands can withstand typhoon wind speeds. Most shelters are designed to temporarily house those whose homes have been flooded during a national disaster until relief efforts allow those families to return to their homes. As a result, stronger typhoons due to climate change are direct threats to Palauans' lives and residences.

*Reef fishes are also an important factor in maintaining healthy coral reefs (Conservation policies informed by food system feedbacks can avoid unintended consequences), which are important because they serve as important buffers against sea level rise, storm surges, and typhoon impacts.

Economic Disruption

A disruption in Palau's tourism and ecotourism sectors has the potential to increase poverty in the country. Revenue from tourism is equivalent to 50% of the country's GDP, with coral reef-driven tourism making up almost 45% of GDP.[39] Climate change is expected to cause extensive coral bleaching in Palau over the next twenty years, potentially greatly reducing tourism for this purpose.[40] A drastic reduction in tourism in Palau as a result of climate change's impact on ecotourism may lead to a significant increase in the levels of poverty in Palau, causing additional hardship and creating greater vulnerability.

5.4.2 Existing Risk Reduction Measures

Adaptation and Disaster Preparedness Plans

The Palau Climate Change Policy For Climate and Disaster Resilient Low Emissions Development was created in 2015 as the main policy for proactive climate change adaptation, mitigation, and resilience. The policy was developed in collaboration with stakeholders from multiple sectors, community members, and experts who formed an Ad Hoc Climate Change Committee. According to a key informant from the Office of Climate Change, progress towards the implementation of the outlined initiatives has been delayed due to capacity challenges and Coronavirus Disease 2019 ("COVID-19") disruptions.

The development process was supported by the Secretariat of the Pacific Community, United States Agency for International Development (USAID), Deutsche Gesellschaft für Internationale Zusammenarbeit, Finnish Consulting Group, and local consultants.

Examples of climate change adaptation and disaster management plans and frameworks are listed below:

Plan	Palau Climate Change Policy For Climate and Disaster Resilient Low Emissions Development	Pathways to Sustainable Food Systems in Palau	National Disaster Risk Management Framework	Republic of Palau Second National Communication to the United Nations Framework Convention on Climate Change	Achieving Resilient Agriculture and Aquaculture in Palau
Lead Agency	Working Groups of the Ad Hoc Climate Change Committee	Government of Palau	Government of Palau	Government of Palau	United Nations Development Programme ("UNDP") Pacific Adaptation to Climate Change ("PACC") program
Date Published	2015	2021	2010 (Amended 2016)	2013	2015
Purpose	Outlines goals and Five-Year Action Plan for each sector	Coordinate across sectors, support sustainable livelihoods, eliminate hunger, increase cultural and environmental resiliency	Strengthen national disaster risk management structures and mechanisms to support the improved integration of disaster management and climate change adaptation	National greenhouse gas emissions inventory; Vulnerability, adaptation, and mitigation assessments; Capacity needs and recommendations	A national policy for strengthening food security in Palau as a priority climate change adaptation measure
Key Information	Shares existing climate adaptation projects and plans; Highlights gaps and opportunities	Outlines pathways to success; Suggests plans and practices for Executive Branch Agencies	Development, review, and testing of emergency response plans, including contingency plans for business continuity during and following disasters	Financial and technical limitations restrict research and implementation measures	Strategic goals, objectives, actions, and key implementing agencies were identified based on stakeholder input

Table 5.4.2: Palau Climate Change Adaptation and Disaster Management Plans and Frameworks

Other relevant policies, plans, and trainings include:

- Sustainable Land Management Policy
- National Water Policy
- Action Plan: The Way Forward to a Clean Energy Future
- Republic of Palau Intended Nationally Determined Contribution
- Community-Based Disaster Risk Reduction Training Program

Addressing Water Security and Sanitation

Concerns over water and wastewater management, including water demands outstripping supply and water quality issues, have been the subject of numerous projects in Palau. Previous projects include a Water Sector Improvement Program in 2017 supported by the Asian Development Bank ("ADB").[41]*

The ADB currently has an ongoing Koror–Airai Sanitation Project, which is intended to improve wastewater and sewage systems for health and environmental reasons.[42]†

The U.S. Department of the Interior, Bureau of Reclamation, Office of Insular Affairs is working with Palau Public Utilities Corporation ("PPUC") to evaluate the aging infrastructure of water treatment plants and their capacity in order to be able to suggest upgrades and improvements necessary to provide clean drinking water in Palau.[43]

In 2018, Palau began a project to update school evacuation shelters with water systems to provide drinking water during emergencies. Prior to that, none of the designated centers had water collection or filtration systems.[44]

Addressing Poverty

In 2006, the last year for which statistics are available, 24.9% of Palau's population was earning below the poverty line of U.S. $244.67 a week per household.[45] In 2015, Palau identified the United Nations' first Sustainable Development Goal, which is the eradication of poverty, as their focus area by 2030. The goal is to reduce poverty by 50% in that timeframe.[46]

According to the "Pathway to Palau 2030" report, there is a gender-based income gap of 18%, despite society being traditionally matrilineal.[47] Among the partners working to reduce poverty and gender-based income inequality in Palau is the Government of Australia, which has developed a program in partnership with the Palau Chamber of Commerce to fund women-led local businesses and enterprises.[48] In addition to foreign partners, reforms are being proposed to change the laws in order to allow women the right to use personal assets as collateral for business loans.[49]

*The project was reported to be successful in terms of services and operations, although the reporting and monitoring of water supply from PPUC were lacking, leading to some uncertainty as to the final overall success of the program.
†Koror and Airai are the two largest cities in Palau.

Addressing Food Security

Researchers at Palau Community College are exploring taro species that are more resilient in brackish water and developing processes for agricultural production in more upland regions. They created crop production manuals for Palauans and are also identifying opportunities to connect agricultural production with the tourism industry to support local livelihoods.[50]

According to a key informant from PICRC, drainage to prevent saltwater intrusion or standing water is viewed as more important than moving taro patches or building barriers to protect them. When a taro patch is destroyed or damaged due to salt water inundation, it is often abandoned to give the soil time to drain or flush out. After destruction, cultivation does not always return to community taro patches, and families rely on their own taro patches instead. The same key informant also elaborated that there are programs to supply families with replacement crops after typhoons so that cultivation can continue. There are also programs and workshops to teach women taro patch cultivation and provide them with the necessary tools needed for taro patch maintenance.* To promote self-sufficiency in the face of supply chain delays, there have been workshops to teach women how to make their own taro flour, mayonnaise, and other foods.

In 2020, Palau created the Palau National Marine Sanctuary ("PNMS"), which closed 80% of Palau's Exclusive Economic Zone to all types of extractive activities, including fishing, leaving only 20% open for domestic fishing and a limited number of legacy Japanese fishers.[51] This conservation initiative has had negative unintended consequences on food security; commercial tuna fishing left the area, leading to a lower supply of tuna for consumption and a rise in reef fishing to fill that gap, highlighting the need for sustainable domestic fishing.[52]

5.4.3 Stakeholder and Partner Dynamics

International organizations and other countries' national development aid programs provide Palau's climate change initiatives with funding, expertise, and other support. Palau has particularly strong relationships with the United States, Japan, and Taiwan, as well as Australia and New Zealand.†

Additionally, there are active non-governmental organizations ("NGOs") and traditional civil society organizations. The Palau Red Cross Society ("PRCS") is one of the most important NGOs; as an auxiliary to the government, PRCS is the first organization on the ground after a disaster and is very active in the community. A key informant from PRCS said that Red Cross Disaster Action Teams ("RCDAT"), composed of volunteer community members in each state, have been crucial in helping supply families in isolation with food and necessities during the COVID-19 pandemic and are likewise important following weather-related disasters. A PRCS key informant emphasized the importance of the female members of RCDATs, saying that they are the ones who make sure that reporting happens and the appropriate documents are completed.

*Younger generations' decision to pursue economic or educational advancement elsewhere leads to a loss of ancestral and familial best practices with respect to taro cultivation.

†The relationship between Taiwan and Palau has resulted in diminished tourism from the People's Republic of China.

The National Emergency Management Office ("NEMO") is the government body in Palau tasked with managing and coordinating disaster preparedness, response, and relief efforts.[53] NEMO is working with the National Weather Service Office and PRCS to develop awareness programs, including installing early warning sirens for storms. A key informant from PRCS shared that they are supporting NEMO at the community level by installing a secondary system of early warning bells and training local government and traditional leaders on how to use them in the event that the sirens cease to function. A key informant from USAID noted that they have seen significant progress from NEMO when it comes to early warning awareness systems, which USAID also supported with emergency satellite terminals (Chatty Beetles) to send alerts to outer islands.

Palau is a matrilineal society, and Palauans rely heavily on family and clan connections.* A key informant from the Palau Office of Climate Change shared that, although there might be poverty, homelessness is not a severe issue because families take care of each other so people always have somewhere to go. The PICRC key informant expressed that working directly with families is often easier for long-term projects because they are more likely to continue programs after the initial pilot phase.

In addition to family connections, the importance of traditional clan relationships is evidenced by the social and political importance of the Council of Chiefs and women's organizations, two cultural organizations that maintain traditional power, one inside and the other outside of the democratic governance structure. The Council of Chiefs is composed of one chief from each state (16 total) and serves as an advisory element to the President.[54†] The Council works to preserve traditional ways and helps manage the relationship between national and local-level issues. A key informant from the Office of Climate Change expressed that the chiefs have a moral obligation to take care of their communities and that they also want to draw people from Koror back to their communities.

In parallel to the Council of Chiefs, women's organizations also exist in every state, and every adult woman belongs to her local women's organization.* These organizations work to preserve traditional culture, such as the maintenance of taro patches and reef stewardship, and also provide workshops and trainings to equip women with the tools and knowledge needed to maintain taro patches and other food processes for self-sufficiency, according to multiple key informants.†

A more recent development has been the inclusion of the youth in conversations regarding Palau's future.†† The 2005 National Youth Policy codified the importance of youth participation in national development, uplifting youth voices to understand their needs, and supporting their participation in the decision-making process.[55]

*A key informant from the Palau Red Cross Society stated that the close family connections have made it difficult to stop the spread of COVID-19 – if one family member gets the virus, it is challenging to self-isolate, and so the entire family contracts the virus – highlighting how social interconnectedness can lead to further transmission of communicable diseases.
†The chief for each state is decided by a traditional hierarchy of clans within a hamlet and hamlets within the state.

Civil society organizations were involved in the development of the Palau Climate Change Policy, which created the Climate Change Office as a central governance instrument to facilitate and streamline stakeholder participation. The Palau Office of Climate Change works closely with civil society organizations, NGOs, academic and research institutions, and government ministries to serve as the central coordination hub for climate change adaptation, mitigation, and research projects. Since 2018, the focus has been on supporting projects that address the resource or capacity gap. After a project has been developed, the Office supports stakeholders during the grant-writing process, consults to ensure that the stakeholders' priorities, needs, and interests are being addressed through their project, and reviews proposals to avoid duplicating or overlapping efforts with other projects. The final vetting process is done by the National Environmental Protection Consul–a group of agencies and NGOs appointed by the president–to ensure that the project is aligned with national priorities before it is passed to funding bodies for approval. The Palau Office of Climate Change, a small office within the Ministry of Finance, Bureau of Budget and Planning, works closely with civil society organizations, NGOs, academic and research institutions, and government ministries to serve as the central coordination hub for climate change adaptation, mitigation, and research projects.

See Appendix B for a list of relevant stakeholders and partners.

5.4.4 Identified Gaps and Barriers to Adaptation

Water Security

Palau relies mainly on surface water and has minimal groundwater sources. About 96% of Palau's population has access to public water supply systems. Approximately 80% of the population lives in Koror and Airai, and water supply systems are in poor condition in other areas.[56] Increasing deforestation and urbanization contaminates the watershed, and Palau's water treatment facilities are unable to successfully treat the water supply, resulting in substandard drinking water quality.[57]

Food Security

The COVID-19 pandemic highlighted that supply chain struggles are a particular pain point for the delivery of food and other goods in Palau. A destructive typhoon or other climate change impact that disrupts supply chains would delay delivery times. As President Surangel S. Whipps, Jr. noted in his September 2021 Food Systems Summit remarks: "A short disruption in shipping results in rapid depletion of food stocks; certainly, a lengthy disruption from disasters along the existing supply chains would be catastrophic."

*The cultural and social leadership these organizations exercise is not necessarily reflected in the country's formal governance structure, according to a key informant from The Nature Conservancy (TNC). Similar to the Council of Chiefs, there is a hierarchy within hamlets and states.

†According to a key informant from TNC, women's role and involvement in environmental management have not always been incorporated by Western conservation movements. This was a noted gap in the TNC Northern Reef Fisheries Management Project that they are looking to fill in their next project in the western reef. The same TNC key informant revealed that women are excited to share their resource management expertise with the next generation.

††Defined in the 2005 National Youth Policy as all people between ages 15 and 35.

As previously highlighted, locally-produced foods account for only 15-20% of the resident population's diet. This is driven by low production of fishery, aquaculture, agricultural, and livestock products at a commercial scale.[58] Many families fish and farm part-time, but environmental uncertainty due to climate change impacts make larger-scale food production uncertain and economically risky. Larger scale food system production is mostly dominated by foreign labor, ownership, and investment.[59] Based on conversations with key informants, food and other resources were strained by the major influx of tourists between 2014 and 2016 highlighting the potential vulnerability in the relationship between food security and economic opportunity.

Palauans rely greatly on imported foods, which can be expensive due to transportation costs and have led to greater instances of health issues, such as malnutrition, obesity, cardiovascular and kidney diseases, diabetes, and cancer.[60] Palau does not have the healthcare resources to address many of these growing issues; the only hospital is located in Koror, and patients are flown to hospitals in Guam or Hawaii for more complicated medical procedures. Moving forward, the Palauan government has indicated its intention to harmonize modern technologies with existing cultural traditions to create a more healthy and sustainable food system that supports livelihood development in Palau.[61]

A key informant from the PICRC shared that there are initiatives in place to develop local systems to process, market, and sell the leaf and stalk of taro plants as an alternative to imported vegetables, which creates more opportunities for sustainable agriculture and local livelihood development. The "Pathways to Sustainable Food Systems in Palau" initiative outlines proposed solutions to disincentivize unhealthy foods, transform consumption habits, and support local food production through increased government coordination, public-private and multilateral partnerships, and a greater connection to traditional cultural practices with an end goal of zero hunger, decreasing obesity and other health risks, and increasing local total food expenditures to 75% (up from 16%).[62]

Capacity

The lack of existing capacity and capability among local organizations and community groups is a barrier to outside funding and limits Palau's ability to implement programs. Representatives of the European Union in Palau and PRCS identified the lack of local capacity to implement programs long-term as a vulnerability for disaster management in Palau. As a result of the lack of local capacity, outside organizations rely on experienced and qualified retired civil servants and elected officials to help local Palauan organizations meet the funding requirements of international organizations. A key informant from the Office of Climate Change admitted that there needs to be more reporting and storytelling capability to relay back to donors and other organizations providing support how their funding was used and communicate successes and lessons learned.

Migration

Several key informants identified internal migration as a vulnerability for Palau, especially in the outer islands. According to these informants, most of the migration taking place in Palau is economic migration by working age adults and students looking for socio-economic opportunities. Most working age adults and students are moving to either the capital city of Koror or to the United States.* As a result, a key informant shared that many of Palau's outer islands are primarily inhabited by children and senior citizens. With easy access to economic opportunities outside of the outer islands of Palau, there is increased incentive to leave the outer islands, creating barriers to proper disaster management as the population capable of executing response measures lives elsewhere.

Migration issues linked to a lack of housing in Koror as a result of the land tenure system are a special sensitivity that could lead to instability, according to representatives of the Office of Climate Change in Palau. Palau has two coexisting land systems: a western system based on individual property rights and a traditional Palauan system that is based on communal land ownership and family structures.[63] Furthermore, as the center for economic activity, available land is scarce in the capital city of Koror. Therefore, as climate disasters threaten coastal communities, the relocation of those impacted by these natural disasters requires careful consideration. According to key informants, in these types of scenarios, due to most of the land in Koror being claimed through one of the two land systems, the government is forced to relocate these families to government-owned lands, which tend to be in the marshes along the coast.[64] This results in increased living expenses, less access to public services, and greater vulnerability to natural disasters.

*As a Freely Associated State of the United States, the citizens of Palau can move to the United States with relatively few barriers to entry.

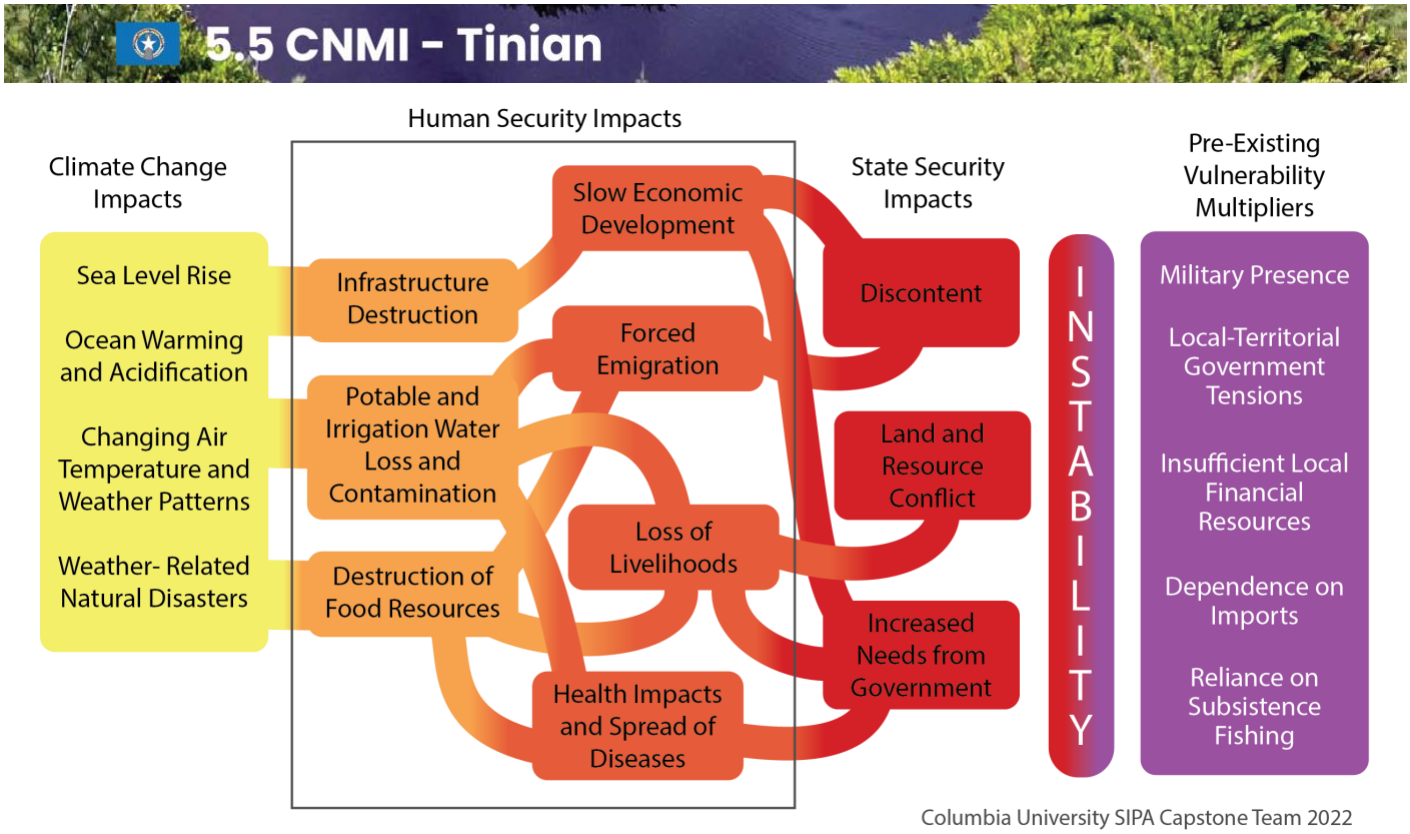

Figure 5.5: Cascading human security threats from climate change that can lead to instability in Tinian and Tinian's pre-existing vulnerability multipliers (non-exhaustive).

5.5.1 Human Security Impacts

Water Security

In the case of extreme weather events, key informants cited water scarcity as the most critical human security impact of climate change. Tinian's water supply relies on groundwater and captured rainwater, and a single water reservoir supplies drinking water.[65] The island's water infrastructure is unreliable as a result of insufficient municipal resources, making it vulnerable to typhoons. Local key informants pointed towards the risk of groundwater salinization due to sea level rise, potential groundwater pollution due to toxic waste, a decline in water reserves due to an increase in low precipitation periods, and an increased water demand due to an influx of migrant workers. Potable water is oftentimes imported to compensate for shortages. Consequently, if supply chains are interrupted, Tinian will face a severe water shortage.

Infrastructure Destruction

According to a senior official and local key informants in Tinian and Saipan, Tinian's private and public property is vulnerable to tsunamis and tropical storms. Private property is rarely built to be storm-resilient and is generally rebuilt by the owners individually following storm damage. Given reconstruction lacks individual and municipal resources and often does not follow minimum construction standards, even reconstructed buildings remain vulnerable to storms.

Critical public infrastructure components in Tinian include the harbor, the gas station, and telecommunications and electricity infrastructure. Impacts to the harbor have and will increasingly lead to significant water, food, and gas shortages. According to a local government official, the harbor is not storm-resilient, with deteriorating piers and a deteriorating breakwater. Local key informants reported that after 2018's Super Typhoon Yutu, shipping services were temporarily suspended. This led to food shortages, forcing the population to rely on subsistence fishing. Key informants anticipate that there will be similar shortages in water and gas after a future storm.

Tinian's single gas station is not storm-resilient and lacks a generator large enough to power the station during power outages. The station also lacks a backup tank in case of main gas tank damage.* According to a local government official, this is exacerbated by the lack of mechanics on-island who could make repairs and provide maintenance. Boats belonging to fishers, transport planes, and privately entities-the only means of transport between Tinian and Saipan–rely on gasoline. Shortages will directly impact access to food, water, and other supplies, as well as access to healthcare, given the nearest hospital is in Saipan.

According to a local key informant, U.S. Federal Emergency Management Agency ("FEMA") funds allowed for the reinforcement of Tinian's electricity and telecommunications towers following Super Typhoon Yutu. A local diesel-generated power plant supplies the island with a capacity of 20 megawatts and an occupancy rate of 15% (3 megawatts for the entire community). According to a local government official, diesel import disruptions would impair the functionality of the power plant, which would directly impact any electricity-dependent activity, including water and gas supply.

Food Security

Tinian is 90% dependent on imports for food resources.[66] Local NGO and community representatives reported that a typhoon that affects the region, including Guam, or any other event that disrupts the supply chains, would require the inhabitants of Tinian to engage in subsistence fishing to prevent starvation. While famine has never broken out in Tinian, the threat is present.

In the future, fishing will become more difficult due to declining fish stocks resulting from ocean water pollution and warming. In addition, competition from external commercial fisheries, in addition to the military's plans to convert local fishing grounds into a training area, threaten the livelihood of local fishers. Multiple key informants agreed that should the local population be deprived of subsistence fishing opportunities, vulnerability to extreme weather events and food scarcity will increase.

Multiple key informants noted that threats to water supply would also negatively impact cattle raising and, consequently, food security. During the last severe drought, water supply was sufficient for human use. However, the drought caused a 75%-100% mortality rate in the island's cattle stocks.[67] Food imports currently bridge gaps in food supply; however, if supply chains are interrupted, food shortages will follow water shortages.

*After Typhoon Yutu, it took days until the gas station was repaired and gas supply was reestablished. However, this lack was partly compensated by fuel delivery from Saipan.

5.5.2 Existing Risk Reduction Measures

Adaptation and Disaster Preparedness Plans

Most local, territorial, and federal informants noted that emergency management and response plans exist at Saipan's Homeland Security and Emergency Management ("HSEM") Office. One senior NGO representative mentioned that it appeared that an emergency plan for CNMI was prepared in 2021 by the HSEM Office. However, during the research period, the project team was unable to obtain any territorial emergency management or climate adaptation plans.

Tinian possesses a "Municipal Emergency Operations Plan" ("MEOP"), which structures municipal emergency response. However, one local government official highlighted the lack of standardized emergency response or climate adaptation procedures, emphasizing that extreme weather events are instead dealt with in a reactionary manner based on previous experience. This approach increases the danger of a repetition of past errors and is aggravated by the lack of after-action reports in Tinian, even though the MEOP requires them.

The community has developed informal procedures for extreme weather event response. The mayor initiates emergency warnings by instructing the police and ambulance service to warn the population of upcoming events through loudspeaker announcements. Web-based weather reports are also commonly used to anticipate extreme weather events. Actions taken by the community to prepare for these imminent threats include stocking up on emergency supplies and mobilizing to higher areas.

Even though the dangers of increasing extreme weather events on the island are well known, most key informants, both local and external, agreed that concerns revolve predominantly around daily life, with climate change adaptation being an afterthought. At the same time, resources for effective climate change adaptation in Tinian are lacking. Opinions differ regarding Tinian's preparedness for future extreme weather events. External actors tend to have positive outlooks, while locals expressed doubt.

Some of the disaster management plans applicable to Tinian are listed below:

Plan	Guam Catastrophic Typhoon Plan	Emergency Preparedness, Response, and Recovery Plan	Resources for Climate Resilience	Municipal Emergency Operations Plan *(not publicly available)*
Lead Agency	Governor of Guam, FEMA	CNMI Department of Community and Cultural Affairs/Child Care and Development Fund (CCDF) Program	FEMA	Office of the Mayor of Tinian and Aguiguan
Date Published	02/2018	06/2019	12/2021	10/2019
Purpose	To facilitate effective and efficient response and recovery operations in response to a catastrophic typhoon strike on Guam and CNMI	To provide guidelines and information to assist child care providers in preparing and responding, appropriately, effectively and efficiently to an emergency/disaster.	To provide a roadmap of FEMA programs and initiatives that advance community climate resilience.	To provide guidelines for the island of Tinian and Aguiguan before, during, and after any natural or man-made disaster, so that the entire community is able to mitigate, prepare, respond, and recover with minimal obstruction.
Key Information	Outlines a process for activating and deploying resources and capabilities to save lives and restore the region's critical infrastructure.	Outlines what steps CCDF takes before, during, and after emergencies, including the coordination and communication in the event of a disaster or emergency and other core functions.	Provides a short description of FEMA programs, program application eligibility, guidelines, and tools.	Describes how local disaster response in Tinian is structured.

Table 5.5.2: Tinian Disaster Management Plans

Trainings and Exercises

Multiple governmental representatives stated that in the past, under the auspices of the HSEM Office, there have been annual typhoon and tsunami exercises involving the Red Cross, FEMA, schools, local government agencies, and U.S. military forces from Guam. Doubt was expressed as to whether these have occurred since COVID-19. The HSEM Office evaluates the exercises; however, it appears that contacts in Tinian have not received the results.

FEMA has been training local authorities in Tinian to manage extreme weather events. The main objective is training on the administrative procedures to obtain external assistance. According to local government officials, this training is well received and contributes to building resilience on the island. FEMA is also currently carrying out internal training in disaster response coordination for Tinian. However, the details of this training and related plans are classified.

The overall impression of local key informants is that better coordination between local stakeholders in Tinian, territorial stakeholders on Saipan, and federal/external stakeholders is needed to make Tinian more resilient in the long term. When asked, a local community official expressed strong doubt that Tinian is better prepared for the next super typhoon.

Addressing Water Security

A local government official pointed toward a project to harden the road above the main island's waterline to protect water distribution in case of extreme weather events. Furthermore, one additional water reservoir is currently being built to diversify water access. One local community member cited individual residential water tanks as a beneficial mitigation measure, as these could be filled by rainwater and could supply the community in times of water scarcity, but indicated that no plans existed to implement this project.

Addressing Housing

FEMA piloted a project in Tinian in which local families were either assisted with resources or provided with storm-resilient homes. However, according to several NGO officials, this project was discontinued due to high costs.

Addressing Infrastructure Vulnerabilities

Local authorities currently coordinate with the DoD on harbor repairs and upgrades. According to a local government official, it is also considering allowing the local population access to the harbor's main gas distribution terminal in the event the gas station is inoperable. To mitigate gas shortages, gas is usually stocked before extreme weather events.

According to a senior official, there are plans to move Tinian's power supply underground in the near future, starting with the power supply to all government buildings and critical infrastructure by the end of next year. If Tinian receives additional funding for this project, private households will also be connected to the underground grid.

Addressing Food Security

Several projects have been launched in Tinian to reduce dependence on food imports. A local community representative pointed to a harbor project in which the marina is to be converted into a spawning area for fish. However, the local harbor breakwater, which serves as a natural shelter for fish spawning, needs to be renovated for it to succeed. Training programs are currently underway to teach island youth subsistence vegetable gardening.

5.5.3 Stakeholder and Partner Dynamics

Tinian's disaster response relies on local (Tinian), territorial (Saipan), and federal/external (U.S. mainland, international) stakeholders. Communication is coordinated through the territorial government on Saipan. Whereas national-level key informants described a good working relationship with Saipan, local key informants pointed to opportunities for improvement between the local and the territorial level.

On the local level, individual reconstruction efforts after extreme weather events dominate. Houses are rebuilt either individually by the residents or with the help of the local community. Local efforts are coordinated by the mayor. The mayor and subordinate authorities have the operational responsibility for coordinating disaster response on the island and are the point of contact for the territorial authorities on Saipan. The interviews indicated that the local stakeholders work very well together, trust each other, and form a cohesive unit. However, they lack the political power and material and financial resources to provide effective disaster response independently.

While the mayor has operational responsibility for disaster response in Tinian, strategic management is led by the HSEM Office on Saipan. It coordinates disaster exercises, maintains disaster management plans for Tinian, and is the primary point of contact for federal/external stakeholders. Tensions exist between Tinian's dependence on territorial political decisions and resources and the way Saipan coordinates with Tinian. According to key informants in Tinian, communication between Saipan and Tinian needs improvement. Emergency plans available in Saipan were largely unknown in Tinian, and disaster assistance from Saipan was perceived as chronically delayed and insufficiently adapted to Tinian's uniqueness. Therefore, there is a desire locally to obtain the political and material resources to establish their own strategic disaster management office and to gain more independence in general. When asked if there could be increased potential for conflict in Tinian due to future climate change impacts, one key informant responded that it was unlikely that conflict would occur in Tinian: if conflict were to occur it would be between Tinian and Saipan.

Finally, both FEMA and the American Red Cross play an important role in Tinian by providing the necessary resources for disaster response. Both organizations have a local office on Saipan and work closely with the HSEM Office. According to Red Cross officials, the collaboration between FEMA, the American Red Cross, and the HSEM Office is effective and has even improved following Hurricane Katrina, with resources and personnel deployed to Saipan days before extreme weather events occur to ensure a prompt disaster response. However, interviews conducted suggest federal resources are slow to get from Saipan to Tinian.

See Appendix B for a list of relevant stakeholders and partners.

5.5.4 Identified Gaps and Barriers to Adaptation

Military Presence

The relationship between the military and the local population can be described as mixed. While some key informants highlight the military's economic and developmental support, especially in infrastructure projects (such as landfill management, breakwater renovation, or road construction), others mention existing tensions. These are mostly described as a perceived lack of communication and transparency towards the local population regarding the environmental impact of military training in Tinian. Local key informants indicate that the lack of transparency leads to a feeling of being ignored. This is further amplified by the perception that the military is not fully committed to meeting obligations to the local population. For example, a local community organization representative noted that the military had created an expectation that they would provide construction of a local hospital and access to schools on the military base in exchange for large tracts of land in Tinian, but as of yet, these expectations have gone unmet.

Four military projects in particular strain the relationship between the local community and the military: the CNMI Joint Military Training (CJMT), the Mariana Island Testing and Training (MITT), the Mariana Island Range Complex (MIRC), and the Divert Airfield. All four projects, but especially MITT and MIRC, were identified by local key informants as a potential threat to indigenous survival in Tinian. Implications of military projects that exacerbate previously mentioned climate change impacts include the reduction and contamination of land and fishing areas, risks to food security, health hazards from aircraft noise, contamination of groundwater, threatened water security, physical and chemical destruction of (ocean) flora and fauna, beach erosion, and the reduction of recreational areas and associated loss of tourism. Several local community members noted that a loss of subsistence fishing areas due to the expansion of military areas, in particular, would have a significant impact on food security in Tinian in the event of a disruption to supply chains.

Key informants indicated that the military has recently opened up to discussions with local communities regarding the environmental consequences of CJMT and has greatly scaled down training ambitions. Nonetheless, there is concern that a more environmentally friendly CJMT would have a minimal impact unless the CNMI were excluded from MITT and MIRC, as all three projects involve the same territory.

Decline in Tourism

The decline of tourism in Tinian can exacerbate vulnerability to the aforementioned climate change-induced human security threats by reducing individual economic power and can potentially increase discontent towards the military. According to local government officials, tourism is one of the most important sources of income on the island. Tourism is not perceived to be threatened by climate change; instead, according to key informants, the sector is threatened by a decrease in labor supply and the CJMT, MITT, and MIRC military programs. Local key informants noted that there are currently five large military ships within sight of Tinian's beaches. The presence of these ships and low-flying military jets make it difficult for the public to attract cruise lines, and the physical destruction of the environment by military equipment decreases the attractiveness of Tinian's flora and fauna. If military activity around Tinian increases, key informants fear that the tourism sector could collapse. This would strain Tinian's struggling employment market, negatively impact Tinian's already low availability of employment, and could lead to further emigration of the local population and heightened anti-military sentiment.

Health

According to key informants, the health situation in Tinian is alarming, with an average life expectancy of 55 years. Key informants attributed this short life expectancy to poor nutrition, lack of health infrastructure, and the military's influence. Tinian is very dependent on external food imports. As a result, most of the food consumed is not freshly produced but canned food. According to local community representatives, the resulting unbalanced diet impacts local health. According to key informants, Tinian has a poorly equipped clinic and no hospital. The nearest hospital is on Saipan, but patients must be flown to Guam for more complex procedures. If air service between Tinian, Saipan, and Guam collapses due to fuel shortages or extreme weather impacts, Tinian will not have access to adequate health care.

In addition, the military presence was cited as a factor detrimental to health by key informants. Key informants mentioned concerns about possible groundwater and soil pollution caused by military waste, as it is believed that the local population is exposed through local agriculture and drinking water. Reduced air quality was also mentioned as a concern. Furthermore, local key informants reported psychological health implications connected to the military presence. These included post-traumatic behavioral disorders triggered by shootings and blasts during military training and planes flying low over houses. Because many Tinian citizens have served in the U.S. military and suffer from war experiences, these stressors can place an increased psychological burden on the local population.

Migration

According to key informants, Tinian's local population is approximately 2,000 and falling. Most key informants agree that this is primarily due to a lack of employment opportunities and the U.S. military presence. A key informant indicated that young families do not see a future on the island and decide to leave. At the same time, the military is taking up more and more space on the island. Currently, the military is still renting out parts of its territory to local farmers for agricultural purposes. Key informants expressed concern that with the expansion of testing activities on and around Tinian, these areas will be declared restricted, and the local population will be deprived of even more essential living resources. The same concerns were expressed regarding fishing grounds. These concerns went so far as to suggest that the military could take away the last subsistence fishing grounds from the local population and cause a hunger crisis. In addition, several key informants pointed out that the military presence generally makes life on the island less attractive for families and discourages foreign investors from investing in Tinian. This youth exodus will exacerbate the labor shortage, thereby directly impacting Tinian's disaster response capacity.

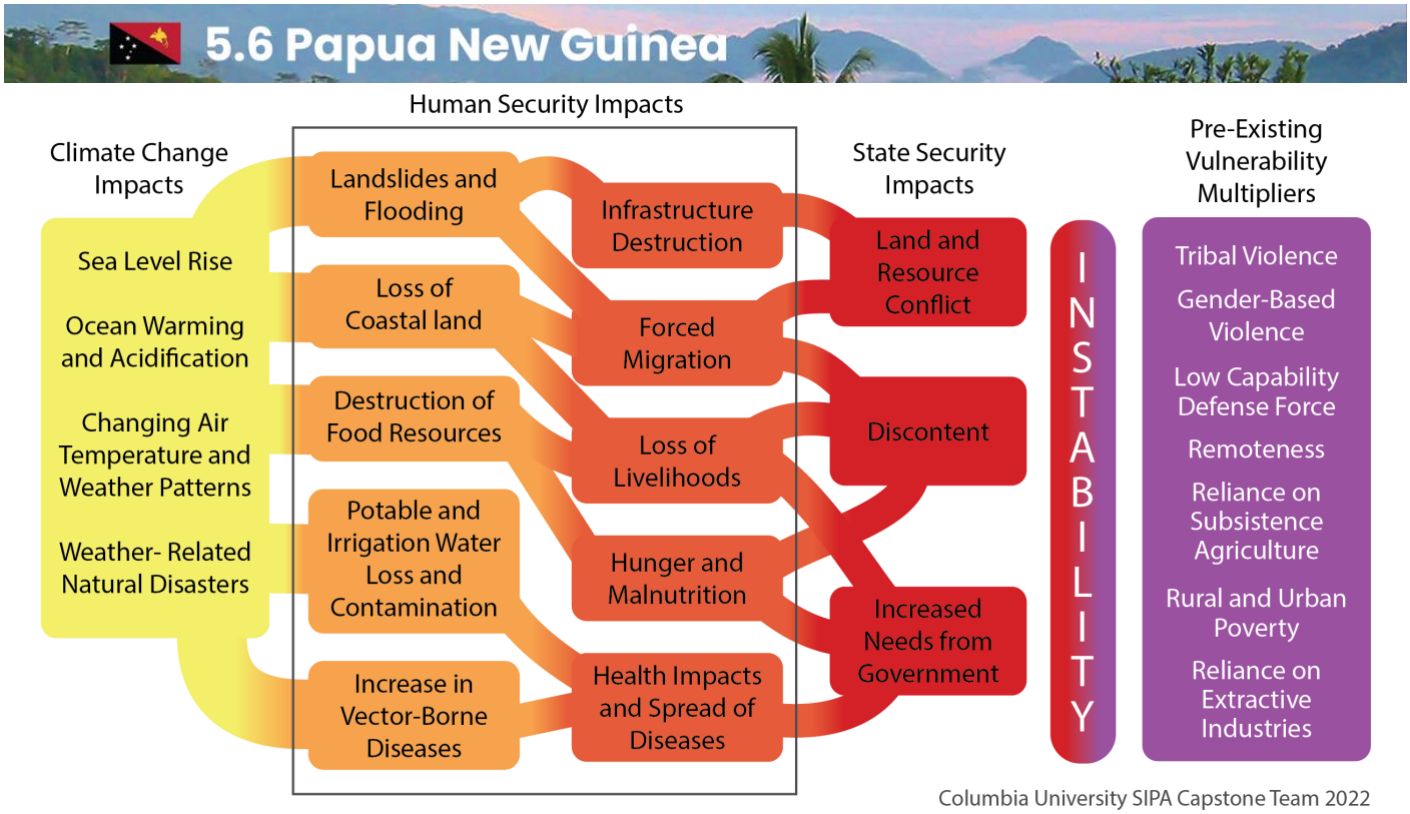

Figure 5.6: Cascading human security threats from climate change that can lead to instability in Papua New Guinea and Papua New Guinea's pre-existing vulnerability multipliers (non-exhaustive).

5.6.1 Human Security Impacts

Water Security

PNG has the lowest rate of piped water in the Pacific region. Less than 40% of the population has access to safe drinking water.[68] Sea level rise and salt water intrusion in coastal regions will eventually destroy freshwater resources and affect up to 30% of the population. There is already evidence that barrier islands, such as Tasman and Mortlock, would be completely submerged under some estimates of sea level rise.[69]

Contamination of potable water sources is also a serious challenge in PNG. Health experts have warned of potential outbreaks of waterborne diseases, including cholera, dysentery, and diarrhea due to the consumption of unsanitary water. Standing water caused by heavy rains creates breeding grounds for mosquitoes, increasing the spread of tropical diseases like malaria, which infects 1.7 million people in PNG annually. Higher temperatures and wetter environments have led to the detection of malaria in the PNG highlands where it was not previously present. Scientists forecast that further temperature increases over the next 20 years will worsen the impact of malaria for those living in previously low malaria risk zones.[70]

Increasingly frequent and severe droughts caused by the seasonal El Niño Southern Oscillation ("ENSO") and rising temperatures will have an impact on PNG nationwide, affecting the viability of crops and access to drinking water, and could lead to widespread forest and grass fires. During dry seasons and droughts, rivers and connected waterways may become impassible, leading to a breakdown in vital transportation and trade between coastal locations.[71] PNG's Second Nationally Determined Contribution under the Paris Climate Accord, released in 2020, acknowledges the challenges to water security from climate change. The country's 2030 target is to ensure that 10% of the population has "increased resilience" with respect to water security, but also acknowledges that improvements to technical approaches and the ability to widely replicate pilots are significant barriers to success. Freshwater depletion or destruction will displace communities and increase internal forced migration, exacerbating social problems and tribal conflict.[72]

Environmental and Infrastructure Destruction

Climate change will exacerbate existing challenges surrounding environmental degradation and infrastructure vulnerabilities. There are real concerns for the ability of PNG's land resources to support communities in the future, especially given PNG's forecasted population growth.* Currently, PNG is experiencing rapid climate change related environmental degradation which is heightened by human-induced deforestation. Each year, 50,000–60,000 hectares of forested land are cleared for agriculture, logging, mining, and infrastructure purposes. Not only does forest degradation negatively impact biodiversity, but it also increases the frequency and severity of inland flooding and landslides.[73]†

Landslides and flooding are common occurrences in PNG, especially in the mountainous highland regions. Changes in rainfall patterns and increased deforestation are expected to make landslides and flash flooding more frequent, with the potential to severely damage vital infrastructure, upland forests, residential areas, and agricultural land, and cause significant casualties. In 2014, the PNG government estimated that 6,000-8,000 people are displaced by inland flooding each year, costing at least U.S. 8-12 million annually.[74] These events are especially dangerous to rural highlands communities that are already inaccessible due to PNG's rugged terrain. The remoteness of these communities and the lack of communication capabilities and infrastructure hinder rescue and recovery operations. Additionally, land slippage and landslides caused by extreme weather are increasingly cutting off rural communities from main towns.

Even major thoroughfares in PNG, including the Highlands Highway, the sole lifeline for the highland communities and export businesses, are susceptible to these environmental disasters.[75] Key informants from the Climate Change and Development Authority ("CCDA") and the IOM highlighted the vulnerability of PNG's existing transportation infrastructure to the impacts of climate change, noting that most roads and bridges were not constructed to withstand the expected changes in rainfall. Interviews with key informants indicated that the increase in landslides and resulting decrease in habitable land has led to competition over land, inflaming tribal tensions in some regions.

*UNFPA estimates the population will reach 13 million by 2032.

†Biodiversity in PNG accounts for 5 - 7% of the global biodiversity

Food Security

Papua New Guinea's economy is dominated by the agricultural sector. More than 80% of PNG's population is employed informally as subsistence farmers, while agriculture accounts for nearly 13% of total export earnings.[76] Earnings from the cultivation of Copra, coffee, cocoa, rubber, and oil palm, and subsistence crops such as sweet potato, cassava, taro, and yams sustain nearly 85% of the population.[77] PNG has the potential to meet food needs largely through internal production, but this self-sufficiency also requires a stable climate to ensure reliable agricultural outputs.

Climate-change induced fluctuations in temperature and rainfall have a significant impact on the growth of plants, including key subsistence and cash crops. There is already substantial evidence that a decline in soil productivity has adversely impacted staple food crop yields like sweet potato.[78] Climate change-induced weather patterns have additionally led to shorter time for crops to mature, leading to a lower overall agricultural output. Sea level rise has also affected agricultural production, contributing to salinization and infertility of coastal soils.[79]

The deterioration of mangrove systems and coral reefs by sea level rise and acidification, and the resulting depletion in fishery stocks, will further threaten food security in PNG. According to a senior government official, the current depletion in fishery stock in PNG has already caused millions of kinas of lost revenue.*

Loss of agricultural productivity will exacerbate cases of hunger and unemployment. According to the Global Hunger Index, PNG already has a "serious" hunger issue and undernourishment rates are growing.[80] These issues are compounded by PNG's population growth rate of around 1.9% annually and the declining amount of arable land in the nation; in 2018 only 0.6% of the total land in PNG was classified as arable.[81] As agricultural output is strained by the effects of climate change, the growing population of PNG will convert more and more land for agricultural use, furthering environmental degradation.[82] Rural communities will struggle to switch to new climate resilient crops and farming practices, adopt effective irrigation methods, and acquire cultivable land.[83] As a consequence, communities may be forced to migrate for better economic opportunities. Furthermore, key informants from USAID expressed concerns that rates of gender-based violence will increase as men are increasingly disenfranchised by the effects of natural disasters and climate changes on their livelihoods, believing that such disenfranchisement will lead to physical abuse and neglect.

Forced Migration

The Internal Displacement Monitoring Center anticipates that almost 31,000 people will be displaced annually in PNG due to sudden onset hazards like floods, landslides, and earthquakes.[84] This figure is perhaps an underestimate; in late 2021, king tides displaced more than 53,000 people in Bougainville, Manus Island, East Sepik, and New Ireland Provinces alone.[85] Such forced migration from disasters adds to the numbers of those displaced within or from PNG due to violence; in 2020, over 14,000 people were displaced by conflict nationwide.[86]

*1 Papua New Guinea Kina = 0.2842 U.S. Dollar

Increased incidence of flooding, droughts, landslides, and destruction of communities due to sea level rise will increase the number of internally displaced persons in Papua New Guinea in the coming decades.[87] Already, PNG has had to manage large-scale relocations in the Manam and Carteret Islands due to volcanic eruptions and the threat of inundation due to sea level rise, respectively.*

Compounding the risk of significant forced internal migration in PNG is the country's traditional land tenure system. Some 97% of land in Papua New Guinea is held by customary traditional title and passed through patrimonial or matriarchal lines.[88] With 82% of the population relying on agriculture for income generation and food, land access is critical and often intertwined with conflict and violence in PNG.[89] A 2015 IOM report highlights the connection between climate change and conflict in PNG, citing that "relocation[s] of large number of people displaced due to environmental degradations caused by environmental change have been triggering tension and conflict between migrants and customary landowners."[90]

Thus, as climate change continues to increase rates of internal migration in PNG, both government and NGOs are struggling to navigate relocating communities in ways that do not contribute to increased violence. As one key informant from the United Nations Development Programme ("UNDP") described, "the land tenure system is part of every single conversation in PNG. It is a real challenge here." Relocation programs are perceived to be more time- and resource-intensive due to the complexity of negotiating over land and tribal differences.

An interesting and complex challenge is the future of relocated communities. One key informant from the IOM described the potential for future disputes of current land sharing agreements for displaced people saying, "due to the informal nature of the land tenure system there is no guarantee that future generations will honor [these] agreements." This indicates the potential for further land conflict and potential violence, especially as arable land for farming becomes less abundant.

*The Carteret Islands communities have been referred to informally and in the media as "the world's first climate refugees." However, both key informants and literature expressed that "refugee" is not a correct term for these communities under international law. Further, the affected community reportedly felt marginalized by the label. Therefore, "migrants" or "displaced persons" should be used instead.

5.6.2 Existing Risk Reduction Measures

Adaptation and Disaster Preparedness Plans

In 2015, the Climate Change (Management) Act became law in Papua New Guinea, establishing the CCDA as the National Designated Authority for coordinating efforts related to climate change. The Act established nine priority climate adaptation areas: coastal flooding and sea level rise, inland flooding, food insecurity caused by droughts and inland frost, cities and climate change, climate induced migration, damage to coral reefs, malaria and other vector-borne diseases, water sanitation and hygiene ("WASH"), and landslides. These areas form the basis for PNG's current climate change and disaster plans, a selection of which are detailed below.

Plan	PNG Nationally Determined Contribution ("NDC")	PNG National Adaptation Plan ("NAP") *(Not publicly released)*	PNG Vision 2050	PNG Disaster Risk Reduction Framework 2017-2050	Papua New Guinea – Australia Climate Change Action Plan
Lead Agency	CCDA	CCDA	National Strategic Plan Taskforce	National Disaster Centre	Governments of Papua New Guinea and Australia
Date Published	2020	TBD	2009	2017	2018
Purpose	International Communication of PNG's Climate Change Mitigation and Adaptation Contributions.	Internal planning process to identify, address, and review PNG's evolving adaptation needs.	40 year development vision for PNG, based on 7 pillars, including one on environmental sustainability and climate change.	Reduce Disaster Risk Nationwide: Provides 6 National Targets for Disaster Risk Reduction, Guiding Principles, and the Roles of Stakeholders.	Solidifies a joint commitment between PNG and Australia to work together to advance climate change mitigation efforts.
Key Information	Highlights gaps and shortfalls in PNG's capabilities that can be addressed by international support	PNG's NAP has not been formalized and is still under development.	Sets a long-term strategic plan for economic, political, and cultural development that has informed the development of other plans.	The plan's accompanying "Action Plan" that will "operationalize" the framework has not been released.	Prioritizes capacity building of PNG national, provincial and local governments to address the impact of climate change.

Table 5.6.2: PNG Climate Change and Disaster Management Plans

Additional Relevant Plans, Policies, and Strategies

- National REDD+ Strategy
- National Strategy for Responsible Sustainable Development
- Medium Term Development Plan III (2018-2022)
- Papua New Guinea Development Strategic Plan 2010-2030

Addressing Water Security

In recognition of the critical need to preserve access to clean, potable water, stakeholders have cooperated on several initiatives aimed at addressing climate-induced irrigation and drinking water shortages. For example, the PNG Solar Powered Seawater Desalination Plants Project introduced ten solar-powered salt water desalination plants in Manus Province to solve the most basic needs of the local communities. As of 2018, the project, funded through the Pacific Environment Community Fund, provided access to fresh and safe drinking water to 4,965 people.[91]

The European Union and German Governments partnered with the CCDA to provide a similar program between 2016 and 2018. The Integrated Water and Sustainable Energy Program supported the socio-economic development of four rural communities in Rigo District, Central Province, to reduce their vulnerability against climate change impacts through the provision of reliable, sustainable water and clean energy.[92*]

Addressing Infrastructure Vulnerabilities

Much of PNG's existing infrastructure is endangered by landslides and flooding. There are several past and current projects to address specific vulnerability points in communities. However, PNG's national roads, bridges, airports, and ports would benefit from investments which increase their resilience and capacity to sustain emergency operations.

The ADB has recently proposed phase two of its Highlands Region Road Improvement Investment Program. The Program is a continuation of phase one, which rehabilitated and upgraded the Highlands Highway, mentioned above as a vital artery for transportation on PNG. Phase two efforts will improve about 289 miles (465 kilometers) of the Highlands core road network, including the reinforcement of bridges, footpaths, and drainage capabilities, thereby improving connectivity for rural highlands communities.[93]

*There are also several proposed programs to address water security, including the *Urban Water Supply and Sanitation Project* currently proposed by the Asian Development Bank and the *Implementing Integrated Water Supply and Hybrid Energy Systems for Household and Farming Irrigation for the Ten Most Drought-Affected Communities in the Oriomo-Bituri LLG of South Fly District in Western Province, PNG* project put forth by the Green Climate Fund ("GCF"). The GCF project will address food and water security to develop adaptive capacity throughout longer drought periods. This project aligns with the National Food Security Policy 2017-2026.

Addressing Food Security

PNG's National Food Security Policy 2017-2026 prioritizes addressing the impact of changing weather patterns on food production and stability of food supply. Pursuant to the aims of the National Food Security Policy, the Department of Agriculture and Livestock ("DAL") established the National Food Security Program which is also supported and complemented by donor-funded bilateral and multilateral food security programs. One of the main goals of the project is to ensure the integrated management and sustainable use of land, water, fisheries, and forest and genetic resources.[94]

The DAL additionally oversees the Climate Smart Agriculture Program, which is funded by the Australian Centre for International Agricultural Research, which aims to facilitate the "use of seasonal climate information in Papua New Guinea farming communities to inform food production decisions and by doing so improve food security outcomes for rural communities." The project will run from March 2019 to December 2023.[95]

Addressing Forced Migration

The UNDP and IOM, along with various international funding partners are implementing disaster risk reduction programming in communities across PNG to prevent and reduce forced migration alongside programs to support communities that have no choice but to migrate. In 2015, IOM published the Assessing the Evidence: Migration, Environment and Climate Change in Papua New Guinea, which maps the relationship between migration, environment, and climate change, examines the existing policy framework and offers guidance to include environmental migration in PNG's national planning.[96]

5.6.3 Stakeholder and Partner Dynamics

PNG's challenging topography and cultural milieu have engendered a complex stakeholder environment. There is a multiplicity of diverse actors in the country working in the realm of climate change adaptation and disaster management and many programs are multilateral endeavors involving both local communities and international organizations.

In an effort to streamline climate change policies and actions within PNG, the government established the CCDA in 2015. The CCDA plays a central role in most climate change adaptation projects; however, funding for initiatives often originates from outside organizations such as ADB or U.N. bodies such as the GCF.

The central government has also established national disaster management bodies, including the National Disaster Committee and National Disaster Center, which serve as forums for the coordination of relevant agencies across the government. However, actual planning, mitigation, and training activities typically take place on the provincial level and are carried out by 22 Provincial Disaster Centers.*

*For example, in fall 2019, the Strategic Program for Climate Resilience's Building Resilience to Climate Change ("BRCC") in PNG program facilitated provincial level trainings in the Autonomous Region of Bougainville and the East New Britain, Manus, Morobe, and Milne Bay Provinces. The trainings focused on climate change, disaster risks, and vulnerability assessments and safeguards and involved representatives from national agencies including the CCDA, international organizations, local governments, NGOs, and provincial authorities.

Due to the obstacles associated with government intervention in rural communities, provincial and local actors, including local tribal councils and NGOs, are very involved in disaster management and climate change adaptation programs in their communities. Any conversation about programming must involve local partners, as the central government's reach remains limited and the customary land tenure system complicates implementation.

Several key informants explicitly mentioned that a significant amount of on-the-ground disaster relief work is undertaken by NGOs, specifically by church-based organizations. These faith-based groups are unique as they have representatives in most provinces and districts of the country and have fostered trusting relationships with rural communities. Unfortunately, despite the critical role NGOs play in disaster response, a key informant noted that the number of active NGOs in the country has dwindled in the past ten years due to the decreasing availability of funding.

Unlike in Palau and CNMI-Tinian, the United States is not the primary development partner in PNG. Geographic proximity and historical linkages have created a unique relationship between PNG and Australia. Australia is PNG's most significant trading and commercial partner, with bilateral trade worth U.S. $4.96 billion in 2018 and total Australian investment in PNG totaling over U.S. $12.5 billion. The two countries have several bilateral agreements in relevant areas of critical infrastructure, climate change, and defense, and 2022 marks the 43rd anniversary of the Papua New Guinea-Australia Defence Cooperation Program.[97] PNG's National Defence Force ("PNGDF") was modeled after the Australian Defence Force, which continues to support PNG forces through joint training and exercises.[98]

In terms of climate change adaptation, Australia has provided approximately U.S. $149.4 million in bilateral climate change and disaster resilience support to PNG since 2016. This support is delivered through programs in infrastructure, education, private sector development, food security, energy, governance, health and community sectors, and direct investments under the PNG Climate Change Portfolio.[99] In 2018, representatives of both governments signed the PNG-Australia Climate Action Plan, which provides a high-level framework for information sharing and cooperation on climate change action. Additionally, Australia supports the PNG public sector to build capacity in climate change policy management by placing an Australian climate change advisor in the CCDA.[100]

The People's Republic of China has recently made efforts towards strengthening its relationship with PNG. On February 5, 2022, government representatives from China and PNG signed a joint statement that reaffirmed the countries' relationship and joint efforts to towards sustainable development, and included a declaration that China will continue to assist PNG in building the necessary capacity to address climate change under the "South-South cooperation framework."[101] While several Chinese-funded development projects were established prior to the signing of this joint statement, a key informant from the U.S. Embassy in PNG estimated that Chinese investments into PNG infrastructure projects will continue to increase as the effects of climate change compound.

See Appendix B for a list of relevant stakeholders and partners.

5.6.4 Identified Gaps and Barriers to Adaptation

Capacity and National-Local Disconnect

While there are many climate change, development, and disaster plans that acknowledge the human security risks of climate change, there is a disconnect between national planning efforts and the implementation of adaptation and risk reduction activities in at-risk communities. Officials with both the IOM and UNDP cited the national government's lack of funding and the struggle to reach remote areas of the country as significant drivers of the disconnect, with one official saying, "the government does not have the funds, they only have the policies."

Key informants also pointed to the siloing of government agencies and overlapping mandates as challenges that create confusion around responsibilities and hamper response and adaptation capabilities. Research points to a lack of alignment between the implementation of development and climate policies, given limited resources and capacity to convert good policies into tangible, integrated programs. Key informants additionally stressed that it is difficult for local communities to integrate and continue certain projects following the end of official funding programs. Gaps in national policy have also been associated with "uncertainty, delay, and duplication of the roles" in disaster response.[102] Lack of coordination on climate change action and financing is a partial product of institutional memory loss within government agencies due to high staff turnover, transfer, and promotion.[103]

The capacity of the national government to implement climate change and disaster planning is evident in CCDA's prioritization of flooding, food security, and landslides over other hazards identified by the CCDA due to the agency's capacity to manage programs. A CCDA official highlighted the geographic challenges of PNG that make program implementation difficult for all development partners. At the same time, multiple key informants indicated that programming often took place in easily accessible communities, leaving rural areas underserved and potentially more vulnerable to climate change impacts. The low capacity of the government to implement planned disaster risk reduction or climate adaptation programming is further hindered by the inaccessibility of most of PNG.

Inaccessibility

Many key informants highlighted the country's remoteness as a significant obstacle to climate change adaptation and disaster response. IOM staff, who have been conducting disaster preparedness training in PNG, cited the time and financial constraints of long travel to remote areas as an explanation for why there are so few trainings. Additionally, according to a key informant, the customary land tenure system requires extensive consultation and face-to-face discussion with rural communities to build trust. Furthermore, a key informant explained that once a development organization reaches a community, they are faced with the challenge of accurately communicating complex information. They also mentioned that low literacy rates among rural populations affects a community's capacity to understand the programs that development organizations are trying to deliver. Projects require significant lead time as a result.

Key informants also pointed to gaps in infrastructure as a contributing factor to the inaccessibility of PNG. One key informant explained that many highland communities are only accessible via helicopter, while six-hour-long boat rides separate some coastal communities. Only twenty-one of PNG's hundreds of airports and airstrips are paved, and there is only one airport in PNG, Jackson International Airport in Port Moresby, that has the capacity for international disaster response.[104] Water travel is essential to daily life in a nation with over 600 islands. However, there are only twenty-two declared ports and only six of those are able to host significant emergency operations.[105]

Capacity of PNG Defense Force

PNGDF has approximately 3,000 personnel, a very small number for an island nation with an exclusive economic zone of 1.19 million square miles (3.1 million square kilometers) and of atolls and islands.[106] A key informant described the PNGDF as being "stretched thin" and believed the number of personnel in the PNGDF was too low to effectively respond to emergencies.[107] Inadequate funding, capacity, and training have "severely undermined" the PNGDF's capacity to act as disaster first responders. A key informant liaising with the PNGDF shared concerns about the force's ability to respond to disasters, saying response in PNG is "so bureaucratically hard to navigate." Notably, multiple key informants believed that the PNGDF was not focusing on the security impacts of climate change in the region and was unprepared to meet the challenges that could arise from climate change.

Existing Conflict and Gender-Based Violence

Conflict is a significant driver of migration in PNG. The International Committee of the Red Cross ("ICRC") estimates that over 30,000 people were displaced by violence in PNG's Enga, Hela, and Southern Highlands provinces in 2021 alone. While violence between ethnic and tribal groups is not new to PNG, the ICRC cites the large population of youth (over 50% of the population is below 24 years of age), rapidly changing social and economic conditions; and the introduction of modern weaponry as reasons for a significant increase in conflict over the past 20 years.[108] When communities are forced to relocate due to climate change, tribal violence makes resettlement more difficult and relocated communities may exacerbate existing tensions over land and resources, fueling more violence.

Over 70% of women in PNG are estimated to be victims of rape or assault during their lifetimes, while over 1.5 million people experience GBV.[109] Recent research suggests that climate change could exacerbate GBV worldwide, and key informants from USAID shared this concern for PNG specifically, citing that natural disasters can affect incomes and create interpersonal conflict as disenfranchised men express frustration and anger as violence toward women.[110]

Contradictions Between Environmental and Economic Goals

Balancing the government's desire for economic development, the needs of communities and resource owners, and environmental sustainability presents a tremendous challenge. Some 40% of PNG's population live in poverty, yet PNG is a resource-rich country. The logging, mineral, and energy extraction sectors account for most of PNG's export earnings and GDP and continue to provide current and future opportunities for economic growth and engagement in foreign markets.[111] However, these extractive industries require large-scale deforestation and further contribute to the degradation of PNG's biodiversity. While counterintuitive to PNG mandates on addressing climate change, key informants point out that the government must prioritize the population's immediate needs, especially when it comes to economic development.

6. Recommendations

6.1 Palau

Integrating Monitoring and Evaluation Into Standardized Procedures

According to key informant interviews, there are many opportunities to strengthen critical infrastructure elements in Palau. Vulnerable areas include the communications system, the hospital, and roads in coastal areas. These elements will benefit from further evaluation regarding their potential relocation and needed resiliency upgrades. Subsequently, there are opportunities to strengthen Palau's capacity to properly maintain these infrastructure projects moving forward. Inadequate monitoring, evaluation, and reporting procedures make it difficult to assess the success of past infrastructure projects and current maintenance needs. There is also a noted gap in information gathering and after-action reporting. In conjunction with infrastructure upgrades, further training, process development, and capacity building should be implemented to improve the oversight of ongoing operations. These initiatives should also create opportunities for learning from past project challenges and best practices to ensure gaps are filled.* A progress report for the projects outlined in the 2015 Palau Climate Change Policy, for example, would help highlight opportunities for growth and chart the next wave of climate change adaptation projects.

Capacity and Capability-Building Opportunities

Those in Palau working on climate change issues tend to have multiple roles and responsibilities, which divide attentions and can limit effectiveness. A key informant from the Office of Climate Change expressed that while they have managed climate change impacts so far, an event that compounds multiple crises at once, such as sea level rise-induced coastal inundation in conjunction with a severe weather event, would strain existing systems. Building the capacity and capability of Palauans to address climate change in their current roles would help integrate climate concerns into existing systems, as well as potentially strengthen the pipeline of viable candidates for climate-specific roles. A key informant from USAID emphasized that capacity building takes more than a few weeks of trainings. Years of sustained on-the-ground investment and interactions are needed to see long-term benefits.

Cross-Sector Involvement and Local Stakeholder Consultation

The 2015 Palau Climate Change Policy illustrates the importance of involving stakeholders from all levels of society to devise a climate policy that effectively addresses the human security concerns of the population as a whole. A key informant from the Office of Climate Change highlighted the importance of investing in regular consultations that ensure that those affected have ownership over local problems and solutions. This whole-of-society approach is essential when it comes to land use, as decisions need to be made in concert with residents to avoid tensions between the traditional and Western land management systems. The key informant emphasized that eminent domain would never be accepted in Palau.

Climate change initiatives should additionally recognize the inefficiency of single-sector projects. A key informant from The Nature Conservancy (TNC) explained that a previous focus on marine projects over land projects was less effective than measures that integrate both land and sea resource management efforts. Therefore, cross-cutting projects that invite collaboration between NGOs, civil society groups, and government agencies should be prioritized.*

6.1 CNMI-Tinian

Identify Vulnerable Infrastructure

Several infrastructure projects to decrease climate change risks in Tinian are either ongoing or are planned. These include the installation of storm-resilient water tanks on private homes, improvements to water distribution infrastructure, the construction of storage facilities for food, water, and fuel, the expansion of the underground electrical grid to private households, and the continuation of repairs to the harbor breakwater and pier. Further research could identify which of these projects could have the greatest impact on climate security in Tinian and identify DoD resources that could provide technical assistance and funding support.

Enhance Disaster Risk Reduction Capabilities

Authorities in Tinian are aware of the climate risks but cannot appropriately address them due to a lack of resources and expertise. Increased support from external partners for climate resilience projects and climate response training could significantly increase Tinian's capacity to respond to the effects of climate change. Of particular importance would be the creation of water, food, and fuel scarcity emergency plans to prepare for harbor and supply chain disruptions. Further research could identify military, territorial, and local stakeholders that can participate in plan development. These efforts could also result in additional multi-stakeholder exercises that enhance communication and coordination.

Enhance Civil-Military Cooperation

Key informants identified current and past military actions as potential contributing factors to climate-induced instability. A shift towards open and more frequent communication between the military and the local population could significantly improve civil-military relations, ensure a voice is given to the local population, and decrease potential for instability. Further research could identify and improve cooperation channels between the military and the local population. Additionally, the identification of potential human security impacts from current and new military projects in Tinian could reduce potential negative externalities and improve civil-military cooperation and collaboration on the island.

*There may be an opportunity to support an upcoming TNC project in the western reef region, which will bring together local fishermen, women who manage reef maintenance, NGOs, and government departments to improve fishery management, and by extension, food security.

6.3 Papua New Guinea

Enhance the Capacity of PNGDF

Key informant interviews and background research highlight that the capacity of PNGDF would be strained in supporting natural disaster response or addressing instability that could arise from climate change's human security impacts.

The project team recommends capacity building efforts between PNGDF and the U.S. military or allied forces. These efforts should focus on growing the size of the force and conducting exercises and training in disaster response and humanitarian assistance to better prepare current leaders and servicemembers. Additionally, CFE-DM can play a valuable role conducting training and facilitating dialogue between the PNGDF and the National Disaster Center and provincial- and local-level governments. Capacity building can be done in coordination with the Australian Defence Forces to strengthen the relationship among the three countries and identify further areas for collaboration.

Identify Vulnerable Infrastructure

There are a number of existing efforts in PNG to enhance climate resilience at major ports and other infrastructure. However, the research team found that a majority of vulnerability assessments were conducted on an ad-hoc province-by-province basis, and was unable to determine if any national-level infrastructure projects exist that prioritize which roads, airports, bridges, and other infrastructure are most vulnerable to the impacts of climate change.

Further research could identify which vulnerable infrastructure poses the greatest threat to human security if damaged or destroyed, ensuring that limited nationwide funding and capacity to enhance infrastructure resilience is targeted towards the most impactful projects.

Identify Funding for Expanding the Reach of Disaster Risk Reduction Programming

While many international and local organizations are implementing disaster risk reduction programs in PNG, most programming is targeting easier-to-reach locations in PNG due to the high cost of travel to remote areas of the country. Furthermore, many programs, such as those providing desalination infrastructure, are implemented at the local level and do not service the population at large. Additional funding or leveraging of partnerships could expand the reach of disaster risk reduction programs and improve the resilience of highly remote and vulnerable communities, potentially reducing the human security threats of climate change.

Key informants also expressed a need for disaster risk reduction and climate change-centric educational outreach to rural communities to help facilitate the implementation of needed adaptation programs. Further research could identify funding opportunities and untapped opportunities for partnerships within INDOPACOM, the U.S. military, or other U.S. foreign aid organizations to support expanding the reach of existing disaster risk reduction programs.

Appendix A: Brief Country Profiles

Palau

The Republic of Palau has eight main islands and over 340 additional islands. The population of Palau is approximately 17,907 and 73% are native Palauans.[112] Its land area is 193 square miles (499 square kilometers) and it has the 42nd largest Exclusive Economic Zone at 230,000 square miles (595,000 square kilometers).[113] Palau's economy is centered around the service industry, with tourism being its primary sector. The country also has subsistence agriculture but relies heavily on imported foods with 86% of its food coming from other countries.[114] Palau is a democratic country with a president, legislative body, and judicial system. It became independent in 1994 after ratifying the Compact of Free Association with the United States, although it had its own constitution since 1981. The Compact of Free Association meant that the United States and Palau voluntarily associated their governments to interlink their economic and military relations.

CNMI-Tinian

Tinian is one of the three main islands of the Commonwealth of the Northern Mariana Islands (CNMI). It has an area of 39.08 square miles (101.2 square kilometers) and a population of 2,044, 35% of whom are children.[115]

The local government is the largest employer of Tinian's workforce, followed by tourism.[116] Agriculture is primarily on the subsistence level, and commercial agriculture in Tinian consists of small-scale vegetable and fruit cultivations.[117] Commercial cattle grazing in Tinian involves a few small, family-owned ranches. The CNMI is 90% dependent on supplies, including food, from off-island sources. [118]

Papua New Guinea

Papua New Guinea ("PNG") is one of the largest countries in the southwestern Pacific with a population of nearly nine million and a land area of over 179,573 square miles (465,000 square kilometers). PNG occupies the eastern half of the island of New Guinea, four large additional islands, Manus, New Ireland, New Britain, and the Autonomous Region of Bougainville, and nearly 600 smaller islands and atolls, bringing PNG's total coastline to 3,201 miles (5,152 kilometers). A country of immense biological diversity, PNG is the third largest island nation in the world and is home to the third largest rainforest, with forests covering over 80% of land. Due to its location on the Pacific Ring of Fire, the country has an extremely rugged and diverse topography characterized by active and dormant volcanoes, low lying coral atolls, and intricate mountain ranges.

PNG has complex cultural dynamics deeply rooted in tribal and ethnic identity.[119] There are 832 living languages spoken across the 10,000 ethnic clans in the country, making PNG the most linguistically diverse country in the world. Over 87% of the population lives in rural environments, estimated to be spread out throughout mountainous highlands and nearly 2,000 coastal villages.[120] The economy and population are extremely reliant on the agricultural sector, with the sector accounting for approximately 30% of GDP and 82% of the population employed informally as subsistence farmers.[121]

Appendix B: Key Stakeholders and Partners By Country

Note: Asterisk* denotes representatives from the organization were interviewed as key informants.

Regional

Stakeholder Category	Agency/Actor	Relevant Responsibilities
U.S. Military	Center for Excellence in Disaster Management and Humanitarian Assistance*	A U.S. DoD organization under U.S. INDOPACOM providing academic research, civil-military coordination training, and operational insight applicable to disaster management, climate change adaptation, and humanitarian crises.
	Pacific Partnership*	A program under U.S. INDOPACOM that brings U.S. military forces together with international partners in the Indo-Pacific region to enhance interoperability and disaster response capabilities, increase stability and security, and build relations.
	U.S. Army Corps of Engineers*	Provides infrastructure and related technical support for climate adaptation and disaster management projects throughout the Indo-Pacific region.
	U.S. Indo-Pacific Command	INDOPACOM is the U.S. DoD's geographic command responsible for military activities taking place from the west coast of the United States to the western border of India and from Antarctica to the North Pole.
Multilateral Organization	Pacific Island Forum Fisheries Agency	An intergovernmental agency with representation from island territories and countries in the Pacific. It facilitates coordination and cooperation amongst its members regarding fisheries policies to achieve conservation and optimum utilization of marine resources.

Palau

Stakeholder Category	Actor	Relevant Responsibilities
National Governmental Agencies	President and Vice President's Office	Leads a working group involving state, national ministries, NGOs, the private sector, and traditional leaders, to engage stakeholders on climate change and environmental matters.
	Palau National Emergency Management Office ("NEMO")	NEMO is focused on all areas of disaster management in the country. It leads interagency efforts to research, plan, coordinate and assist in emergency management efforts.
	Palau Office of Climate Change*	The office is in charge of developing, reviewing, and updating the "Palau Climate Change Policy" plan, which is the main disaster resilience plan in the country.
	Bureau of Marine Resources	Management and regulatory authority on marine resources. Recommends legislation for conservation of vulnerable marine life.
	Ministry of Agriculture	Responsible for plans to improve food security in the country.
	Ministry of Human Resources, Culture, Tourism & Development	Conduct research and build resilience capacity in marine ecosystems.

	Ministry of Education	Provides emergency shelter to those impacted by climate disasters at designated schools.
	Ministry of Health and Human Services	Strengthens the capacity and resilience of existing health infrastructure. Also, provides training to community members on basic emergency health services.
	Ministry of Finance	Works with international organizations to help process environment resistance grants. It also develops and promotes legislation to incorporate risk assessments as part of the environmental impact assessment and permitting process.
	Ministry of Public Infrastructure and Industries ("MPIIC")	Assess risks and develop risk management plans. MPIIC also develops and implements national zoning and planning policy.
	Ministry of Justice	Develops immigration and labor policies to manage migrant workers and local laborers in times of emergency.
International Organizations	U.N. Development Programme ("UNDP")	The UNDP small grants programs works to develop and fund community based approaches to environmental challenges.
	International Organization for Migration ("IOM")*	Works on migration issues related to disasters and assists with disaster preparedness and mitigation programs.
	World Bank	Provides funds for development of communication systems critical to disaster management.
	Secretariat of the Pacific Regional Environment Programme	The secretariat works with the government of Palau to develop disaster resiliency plans.
	Green Climate Fund	Partners with the Ministry of Finance to fund projects on enhancing Climate Information and Knowledge Services.
Foreign Governmental Agencies	United States Agency for International Development ("USAID")*	USAID supports the government of Palau's capacity building and early recovery, risk reduction, and resilience (ER4). It also funds disaster preparedness, through the Red Cross.
	Government of Australia*	Through the "Australia Pacific Infrastructure Financing Facility across the Pacific," Australia is working on helping Palau improve its energy system by producing more renewable energy.
	Government of Japan	Japan is a strong partner of Palau providing funding of programs focused on environmental conservation, improving basic education, and building economic infrastructures through their Japan International Cooperation Authority ("JICA").
	Government of Taiwan	Taiwan is a close partner who funds training and disaster management programs through their "Taiwan International Cooperation and Development Fund."
	European Union Delegation to the Pacific*	Funds programs on climate adaptation, energy, and ocean governance.

	New Zealand Ministry of Foreign Affairs and Trade	Works with the government of Palau by funding disaster management and job training efforts.
NGOs	The Nature Conservancy*	Fund and operate programs dedicated to expanding food security through sustainable fishing.
	Palau International Coral Reef Center*	Conducts educational programming and research about Palau's oceans.
	Palau Community College	Conducts workshops, training, and research on climate change impacts on the island.
	Palau Red Cross Society*	Provides training to locals and manages shelters during climate emergencies.

CNMI-Tinian

Stakeholder Category	Agency/Actor	Relevant Responsibilities
National Government Organizations	Federal Emergency Management Agency*	Provides resources for disaster response as requested by territorial government in Saipan.
	CNMI Department of Community and Cultural Affairs	Consults territorial government on child-specific disaster response. Additionally is responsible for the Child Care and Development Program.
	Cybersecurity & Infrastructure Security Agency	Coordinates private and public disaster management actors.
	National Oceanic and Atmospheric Administration	Supports disaster adaptation and response in Tinian through scientific research.
Territorial Government Organizations	Homeland Security and Emergency Management Office	Plans and coordinates disaster response for CNMI (incl. Tinian) on a strategic level.
	CNMI Department of Labor	Coordinates labor implications of natural disasters.
	CNMI Division of Coastal Resources Management*	Regulates coast utilization in Tinian.
	CNMI Division of Fish & Wildlife	Regulates terrestrial and maritime fauna utilization in Tinian.
	CNMI Office of the Governor	Communicates with federal authorities to initiate federal disaster response.
	Commonwealth Utilities Corporation	Operates the electric power, water, and wastewater services in Tinian.

Local Government Organizations	Office of the Mayor of Tinian and Aguiguan*	Coordinates local disaster response in Tinian.
International NGOs	American Red Cross CNMI*	Provides resources and disaster response consulting to territorial authorities as only NGO that is permanently on the ground.
	Direct Relief	Provides resources for disaster response.
Local NGOs	PaganWatch*	Advocates for a sustainable relationship between the local population and the military.
	Micronesia Island Nature Alliance*	Supports community and science based conservation programs to enhance and sustain Micronesia's environments.
	Watershed Working Group	Facilitates territorial and local agency coordination in regard to water supply in Tinian.
	Friends of the Marianas Trench	Coordinates local engagement in the preservation of CNMI's environment.
	Tinian Women's Association*	Coordinates local engagement in the preservation of Tinian's environment and culture.

Papua New Guinea

Stakeholder Category	Actor	Relevant Responsibilities
National Governmental Agencies	National Disaster Committee	Composed of various heads of government departments with relevant responsibilities related to Disaster Management who coordinate on whole-of-government disaster preparedness plans
	National Disaster Center ("NDC")	Serves as the lead agency for disaster risk management, oversees state-wide emergency preparedness and coordination of a whole of government response. Drafts the National Disaster Management Plan.
	Provincial Disaster Centers	Each center is responsible for conducting hazard assessments, fostering public awareness, and organizing trainings.
	Climate Change Development Authority ("CCDA")*	Coordinating entity for all climate change related policies and actions in the country.
	Conservation and Environmental Protection Authority ("CEPA")	Responsible for the development of PNG's environment management and biodiversity protection policies
	National Weather Office	Provides meteorological and climate data. Responsible for the warning and tracking of rainfall, droughts, frosts, cyclones, and strong winds.
	The Geological Survey Office	Responsible for the warning and tracking of geological events including landslides and floods.
	The National Department of Health	Responsible for managing response to tropical diseases such as malaria, dengue fever, and other waterborne illnesses.
	Papua New Guinea Defense Forces ("PNGDF")	Participates in disaster relief operations.

	Department of Agriculture and Livestock	Manages the agricultural sector and provides policy advice and technical support for optimal agricultural performance.
	National Fisheries Authority	Responsible for promoting sustainable fishing practices.
	Department of Lands and Physical Planning ("DLPP")	Deals with matters relating to state-owned, alienated, and customary land.
	PNG Forest Authority ("PNGFA")	Promotes sustainable forest management.
	National Research Institute*	Mandated by the government to carry out independent research and analysis on development issues.
International Organizations	U.N. Development Programme ("UNDP")*	Works across all levels of government to address the effects of climate-related risks.
	International Organization for Migration ("IOM")*	Works on migration issues related to disasters and assists with disaster preparedness and mitigation programs.
	Asian Development Bank ("ADB")	Funds several developmental and sustainability programs in PNG. 2020 cumulative loans and grants totaled U.S. $551.39 million.
	Green Climate Fund ("GCF")	Has provided U.S. $2.4 million in financing to PNG to-date support investments in renewable energy and sustainable development.*
Foreign Governmental Agencies	United States Agency for International Development ("USAID")*	Implements climate-change related development initiatives including USAID Climate Ready, biodiversity conservation, and the PNG Electrification Activity.
	Office of Defense Cooperation, U.S. Embassy Port Moresby*	Serves as a point of contact between the U.S. DoD and the PNGDF.
	Australian Government	The Australian Government is a close partner of PNG and is involved with several high level strategies and bilateral initiatives to address climate change and development priorities.
	Japan International Cooperation Authority ("JICA")	Funds several programs aimed at improving PNG's economic infrastructure and agricultural development.†
NGOs	PNG Red Cross Society	Participates in emergency response activities, climate change education, and disaster response and preparedness trainings
	OXFAM	Focuses on WASH activities and disaster risk reduction.
	Hope Worldwide	Operates several critical health clinics
	Wildlife Conservation Society	Works with local communities on conservation efforts
	Médecins Sans Frontières	Improves access to screening and treatment for vector-borne diseases.

*The GCF developed a Country Programme for advancing actions to address climate change. The Country Programme serves as a guideline for domestic, regional, and international partners to prepare proposals in line with national climate change priorities and commitments.
†Relevant programs include The Project for Biodiversity Conservation by Implementing the PNG Policy on Protected Areas (2020) and the Capacity Development Project for Operationalization of PNG Forest Resource Information Management System for Addressing Climate Change (2019)

Appendix C: Key Informant Email Templates

For Key Informants for whom contact was arranged through CFE-DM

Greetings,

My colleagues and I are graduate students at Columbia University and we are partnering with the U.S. Center for Excellence in Disaster Management & Humanitarian Assistance (CFE-DM) on a project to analyze climate-related security challenges in [Insert specific country/territory and/or INDOPACOM]. CFE-DM's Dr. Alberto Morales recommended that my team reach out to you to discuss your experience in this area. **Could you tell me if any of the following dates and times work for you to do a 30 minute video call with me and other members of my team?: DATE/TIME1, DATE/TIME2, DATE/TIME3**

We're interested in learning about the climate-related hazards and their resulting impacts to humans, as well as partners and other stakeholders, existing plans, recent trainings and exercises, and any pre-existing vulnerabilities. It will also help me to prepare for our meeting if you could fill out this quick 10-minute survey at this link.

Please note that all responses will be kept anonymous. Externally shared information will not be attributed to you without your consent. Your assistance will help us to ensure a comprehensive analysis of climate-related security challenges in your area of responsibility, leading to reduced risk from their impacts. We greatly appreciate your time and effort in supporting this important project.

Sincerely,
First Name Last Name
MIA/MPA Candidate
Columbia University | School of International & Public Affairs

For Key Informants for whom contact was made independently from CFE-DM

Greetings,

My colleagues and I are graduate students at Columbia University and we are partnering with the United States Center for Excellence in Disaster Management & Humanitarian Assistance (CFE-DM) on a project to analyze climate-related security challenges in [Insert specific country/territory and/or INDOPACOM].

We're reaching out because of your expertise and experience in [**insert specific field/country -** e.g. humanitarian assistance in Papua New Guinea]. **Could you tell me if any of the following dates and times work for you to do a 30 minute video call with me and other members of my team?: DATE/TIME1, DATE/TIME2, DATE/TIME3**

We're interested in learning about climate-related hazards and their resulting impacts to humans, as well as partners and other stakeholders, existing plans, recent trainings and exercises, and any pre-existing vulnerabilities. It will also help me to prepare for our meeting if you could fill out this quick 8-minute survey at this link.

Please note that all responses will be kept anonymous. Externally shared information will not be attributed to you without your consent. Your assistance will help us to ensure a comprehensive analysis of climate-related security challenges in your area of responsibility, leading to reduced risk from their impacts. We greatly appreciate your time and effort in supporting this important project.

Sincerely,
First Name Last Name
MIA/MPA Candidate
Columbia University | School of International & Public Affairs

Appendix D: Climate Risk Survey

Climate Risk Survey

Please complete this survey to help us assess the risks of climate-related threats in your geographic area of responsibility. If you are unsure about the answer to any question you may leave it blank.

* Required

1. Name *

2. Position *

3. Agency/Organization *

4. Country/Territory *

Mark only one oval.

- ◯ Palau
- ◯ Papua New Guinea
- ◯ Tinian

5. Email Address *

6. Phone Number including Country Code

7. What is the *probability* that climate change will cause any of the following in your area of responsibility? *

Mark only one oval per row.

	Highly Unlikely	Unlikely	Moderately Likely	Likely	Highly Likely
Sea Level Rise					
Increased Impacts from Tsunami					
Heavy Rainfall/Flooding					
Typhoon/Tropical Storm					
Landslides					
Drought					
Ocean Warming/Acidification					
Erosion					
Desertification					
Wildfire					
Other - Please Expand in Additional Comments Below					

8. If any of the below occur in your area of responsibility, how *severe* would you expect the impacts to be? *

Mark only one oval per row.

	Very Minor	Minor	Moderately Severe	Severe	Very Severe
Sea Level Rise	◯	◯	◯	◯	◯
Increased Impacts from Tsunami	◯	◯	◯	◯	◯
Heavy Rainfall/Flooding	◯	◯	◯	◯	◯
Typhoon/Tropical Storm	◯	◯	◯	◯	◯
Landslides	◯	◯	◯	◯	◯
Drought	◯	◯	◯	◯	◯
Ocean Warming/Acidification	◯	◯	◯	◯	◯
Erosion	◯	◯	◯	◯	◯
Desertification	◯	◯	◯	◯	◯
Wildfire	◯	◯	◯	◯	◯
Other - Please Expand in Additional Comments Below	◯	◯	◯	◯	◯

9. The climate-related threats mentioned above can lead to human security and state security impacts, either directly or indirectly. What is the *probability* of climate-related threats leading to the following impacts?

	Highly Unlikely	Unlikely	Moderately Likely	Likely	Highly Likely
Damage to Homes	◯	◯	◯	◯	◯
Damage to Infrastructure	◯	◯	◯	◯	◯
Reduction of Habitable Land	◯	◯	◯	◯	◯
Loss of Livelihoods	◯	◯	◯	◯	◯
Impact to Tourism	◯	◯	◯	◯	◯
Impacts to Agriculture	◯	◯	◯	◯	◯
Food Insecurity	◯	◯	◯	◯	◯
Water Insecurity	◯	◯	◯	◯	◯
Water Salination	◯	◯	◯	◯	◯
Impacts to Fisheries	◯	◯	◯	◯	◯
Communicable Diseases	◯	◯	◯	◯	◯
Migration	◯	◯	◯	◯	◯
Conflict	◯	◯	◯	◯	◯
Political Instability	◯	◯	◯	◯	◯
Other - Please Expand in Additional Comments Below	◯	◯	◯	◯	◯

10. If the human security and state security impacts below occur as a result of climate-related threats, how *severe* would you expect those impacts to be?

Mark only one oval per row.

	Very Minor	Minor	Moderately Severe	Severe	Very Severe
Damage to Homes	◯	◯	◯	◯	◯
Damage to Infrastructure	◯	◯	◯	◯	◯
Reduction in Habitable Land	◯	◯	◯	◯	◯
Loss of Livelihoods	◯	◯	◯	◯	◯
Impact to Tourism	◯	◯	◯	◯	◯
Impacts to Agriculture	◯	◯	◯	◯	◯
Food Insecurity	◯	◯	◯	◯	◯
Water Insecurity	◯	◯	◯	◯	◯
Water Salination	◯	◯	◯	◯	◯
Impacts to Fisheries	◯	◯	◯	◯	◯
Communicable Diseases	◯	◯	◯	◯	◯
Migration	◯	◯	◯	◯	◯
Conflict	◯	◯	◯	◯	◯
Political Instability	◯	◯	◯	◯	◯
Other - Please Expand in Additional Comments Below	◯	◯	◯	◯	◯

11. Additional Comments

Appendix E: Risk Perception Data From Survey Answers

Location: Palau					
	Number of Survey Responses w/Breakdown by Perceived Risk Level				
Primary Climate Threat	**Very Low**	**Low**	**Moderate**	**High**	**Very High**
Sea Level Rise	0	0	0	**4**	3
Increased Impact from Tsunami	0	1	**4**	0	2
Heavy Rainfall/Flooding	0	0	1	**3**	**3**
Typhoon/Tropical Storm	0	0	0	3	**4**
Landslides	0	0	0	**5**	2
Drought	0	0	2	**3**	2
Ocean Warming/Acidification	0	0	1	**4**	2
Erosion	0	0	1	**4**	2
Desertification	0	1	**3**	**3**	0
Wildfire	1	0	1	**5**	0
Human Security / State Security Impacts					
Damage to Homes	0	0	**3**	1	3
Damage to Infrastructure	0	0	1	**4**	2
Reduction of Habitable Land	0	0	**4**	1	2
Loss of Livelihoods	0	0	2	2	**3**
Impact to Tourism	0	0	2	2	**3**
Impact to Agriculture	0	0	1	**3**	**3**
Food Insecurity	0	0	1	**3**	**3**
Water Insecurity	0	0	3	0	**4**
Water Salination	0	0	**3**	1	**3**
Impact to Fisheries	0	0	2	1	**4**
Communicable Disease	0	0	2	**4**	1
Migration	0	0	**4**	0	2
Conflict	0	1	**5**	1	0
Political Instability	0	3	**4**	0	0
	*Risk level with the most responses is highlighted in bold for each category				

Location: Tinian					
	Number of Survey Responses w/Breakdown by Perceived Risk Level				
Primary Climate Threat	**Very Low**	**Low**	**Moderate**	**High**	**Very High**
Sea Level Rise	0	1	2	**4**	2
Increased Impact from Tsunami	0	2	**4**	2	1
Heavy Rainfall/Flooding	0	0	2	**4**	3
Typhoon/Tropical Storm	0	0	2	2	**5**
Landslides	1	1	**4**	1	2
Drought	0	0	**5**	3	1
Ocean Warming/Acidification	0	1	2	2	**4**
Erosion	0	1	2	**3**	**3**
Desertification	0	**3**	**3**	2	0
Wildfire	0	1	2	**3**	**3**
Human Security / State Security Impacts					
Damage to Homes	1	0	2	**3**	2
Damage to Infrastructure	1	0	**3**	**3**	2
Reduction of Habitable Land	0	1	3	**4**	1
Loss of Livelihoods	1	**2**	**2**	**2**	**2**
Impact to Tourism	0	1	**3**	**3**	2
Impact to Agriculture	0	0	3	**4**	2
Food Insecurity	0	2	2	**4**	1
Water Insecurity	0	1	3	**4**	1
Water Salination	0	1	**4**	3	1
Impact to Fisheries	0	0	2	**3**	**3**
Communicable Disease	1	**2**	**2**	**2**	1
Migration	0	2	**3**	**3**	1
Conflict	1	1	**4**	2	1
Political Instability	**2**	**2**	**2**	**2**	1
	*Risk level with the most responses is highlighted in bold for each category				

Location: Papua New Guinea					
	Number of Survey Responses w/Breakdown by Perceived Risk Level				
Primary Climate Threat	**Very Low**	**Low**	**Moderate**	**High**	**Very High**
Sea Level Rise	0	0	0	**2**	**2**
Increased Impact from Tsunami	0	0	**2**	**2**	0
Heavy Rainfall/Flooding	0	0	1	**3**	0
Typhoon/Tropical Storm	0	0	1	**3**	0
Landslides	0	0	1	**3**	0
Drought	0	0	1	**3**	0
Ocean Warming/Acidification	0	0	**2**	1	1
Erosion	0	0	1	**3**	0
Desertification	0	**2**	1	1	0
Wildfire	0	0	**2**	**2**	0
Human Security / State Security Impacts					
Damage to Homes	0	0	0	**4**	0
Damage to Infrastructure	0	0	0	**3**	1
Reduction of Habitable Land	0	0	1	**2**	1
Loss of Livelihoods	0	0	1	**2**	1
Impact to Tourism	0	0	1	**3**	0
Impact to Agriculture	0	0	0	**3**	1
Food Insecurity	0	0	0	**3**	1
Water Insecurity	0	0	0	**3**	1
Water Salination	0	0	0	**3**	1
Impact to Fisheries	0	0	1	**3**	0
Communicable Disease	0	0	1	**3**	0
Migration	0	0	0	**3**	1
Conflict	0	0	1	**3**	0
Political Instability	0	0	**2**	**2**	0
	*Risk level with the most responses is highlighted in bold for each category				

Appendix F: Interview Questionnaire Template

Interviewee Name:

Interviewee Position:

Interviewee Agency/Office:

Interviewee Country/Territory:

Interviewee Contact Info:

Does the timing of this meeting still work for you and are you available for the full half-hour?

We will be taking notes during this meeting; however, information that you share with us will be kept anonymous. Information shared externally will not be attributed directly to you without first obtaining your consent.

Is it ok if we record this meeting?

If there are any questions during this interview for which you do not know the answer you may refrain from answering those questions.

KEY INFORMANT OPEN-ENDED DISCUSSION

Can you tell me about the climate-related threats in your country/territory and the challenges faced in managing those threats?

Answer:

Do you have any recommendations for how best to mitigate against and prepare for these climate-related threats and their impacts?

Answer:

PRE-EXISTING VULNERABILITIES

What types of pre-existing vulnerabilities exist in your country/territory that increase the risk associated with climate-related threats? Please explain.

Answer:

PARTNERS/STAKEHOLDERS

With which other organizations does your organization currently have partnerships, either formal or informal? Please include government, civil, and international organizations and their roles.

Answer:

Who are the other stakeholders involved in disaster management and climate change adaptation?

Answer:

PLANS

What written plans does your organization have for disaster management and climate change adaptation, if any, and can we get copies of those plans?

Answer:

Have these plans been tested in either exercises or real-world scenarios and have any strengths or weaknesses been identified in these plans?

Answer:

Are there applicable disaster management or climate change adaptation plans from other organizations that you recommend we look at?

Answer:

TRAININGS & EXERCISES

In what types of disaster management or climate change adaptation trainings and exercises has your organization participated in recent years, if any, and can we get copies of after-action-reviews?

Answer:

What were the training objectives and who were the other participants?

Answer:

What were the outcomes of the trainings and exercises?

Answer:

Are you aware of any disaster management or climate change adaptation trainings or exercises in which your organization did not participate?

Answer:

HUMAN SECURITY & STATE SECURITY IMPACTS

Infrastructure, Businesses, and Housing

How might each of the climate-related threats impact infrastructure, businesses, and housing?

*Critical infrastructure that should be considered when discussing with key informants includes: roads, railroads, bridges, dams, airports, helicopter landing pads, sea ports, electrical power infrastructure, communications infrastructure, water and sanitation infrastructure, fuel supply, other supply lines, government buildings, healthcare facilities, schools, military installations, and others as indicated by the key informant.

Answer:

Livelihoods, Agriculture, Fisheries, and Food/Water Insecurity

Is there a significant risk that any of the climate-related threats could lead to loss of livelihoods, impacts to agricultural production, impacts to fisheries, food insecurity, or water insecurity (including impacts from water salination), either directly or indirectly? How might this occur?

Answer:

Migration

Is there a significant risk that any of the climate-related threats could lead to forced migration, either directly or indirectly? How might this occur?

Answer:

Diseases

Is there a significant risk of any of the climate-related threats resulting in an increased incidence of diseases?

Answer:

State Security Impacts

Is there a significant risk that any of the climate-related threats could indirectly lead to conflict, political instability, opportunities for extremist groups to gain power, or other impacts to state security? How might this occur?

Answer:

REFERRALS FOR OTHER CONTACTS

Are there any other individuals or organizations who you recommend we talk with about climate security and can you provide their contact information?

Answer:

FOLLOW-UP QUESTIONS

Is it alright if we contact you again if we have some additional questions about this topic?

Answer:

CLOSING REMARKS AND OPPORTUNITY FOR ADDITIONAL KEY INFORMANT POINTS

Thank you for taking the time to speak with me.

Before we end, is there any other information that you think would be helpful to us in conducting our analysis of climate security in your area of responsibility?

Answer:

Thanks again for talking to me. This interview was super helpful. As I mentioned, we won't attribute anything directly to you from this interview but if there are any specific quotes that I think are critical to include in our report, I'll reach back out to you for permission.

Appendix G: Interview Themes Results

Below is a snapshot of the interview answer tracker developed by the data team (sensitive information identifying key information has been taken out).

GENERAL INFORMATION						KEY INFORMANT OPEN-ENDED DISCUSSION	
Date/Time of Interview	Interviewee Name	Interviewee Position	Interviewee Agency/Office	Interviewee Country/Territory	Interviewee Contact Info	Can you tell me about the climate-related threats in your country/territory and the challenges faced in managing those threats?	Do you have any recommendations for how best to mitigate against and prepare for these climate-related threats and their impacts?
March 06, 2022			Red Cross - Palau	Palau		The frequency of tropical storms and typhoons is increasing with climate change to Palau. Tropical storms can happen now on a yearly basis. Last big typhoon was in April in 2021. Last two disaster, government had a lot of red tape so they gave the responsibility to the red cross to manage the shelters until they have	
March 22, 2022			FEMA	CNMI		I can tell you personally, that the places I play the beach volleyball every week, I can no longer park my truck on the same places on the beach that I could six months ago. The erosion is really tremendous. CNMI is constantly losing beachfront.	NMI Attorney General's office, as well as the Bureau of environmental and coastal quality, are working to propose legislation to approve our reef systems under critical infrastructure. If that's successful, the reefs themselves may be able to be protected under competitive mitigation grants, such as the BRIC program.
March 23, 2022			USAID	Palau		Coastal communities are facing the greatest threat as they face flooding and disruption to their agriculture. Palau Kayengo is repeatedly in the paths of cyclones. Salt water, rising sea levels, taro patches are becoming unbearable.	Invest in Taro that is saltwater resistant and help farmers farm inland. Continue to improve early waring systems for possible floods. Public communications when King TIdes are coming have improves significantly since these are predictable. These should not be

-ENDED DISCUSSION	PRE-EXISTING VULNERABILITIES	PARTNERS/STAKEHOLDERS		
Do you have any recommendations for how best to mitigate against and prepare for these climate-related threats and their impacts?	What types of pre-existing vulnerabilities exist in your country/territory that increase the risk associated with climate-related threats? Please explain.	With which other organizations does your organization currently have partnerships, either formal or informal?	Who are the other stakeholders involved in disaster management and climate change adaptation?	What written plans does your organization have for disaster management and climate change adaptation, if any, and can we get copies of those plans?
		NEMO; Disaster Office and Weather Service	NEMO, weather service, and all 16 state governments. RDST- community members that live in the 16 states. All gender, retirees, housewives, etc- the become red cross action team volunteers. Women's community groups are over a century old. They are in a matrinilar society. As soon as a female is born	
NMI Attorney General's office, as well as the Bureau of environmental and coastal quality, are working to propose legislation to approve our reef systems under critical infrastructure. If that's successful, the reefs themselves may be able to be protected under competitive mitigation grants, such as the BRIC program.		NOAA, MINA	FEMA is the leading agency. DOD, Coast Guard, basically every local government agency from public works to the ports authority are involved on all kinds of disaster response. For Climate change, currently the only people working on that are a few local nonprofits.	
Invest in Taro that is saltwater resistant and help farmers farm inland. Continue to improve early waring systems for possible floods. Public communications when King TIdes are coming have improves significantly since these are predictable. These should not be		UN, IoM, DoD, Japanese Government, Taiwanese Government, Palauwan states.		USAID/OFDA supports IOM to implement the PEPER project, which seeks to contribute to the country's preparedness and response capacity by strengthening evacuation shelters, training community leaders on shelter management, conducting response exercises, and pre-positioning

In addition to the answer tracker, a written analysis of the interviews was conducted by the data team to inform the drafting of the final report. An example from Palau can be found below.

1. Can you tell me about the climate-related threats in your country/territory and the challenges faced in managing those threats?

- **Sedimentation** has been identified as impacting fisher communities on the west coast.
- **Increase in rainfall, leading to flash flooding and landslides** which can damage infrastructure, particularly roads
    - King tides are being experienced often! Homes are being inundated. People are having to walk into a foot of water to get into their homes.
- **Sea level increase** results in inundation into densely populated areas that possibly weren't seeing it before → may need to move elsewhere
- **Food security impact** ; Taro conference → inundation impacts taro crops along sea front, move crops further inland? How to improve soils to reinforce food security?
- The **frequency of tropical storms and typhoons is increasing** with climate change to Palau.
    - Tropical storms can happen now on a yearly basis. Last big typhoon was in April in 2021. Last two disasters, the government had a lot of red tape so they gave the responsibility to the red cross to manage the shelters until they had the budget.
- **Coastal communities** are facing the greatest threat as they face flooding and disruption to agriculture.
- **Food security and water security** are the biggest concerns
- **Exacerbation of existing la Nina effects**, sea-level rise, and salinization

2. Do you have any recommendations for how best to mitigate against and prepare for these climate-related threats and their impacts?

- **Measures to mitigate** against the impacts to coral reefs and fisheries would limit negative impacts to the economy and food security.
- **Satellite communications** have greatly improved communications with small, isolated islands. Sat Comms could be even more valuable for maintaining communications if other forms of communication infrastructure have been damaged by a natural disaster.
- **Invest in Taro that is saltwater resistant** and helps farmers farm inland.
- **Improve early warning systems** for possible floods.
- **Public communication** when King TIdes are coming have improved significantly since these are

3. What types of pre-existing vulnerabilities exist in your country/territory that increase the risk associated with climate-related threats? Please explain.

- **Tourism and fishing** are major parts of the economies
    - Impacts to coral and other ocean life from ocean acidification and warming could negatively impact tourism and fishing, affecting local livelihoods.
- **Fragile supply chains** and are heavily dependent on small gas-powered boats to get back and forth between islands.
- **Very few airfields**
- No higher-level medical treatment facilities
- **Gender-based violence**
- Many **overlapping mandates** within the government as climate change touches many overlapping sectors
- **Capacity building is a constant challenge** - implementation and delivery is varied on both the national and regional / provincial level
- Funding and technical capacity - difficult for the government to do actual resiliency projects in the community
- **Progress is slow in policy development** due to low technical capacity
- **Disconnect between disparate government entities** - entities are siloed, causing delays
- Projects deteriorate after foreign funding ends

4. With which other organizations does your organization currently have partnerships, either formal or informal?

- **Pacific Partnership** is an annual military operation in which the US military provides humanitarian assistance to countries in the Pacific, including Palau
- **Northern fisheries cooperative** was established to be a compromise to bring more benefits to fisherpeople.
- **TNC** is trying to work with community, state, and national-level governments.
- **Fisherpeople** are organizing themselves to operate as a small corporation."
- **Disaster Office and Weather Service**
- **UN, IoM, DoD, Japanese Government, Palawan states**

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