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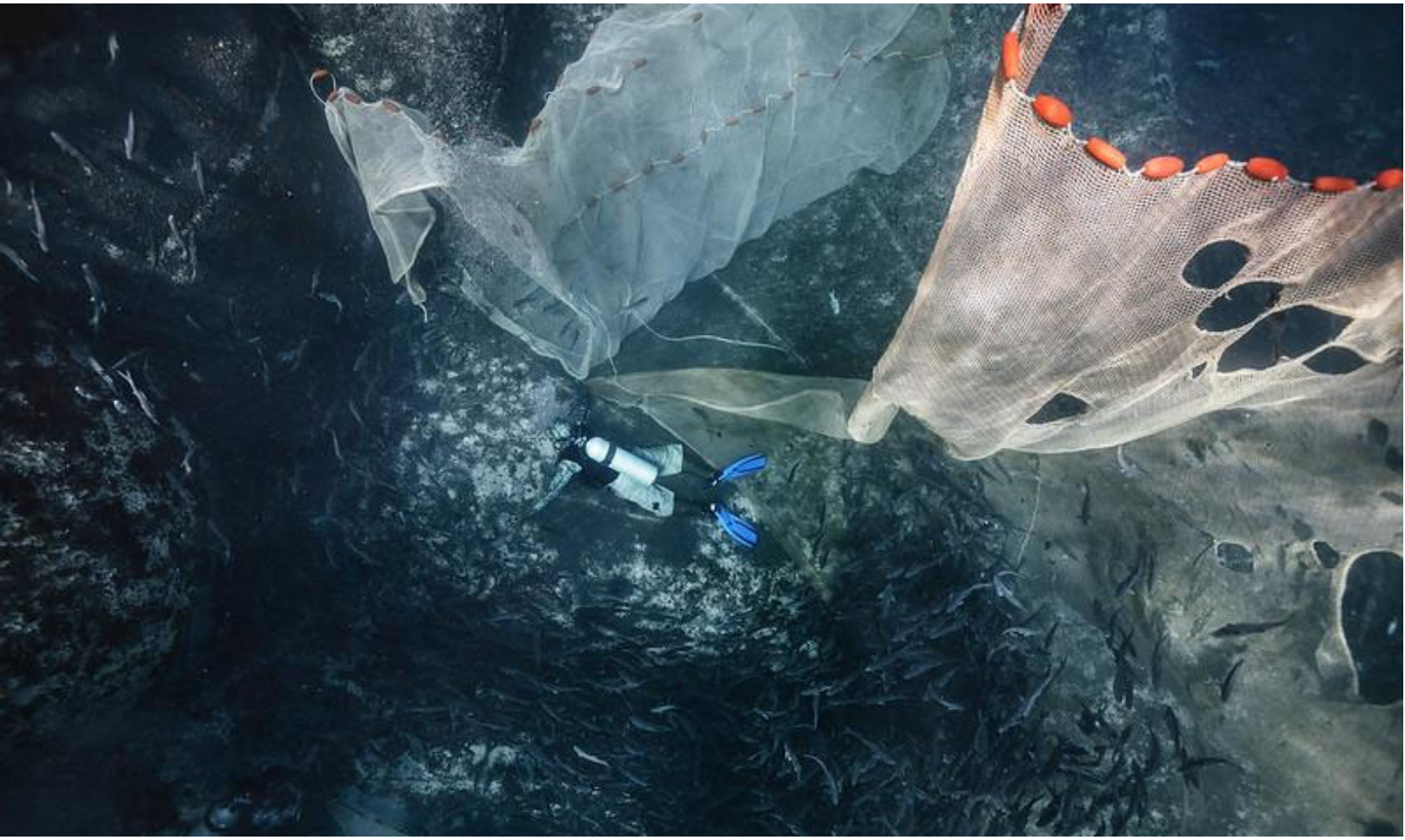

Source: USAID Pacific Islands' "Fish for All" Program in the Marshall Islands

USAID CLIMATE RISK ANALYSIS FOR PACIFIC ISLAND COUNTRIES

Assessment Report

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USAID Climate Risk Analysis for Pacific Island Countries

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ACRONYMS

°C	Degree Celsius
ADB	Asian Development Bank
CSIRO	Commonwealth Scientific and Industrial Research Organization
DO	Development Objective
ENSO	El Niño Southern Oscillation
GDP	Gross Domestic Product
GHG	Greenhouse Gas
LEDS	Low Emissions Development Strategy
IR	Intermediate Result
NAP	National Adaptation Plan
NAPA	National Adaptation Program of Action
NDC	Nationally Determined Contributions
PAD	Project Appraisal Document
PIC	Pacific Island Countries
PNG	Papua New Guinea
RDCS	Regional Development Cooperation Strategy
SPC	Secretariat of the Pacific Community
SPREP	Secretariat of the Pacific Regional Environmental Program
tCO2e	Tons of Carbon Dioxide Equivalent
UNFCCC	United Nations Framework Convention on Climate Change
USAID	United States Agency for International Development

1. OVERVIEW OF THE PACIFIC ISLAND COUNTRIES

The twelve Pacific Island countries (PIC) included in this analysis (the Federated State of Micronesia, Fiji, Kiribati, Nauru, Palau, Papua New Guinea, Marshall Islands, Samoa, Solomon Islands, Tonga, Tuvalu, and Vanuatu) have a total population of nearly twelve million inhabitants. Papua New Guinea (PNG) is by far the largest country, accounting for over 9,100,000 people (78% of the regional population), followed by Fiji (900,000 people) and the Solomon Islands (700,000 people). Comparably, other territories in the region have very sparse populations, such as Nauru (10,000) and Tuvalu (11,000).[1]

Spreading over an area exceeding 9 million square kilometers, PIC have great diversity, ranging from mountainous islands with peaks standing at 4,884 meters above sea level with complex bio-geographies (i.e., PNG) to volcanic islands (i.e., Fiji, Tonga, and Vanuatu) and coral islands and atolls at sea level (i.e., Tuvalu and Nauru).[2] As such, the region is characterized by significantly different islands that support diverse ecosystems. Despite these differences, PIC face common challenges – high economic dependence on natural resources, volatile domestic markets, and heavy reliance on external markets; relatively small populations spread over many islands; high costs for energy, infrastructure, communication, and services; long distances from export markets and import resources; limited resilience to natural disasters; demographic pressure; and relatively fragile natural environments.

Figure 1. Pacific Island Countries Included in the Analysis. Source: Map prepared using official boundaries and exclusive economic zones from GADM and the Pacific Data Hub.

Note: The map shows exclusive economic zones associated with each country for easier identification; note that Kiribati has three distinct exclusive economic zones due to the geographic spread of the country.

PIC are among the most at-risk countries to the impacts of climate change due to their small size, geographic isolation, high reliance on rain-fed agriculture and traditional fishing, as well as exposure to climate hazards such as floods, droughts, typhoons, and sea-level rise. The World Risk Index 2021, which

[1] SPC, 2022. Pacific Data Hub. https://pacificdata.org/

[2] World Bank, 2017. Climate and Disaster Resilience: #PacificPossible Series. Washington, D.C.: World Bank

assesses the impacts of climate hazards globally, ranks six PIC among the twenty most at-risk. Vanuatu, Solomon Islands, Tonga, PNG, Fiji, and Kiribati rank 1, 2, 3, 9, 14, and 19 respectively.[3]

The international community recognizes the unique vulnerabilities that the Pacific Islands face under climate change. The region has become an archetype of the impacts of climate change with sea-level rise threatening the existence of various low-lying islands in the region. Several PIC have made substantial commitments to address climate impacts and all PIC have already submitted at least one Nationally Determined Contributions (NDC) document featuring mitigation and adaptation pledges to the United Nations Framework Convention on Climate Change (UNFCCC). In addition, Fiji, Kiribati, and Tonga have submitted a National Adaptation Plan (NAP) with detailed adaptation solutions to support key vulnerable sectors. As of July 2022, PNG is in the process of finalizing a NAP.

2. CLIMATE RISKS

2.1. HISTORICAL CLIMATE

Climate change is one of the most pressing environmental and social challenges for PIC. Generally, PIC receive between 2,400 to 4,000 millimeters of rainfall per year during the rainy season (November to April). Conversely, during the dry season (May to October) the winter trade winds lower temperatures to around 21-27°Celsius (C).[4] Evidence suggests that the Pacific region has already begun to experience warming, with an increase in temperature 0.05°C per decade over the period 1950-2016; however, there is insufficient information to ascertain whether any changes in rainfall patterns are attributable to climate change.[5]

Rainfall variability in the Pacific is largely driven by the El Niño Southern Oscillation (ENSO) cycle. Years with strong ENSO signals (warmer-than-average sea surface temperatures in the eastern Pacific) have been linked to greater drought risk due to higher temperatures and lower rainfall levels in the key months of December, January, and February. These dry conditions exacerbate water shortages – in a region which already experiences water shortages under normal climate conditions. The warm and dry conditions associated with a strong ENSO cycle also affect the distribution of fisheries, potentially impacting food security. To illustrate the impact of dry conditions, during the 2014-2016 ENSO event, over 2.3 million across the Pacific experienced water shortages, food insecurity, and higher disease incidence.[6] Conversely, La Niña conditions occur when sea surface temperatures are colder than average in the Eastern Pacific; and the conditions are associated with increased rainfall and higher incidence of floods.

Cyclones have represented a significant threat to the islands of the Pacific region resulting in millions of dollars in losses, as dramatically demonstrated by Cyclones Winston (2016) and Pam (2015). The main

[3] Aleksandrova, M., 2021. World Risk Report 2021. RUB/IFHV.

[4] Australian Bureau of Meteorology, 2021. Pacific Climate Change Data Portal. Available online at: http://www.bom.gov.au/climate/pccsp/

[5] Pringle, P. 2018. Pacific marine climate change report card. Science Review 2018: pp 189-200 Available online at: https://reliefweb.int/sites/reliefweb.int/files/resources/12-1.5-degree-temperature-rise.pdf

[6] UNDP, ESCAP, OCHA, RIMES and APCC, 2017. Enhancing Resilience to Extreme Climate Events: Lessons from the 2015-2016 El Niño Event in Asia and the Pacific. Available online at: https://reliefweb.int/sites/reliefweb.int/files/resources/El percent20Nino percent20report- percent20finalized percent20ESCAP07082017.pdf

cyclone season runs from November to April with cyclones forming in the Western Pacific and Southern Pacific Basins. The most destructive cyclones typically form in the Western Pacific Basin near the Philippine Area of Responsibility and can have devastating impacts on infrastructure in northern PIC (e.g., Palau, Micronesia). In recent years, however, cyclone activity in the Southern Pacific has become more intense resulting in Category 5 typhoons making landfall in Fiji, Vanuatu, and Tonga.[7]

Finally, sea-level rise is another trend that presents a major climate risk in the Pacific Islands. Evidence suggests that, since 1960, the average sea level in the Pacific region has risen at a rate of 10 millimeters per year – faster than the global rate of 3 millimeters per year. Rising sea levels are particularly worrisome given that most of the population of the Pacific lives near the coasts, and that the majority of critical infrastructure (e.g., roads, maritime ports) are in low-lying coastal zones.[8] While sea-level rise can be somewhat mitigated by relocating communities and infrastructure, this is often an expensive endeavor – and in low-lying atoll island, relocation may not be feasible at all. Sea-level rise also exacerbates climate risks by intensifying storm surges. In addition, rising sea levels can affect the quality of water through saline intrusion of saltwater into groundwater.

2.2. Future Climate Projections

Future climate change is likely to bring about significant impacts across the Pacific. "Heavy precipitation and associated flooding events are projected to become more intense and frequent in the Pacific Islands (and across many regions of North America and Europe) (medium to high confidence)."[9] The latest (2021) Assessment Report of the Intergovernmental Panel on Climate Change suggests an increase of up to 2°C by mid-century (2041-2060) and 2-4°C by the end of the twenty-first century (2081-2100) under a high-risk scenario (RCP 8.5).[10] Similarly, the number of hot days is expected to increase towards the end of the century with some countries projected to experience an additional 30-60 days with temperatures exceeding 41°C by 2100 under a high-risk scenario.[11]

Future rainfall patterns are difficult to discern given the complex interactions between oceans and the atmosphere; however regional climate models suggest a slight trend towards increased precipitation due

[7] Chand, S.S., Dowdy, A., Bell, S. and Tory, K., 2020. A review of South Pacific tropical cyclones: impacts of natural climate variability and climate change. *Climate Change and Impacts in the Pacific*, pp.251-273.

[8] Dangendorf, S., Hay, C., Calafat, F.M., Marcos, M., Piecuch, C.G., Berk, K. and Jensen, J., 2019. Persistent acceleration in global sea-level rise since the 1960s. *Nature Climate Change*, 9(9), pp.705-710.

[9] IPCC, 2021: Summary for Policymakers. In: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Masson-Delmotte, V., P. Zhai, A. Pirani, S.L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M.I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J.B.R. Matthews, T.K. Maycock, T. Waterfield, O. Yelekçi, R. Yu, and B. Zhou (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 3−32, doi:10.1017/9781009157896.001

[10] Representative Concentration Pathways (RCP) is a trajectory of greenhouse gas concentrations (as opposed to emissions). The RCPs – originally RCP2.6, RCP4.5, RCP6, and RCP8.5 – are labelled after a possible range of radiative forcing values in the year 2100 (2.6, 4.5, 6, and 8.5 W/m^2, respectively). RCP8.5 represents the worst case scenario.

[11] Ranasinghe, R., Ruane, A., Vautard, R., Arnell, N., Coppola, E., Cruz, F., Dessai, S., Islam, A., Rahimi, M., Carrascal, D.R. and Sillmann, J., 2021. Climate Change Information for Regional Impact and for Risk Assessment. Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Ed. by V.

to warming oceans, especially in the Southern Pacific.[12] Projections also suggest more intense rainfall events.

Cyclone activity is projected to change as a result of warming sea-surface temperatures. The most significant cyclone trends include: the shift in tracks, with more cyclone activity projected in the Southern Pacific; the slowdown of tropical cyclones, resulting in more intense rainfall events; and less frequent tropical cyclones in the North and Western Pacific but more frequent cyclones in the Southern Pacific.[13]

As outlined earlier, sea-level rise is a major threat to PIC, particularly as it exacerbates impacts associated with cyclones. Sea levels are projected to rise as a result of both thermal expansion of the oceans and glacier melt, though the rate of increase is subject to model uncertainty. Under scenarios of extreme carbon mitigation, sea levels are projected to rise by up to 0.6 meters towards 2100, while worst case scenarios suggest a sea-level rise of up to 1.6 meters in the same period. A sea-level rise of as little as 0.5 meters on Pacific Islands' coastal communities can result in over 77,000 kilometers of shoreline affected with direct costs of almost US$1.5 million.[14]

Future climate change will affect ocean health, both through increasing ocean temperatures (which could perturb marine habitats) and through ocean acidification. Depending on overall greenhouse gas emissions, ocean acidification, is expected to increase in the twenty-first century resulting in lower oxygen content and potentially affecting the health of corals and fisheries.

Table 1. Climate Projections. Source: Ranasinghe et al., (2021) [11]

Climate Projections			
1-2°C increase in temperature 2041-2060	More extreme rainfall events 2041-2060	Slower cyclones, with more frequent events in the Southern Pacific	Ocean acidification with more coral bleaching and marine habitat damage

Table 2. Key Climate Impacts based on summary of findings

Key Climate Impacts			
Coastal Zones	**Agriculture**	**Energy**	**Water Resources**
• Damage to infrastructure	• Crop loss and crop failure due to more	• Reduced access to energy services due	• Reduced water quantity and quality

[12] Almazroui, M., Saeed, F., Saeed, S., Ismail, M., Ehsan, M.A., Islam, M.N., Abid, M.A., O'Brien, E., Kamil, S., Rashid, I.U. and Nadeem, I., 2021. Projected changes in climate extremes using CMIP6 simulations over SREX regions. *Earth Systems and Environment*, *5*(3), pp.481-497.

[13] Knutson, T., Camargo, S.J., Chan, J.C., Emanuel, K., Ho, C.H., Kossin, J., Mohapatra, M., Satoh, M., Sugi, M., Walsh, K. and Wu, L., 2020. Tropical cyclones and climate change assessment: Part II: Projected response to anthropogenic warming. *Bulletin of the American Meteorological Society*, *101*(3), pp. E303-E322.

[14] WFP. 2018. Food Security in Vulnerable Islands: A regional food security atlas of the Pacific.

Key Climate Impacts			
• Reduced access to services • Degraded coastal ecosystems (and lower access to fisheries) • Coastal flooding and sea-level rise (including saltwater intrusion) • Damage to coral reefs due to ocean acidification • Higher prevalence of food insecurity due to loss of fish and damage to marine ecosystems	extreme weather events, including drought, floods, and cyclones • Reduced access to agricultural land • Reduced access to water for irrigation • Inland flooding resulting in loss of agricultural crops	to cyclones and sea-level rise	for domestic use and consumption, including sanitation • Damage to critical water infrastructure due to cyclones and sea-level rise • Damage to sanitation infrastructure
Disaster Management • More frequent hazard events • Greater economic losses due to droughts, cyclones, floods, and sea-level rise • Increased displacement, exacerbated by complex crises and ongoing conflicts in the region.	**Livelihoods** • Lower economic gains from crop production • Reduced access to fish due to changing migration patterns	**Digital Connectivity** • Reduced access to digital services due to cyclones and sea-level rise	**Health** • Higher infectious disease burden due to malaria and other vector-borne diseases becoming more frequent under climate change. • Increased heat stress • Reduced access to health services due to damage from cyclones and floods

3. POLICIES, LEGAL FRAMEWORKS, AND STRATEGIES

The governments of PIC are acutely aware of the implications of climate change, even suggesting that climate change poses an existential threat to the way of living in the region in some cases. For instance, Fiji presided over the Twenty-third Session of the Conference of the Parties (COP-23) to the UNFCC and highlighted the importance of investing in loss and damage mechanisms in order to manage the

unavoidable consequences of climate change.[15] Following this trend, all PIC have submitted at least one NDC document to the UNFCCC outlining commitments on both mitigation and adaptation. In addition, Fiji, Kiribati, and Tonga have submitted a National Adaptation Plan with priority activities and funding required to implement them. Table 3 provides a summary of the main climate commitments made by the countries of the Pacific region.

Table 3. Summary of NDC and National Adaptation Plans (NAP) Priorities by Country

Country	NDC	Priorities	NAP Priorities
	Mitigation	**Adaptation**	
Federated States of Micronesia	• Reduce emissions from electricity generation (35 percent) and transport (35 percent) by 2025	• No adaptation commitments	
Fiji	• Reduce emissions from electricity generation (30 percent) and transport (40 percent) by 2030	• Agriculture • Infrastructure • Health • Land and marine ecosystems	• Food security • Health • Human settlements • Infrastructure • Biodiversity and ecosystems
Kiribati	• Reduce emissions by 13.7 percent by 2025 from energy generation • Planting mangroves to act as carbon sinks	• Agriculture • Governance • Infrastructure • Health • Land and marine ecosystems • Education • Disaster management	• Agriculture • Governance • Infrastructure • Health • Land and marine ecosystems • Education • Disaster management
Marshall Islands	• 45 percent reduction in emissions from transport by 2030 • 40 percent reduction in emissions from shipping by 2030	• No adaptation commitments	
Nauru	• Achieve 50 percent renewable energy capacity by 2030	• Agriculture • Governance • Food security • Water security	

[15] Benjamin, L., Thomas, A. and Haynes, R., 2018. An 'Islands' COP'? Loss and damage at COP23. *Review of European, Comparative & International Environmental Law*, 27(3), pp.332-340.

Country	NDC	Priorities	NAP Priorities
	Mitigation	**Adaptation**	
	• Reduce emissions from energy generation by 30 percent, by 2030	• Health • Land and marine ecosystems •	
Palau	• 22 percent energy sector emissions reductions below 2005 levels by 2025 • 45 percent Renewable Energy target by 2025 • 35 percent Energy Efficiency target by 2025	• No adaptation commitments	
Papua New Guinea	• Reduce emissions from electricity generation (carbon neutrality by 2030) and land use • 100% renewable energy by 2030 contingent on funding made available • By 2030, reduction in annual emissions from deforestation of 10,000 gigatons CO_2 equivalent compared to 2015	• Agriculture • Health • Infrastructure • Transport • •	• Agriculture • Health • Infrastructure • Transport
Samoa	• Reduce greenhouse has (GHG) emissions in the energy sector by 30 percent in 2030 • Reduce GHG emissions in the waste sector by 4 percent in 2030 • Reduce GHG emissions in	• Land and marine ecosystems	

Country	NDC	Priorities	NAP Priorities
	Mitigation	**Adaptation**	
	agriculture, forestry, and other land use by 26 percent in 2030		
Solomon Islands	• Reduce overall emissions by 14 percent (by 2025) and 33 percent (by 2030). With appropriate international assistance, emissions can be reduced by more than 50% by 2050	• Disaster management • Information management • Land and marine ecosystems • Waste management • Infrastructure • Tourism	
Tonga	• Reduce emissions from the energy sector by 13 percent by 2030	• Agriculture • Land and marine ecosystems • Coastal habitats and fisheries	• Agriculture • Fisheries • Infrastructure • Water resources • Biodiversity and ecosystems
Tuvalu	• Reduce GHG emissions by 100 percent from the electricity sector by 2025 • Reduce GHG emissions from energy sector by 60 percent below 2010 level by 2025	• No adaptation commitments	
Vanuatu	• Transition to nearly 100 percent renewable energy in electricity sector by 2030 • By 2030, improvement of efficiency (10 percent) in transport sector (land and marine)	• Agriculture • Water resources • Disaster management (L&D)	

At the regional level, the Secretariat of the Pacific Community (SPC) represents the largest multilateral international development body in the Pacific, supporting twenty-two nations and territories, including the twelve islands supported by the United States Agency for International Development (USAID). SPC provides technical guidance on climate change (and other development priorities of the member states) advocating for greater awareness of the unique issues facing the region. SPC has prioritized climate change and one of its nine technical units – the Climate Change and Environmental Sustainability Division – is dedicated to understanding climate impacts and implementing adaptation and mitigation activities.

In addition to SPC, the Secretariat of the Pacific Regional Environmental Programme (SPREP), headquartered in Samoa, promotes policies to protect the Pacific environment. With respect to climate change, the SPREP promotes the Framework on Resilient Development in the Pacific to guide a collaborative approach with regional organizations, donors, and the United Nations system to strengthen resilience to climate change. In addition, the Pacific Island Forum (PIF) leads economic and policy cooperation across 18 countries in Oceania (including all 12 PICs supported by USAID). The Council of Regional Organizations in the Pacific (CROP) also fulfills a support role, with a mandate to improve cooperation, coordination, and collaboration among the various intergovernmental regional organizations to work toward achieving the common goal of sustainable development in the Pacific region.

Other international partners with presence in the region include the United Nations Development Programme (UNDP), the United Nations Environment Programme (UNEP), the Global Green Growth Institute (GGGI), the Food and Agriculture Organization (FAO), the World Food Programme (WFP), and the United Nations Educational, Scientific and Cultural Organization (UNESCO).

4. ANALYSIS OF OVERALL AND SECTOR-SPECIFIC CLIMATE RISKS

The Analysis of Overall and Sector-Specific Climate Risks section discusses adaptive capacity, opportunities, gaps, and actions needed to address climate risk both overall and by sector, as well as sector-specific impacts and vulnerabilities. The Climate Risk Screening Table in Annex I provides a summary of these issues relevant to the three development objectives of the Strategic Framework (**Community Resilience Strengthened**, **Resilient Economic Growth Advanced**, and **Democratic Governance Strengthened**) along with their associated intermediate results. In addition, Annex II provides additional information on greenhouse gas mitigation in the context of the Strategic Framework, and Annex III includes additional information on Clean Energy, Sustainable Landscapes, and Adaptation.

4.1. OVERALL

Adaptive Capacity

Adaptive capacity in the Pacific region varies from country to country. Some countries, like Fiji, have stronger institutions and presence of international organizations to drive adaptation efforts; and others, like Kiribati, have limited capacities and economic resources to adapt to climate change. Overall, the Pacific region has relatively low adaptive capacity compared to other regions, and several PIC rank among the most vulnerable to climate change globally – largely due to limited economic output, limited access to services (especially in the more remote outer islands), depleting natural resources, limited technical and

financial capacity, and limited connectivity.[16] Rapid demographic change in the PIC, including rapid urbanization rates, are also changing the dynamics of vulnerability and adaptive capacity. On the one hand, movement towards cities places additional stress on services (such as sanitation and waste management), while on the other, migration to urban centers offers the possibility to access better education and learn skills that can support climate change management efforts.

Opportunities and Gaps

Recognizing the risks associated with climate change, several PIC have developed ambitious plans to mitigate greenhouse gas (GHG) emissions and to address adaptation needs. These ambitions are articulated in the NDC documents as well as the NAPs. There is an opportunity to leverage these policy commitments and support them through the USAID Strategic Framework for PIC. At the same time, there are a number of donors that are actively engaged in the region – including the European Union, Australia, New Zealand, Japan, Korea, India, the United Kingdom, France and various multilateral organizations (the World Bank, the Asian Development Bank, the United Nations system). The presence of partners which share a common vision with USAID offers an additional opportunity to build on existing initiatives and scale climate change interventions.

Despite these opportunities, key gaps remain. Discussions with regional stakeholders reveal that climate change investments are biased towards larger countries such as PNG, the Solomon Islands, Fiji, and Vanuatu, whereas smaller countries like Nauru, Palau, Tuvalu, Tonga, and Kiribati receive less donor attention. In part this is because of smaller populations, the size of the countries, and their NDC targets. The bias in investments can exacerbate existing vulnerabilities for countries which already lack financial resources to invest in climate risk management. In addition, key informants highlighted that funding for climate change interventions does not currently address the needs of marginalized groups – especially women, youth, and people living with disabilities, again exacerbating vulnerabilities. Nevertheless, USAID incorporates mainstreaming of gender and social issues throughout the program development cycle. Co-financing development projects in the Pacific region with other development agencies can foster stronger relationships with partners and local governments. For instance, given that many development partners require a mitigation component, it may be beneficial to collaborate with other agencies and agree on a set of mitigation criteria. Similarly, major climate finance bodies such as the Green Climate Fund, the Global Environment Facility and the Adaptation Fund have established criteria for inclusion of marginalized groups and women in climate change projects.

Finally, another major gap is the lack of capacity to interpret and use climate information for decision-making. Currently, a major source of information for PIC is the Commonwealth Scientific and Industrial Research Organization's (CSIRO) "Climate Change in the Pacific: Scientific Assessment and New Research" reports. Moving forward, efforts should focus on regularly updating climate data and building local capacities to use the kind of information provided in the CSIRO reports across various sectors. At the same time, there is a need to build the capacities of scientific institutions to understand information needs and processes in local contexts to ensure that information is useful for end users.

[16] Warrick, O., Aalbersberg, W., Dumaru, P., McNaught, R. and Teperman, K., 2017. The 'Pacific Adaptive Capacity Analysis Framework': guiding the assessment of adaptive capacity in Pacific Island communities. *Regional Environmental Change*, *17*(4), pp.1039-1051.

Recommended Actions to Address Climate Risk

On the basis of our review, we present a set of recommended actions to address climate risks. The specific actions needed to address climate risks depend on the sector and are presented below; however, some key commonalities exist:

- **Identify mitigation co-benefits of climate risk management solutions.** Despite the relatively small contribution of the PIC to GHG emissions there are advantages to identifying the mitigation co-benefits associated with different investments. For instance, investments in the agricultural sector could focus on practices that simultaneously increase production, reduce impacts associated with hazards, and reduce GHG emissions (e.g., agroforestry). Similar co-benefits should be explored in other sectors.

- **Improve access to climate information and capacity of key stakeholders to use the information.** A major gap in the region is the relative lack of climate science produced locally. Most of the climate information in the region comes from international climate service providers such as the Australian Bureau of Meteorology, and to a lesser extent, from the United States' National Oceanic and Atmospheric Administration. Increased engagement from local meteorological services in PIC will ensure greater ownership of climate information and local capacity to interpret and use climate information. Efforts should continue to focus on building the capacity of key stakeholders and communities to use climate information in their decision-making processes, including for example through sponsored classes that focus on developing climate finance proposals. As highlighted earlier, though, it is also important for scientific and technical organizations to build capacities to understand the needs of end users and ensure that information products are useful.

- **Develop stronger partnerships with private sector and inter-agency stakeholders.** To date, the majority of climate finance in the Pacific comes from multilateral funds (e.g., the Green Climate Fund, Adaptation Fund, Asian Development Bank funds) or bilateral partners (e.g., USAID, Australia Department of Foreign Affairs and Trade). The private sector has a potentially significant role in scaling climate solutions, but the scope of these partnerships should be further explored. Inter-agency stakeholders engaged in climate change activities, such as the U.S. International Development Finance Corporation, the United States Trade and Development Agency, the Export-Import Bank of the United States, and the Department of Defense should also be considered for potential partnerships.

- **Strengthen partnerships at the community level to ensure context-specific solutions.** Community-ownership of different climate risk management efforts is critical to the success of these initiatives. Projects should continue to identify appropriate mechanisms to engage communities (and community leaders) in the design and implementation of climate change activities so that climate solutions are relevant to the context. Often, impacts and needs vary across islands (and even within islands), so the success of climate risk management depends on ensuring that these unique needs are identified and integrated into program design.

- **Focus on marginalized groups.** Marginalized groups, especially women, youth, and people with disabilities, are not always included in the design and implementation of climate solutions. Their unique vulnerabilities should be more explicitly considered in the design of programs and projects.

4.2. Fisheries, Coastal Zones and Ecosystems

Impacts and Vulnerabilities

Excluding PNG, 90 percent of Pacific islanders live in coastal areas and depend on associated land and marine coastal resources for their livelihood.[17] The majority of cities and larger population centers are also located in coastal zones and are vulnerable to storm surges and coastal flooding. Coastal areas provide many ecosystem services that support human wellbeing: for instance, seagrass beds and mangrove habitats are important habitats for spawning, nursery, and feeding grounds for a number of species whilst for tropical small islands, coral reefs constitute the primary coastal protection structures, and provide sand for the formation of atolls, islets, and beaches.[18] In addition, coral reefs provide a critical source of food and employment for coastal communities and provide other functions, including protection against extreme events such as storms and hurricanes, storage and cycling of nutrients, sustaining biodiversity, and maintaining water balance.[19]

The coastal zones of PIC face extreme pressure due to sea-level rise, stronger storm surges and typhoons, ocean acidification and drought associated with the ENSO phenomenon, and the loss of endemic species of fish, coral, bird, and ecosystems (freshwater, coastal, marine, and terrestrial) as a result of increased global mean temperatures.[20,21] One of the most significant risks is the possibility of mass coral bleaching events due to sudden increases in ocean temperatures, which could degrade marine ecosystems and trigger major shifts in fish migration patterns. These patterns can have devastating impacts on food security and the gross incomes of coastal communities. As well as being a key source of food for communities, coral reefs buffer erosion from waves on island shorelines. Consequently, degraded coral reefs not only support less fish, but they also become less effective at moderating shoreline erosion.[22] Another major risk is the reduced availability of freshwater as a result of saltwater intrusion into coastal areas. Existing groundwater resources, which are already quite limited, could be heavily contaminated (see section on *Water Resources*).

Adaptive Capacity

The fisheries sector is not well-adapted to the impacts of coral bleaching (which could result in habitat loss for key fish species). In addition, the majority of fishing communities in the region rely on traditional fishing methods which are not designed to withstand the effects of more intense tropical storms and

[17] Andrew, N. L., Bright, P., de la Rua, L., Teoh, S. J., & Vickers, M. (2019). Coastal proximity of populations in 22 Pacific Island Countries and Territories. *PloS one*, *14*(9), e0223249.

[18] Ram-Bidesi, V., P. N. Lal, and N. Conner 2011. Economics of Coastal Zone Management in the Pacific. Gland, Switzerland: IUCN and Suva, Fiji: IUCN, xiv + 88. https://portals.iucn.org/library/sites/library/files/documents/2011-119.pdf

[19] Martinez, M. L., Intralawan, A., Vazquez, G., Sutton, P., & Landgrave, R. (2007). The Coasts of our World: ecological, economic and social importance. Ecological Economics, 63, 254–272.

[20] Climate Risk Country Profile: Micronesia (2021): The World Bank Group and the Asian Development Bank. URL: https://reliefweb.int/sites/reliefweb.int/files/resources/climate-risk-country-profile-micronesia.pdf [Accessed 06 May 2023]

[21] Oliver, E. C., Donat, M. G., Burrows, M. T., Moore, P. J., Smale, D. A., Alexander, L. V., . . . & Holbrook, N. J. (2018). Longer and more frequent marine heatwaves over the past century. Nature communications, 9(1), 1324

[22] Hanich, Q., Wabnitz, C. C. C., Ota, Y., Amos, M., Donato-Hunt, C., & Hunt, A. (2018). Small-scale fisheries under climate change in the Pacific Islands region. Marine Policy, 88, 279–284. DOI: https://doi.org/https://doi.org/10.1016/j.marpol.2017.11.011

cyclones, as projected for the region.[23] Communities in low-lying atoll islands are especially vulnerable as they often lack capacity to manage the added risk of sea-level rise. Finally, coastal communities do not receive training on how to use climate information and therefore do not often make key livelihood decisions based on climate trends.[24]

Opportunities and Gaps

The fisheries sector features prominently in national development and adaptation plans throughout the Pacific region. The high policy-level commitments offer an opportunity to achieve long-term adaptation goals for coastal fishing communities. However, key gaps exist. First, there is limited capacity to use and interpret climate information to make decisions about where and when to fish. Second, there are limited investments in the restoration of corals which offer a habitat to the types of fish that coastal communities depend on. Third, the technology that fisherfolk use needs modernization. Nature-based solutions for climate mitigation could reach 30 percent of the world's mitigation potential,[25] given that utilizing ecosystems is a cost-effective and more sustainable way in reduce people's vulnerability to climate change impacts while maintaining or restoring local, regional and/or global ecosystem services. Stakeholders have indicated that the coastal management sector is prone to maladaptation measures, mainly due to the preference for seawalls which have limited benefits for preventing coastal erosion.

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Recommended Actions to Address Climate Risk

- **Invest in real-time monitoring.** Given the large area covered by the PIC, there is limited real-time information on the status of fisheries. There is therefore a need to invest in monitoring the state of fisheries and reefs to better understand regions that need priority support. Such information will enable program implementers to ascertain whether different solutions are having positive or negative impacts.

- **Modernize fishing techniques and equipment.** There is also a need to modernize fishing techniques in a way that is beneficial to the poorest fisherfolk. Communities use boats and fishing equipment that are vulnerable to the impacts of intense tropical storms. Severe storms can destroy these critical livelihood assets, rendering communities unable to make an income from fishing. Stakeholders suggested investing in inshore fish aggregating devices to ensure that coastal communities can have better access to the tuna they will need for food security in the future.

- **Engage with the private sector.** Finally, addressing climate risk requires engagement with the private sector through public-private partnerships. Specifically for fisheries, the governments and private sector could offer incentives to limit coastal fishing as a way of promoting reef health and ensuring that the ocean acts as a carbon sink.

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[23] Karcher, D.B., Fache, E., Breckwoldt, A., Govan, H., Ilosvay, X.E.E., King, J.K.K., Riera, L. and Sabinot, C., 2020. Trends in South Pacific fisheries management. *Marine Policy*, *118*, p.104021.

[24] Warrick, O., Aalbersberg, W., Dumaru, P., McNaught, R. and Teperman, K., 2017. The 'Pacific Adaptive Capacity Analysis Framework': guiding the assessment of adaptive capacity in Pacific island communities. Regional Environmental Change, 17(4), pp.1039-1051.

[25] Griscom, B. et al. We need both natural and energy solutions to stabilize our climate - Griscom - 2019 - Global Change Biology - Wiley Online Library. Available at: https://onlinelibrary. wiley.com/doi/full/10.1111/gcb.14612. (Accessed 14th September 2019)

4.3. AGRICULTURE

Impacts and Vulnerabilities

Approximately 67 percent of the region's population depend on agriculture for their livelihood,[26] but there is variation in the relative contribution of the agriculture sector to overall economic output. For instance, in Fiji, agriculture accounts for 9.3 percent of the gross domestic product (GDP), in PNG accounts for 16.98 percent of the GDP while in Solomon Island, 29.7 percent of the GDP comes from agricultural activities.[27] However, despite the large contribution of agriculture to the livelihoods of Pacific Islanders, the region is critically dependent on food imports from the United States, Japan, Australia, the European Union and increasingly, the People's Republic of China.

Climate risks affect agriculture in the region through multiple pathways. First, more erratic rainfall patterns have impacts on the availability of water for rainfed agriculture, and more unpredictable rainfall distribution affects the ability of farmers to plan their agricultural activities. Second, more severe tropical storms can destroy crops and kill livestock, resulting in lost income and reduced access to food. Third, sea-level rise could accelerate saltwater intrusion, thereby affecting the availability of freshwater for agriculture and ultimately the quality of crops.[28]

Adaptive Capacity

Adaptive capacity is limited by the fact that agriculture in the Pacific is predominantly rain-fed, and there is generally very limited access to irrigation infrastructure. As a result, the agriculture sector is highly vulnerable to the impacts of more erratic rainfall patterns and more frequent and intense extreme weather events. In addition, the agriculture sector in the Pacific is not set up to withstand the effects of sea-level rise (and the resulting salt intrusion). Land conversion to agriculture is also a major contributor to deforestation in PNG and the Solomon Islands, and thereby contributes to GHG emissions.[29]

Opportunities and Gaps

PIC governments give high priority to the agricultural sector, both overall and in terms of climate issues, which is a source of opportunity. Agriculture is mentioned as a priority sector in six of the NDC documents of the region (PNG, Fiji, Kiribati, Nauru, Tonga, and Vanuatu). Adaptation priorities include developing climate-smart agriculture systems that ensure increased crop productivity while adapting to a changing climate and reducing GHG emissions; improving soil and water resource efficiency; modifying crop practices; and integrating agroforestry practices. There are various opportunities to build on these priorities and engage governments, communities, and the private sector. Land use conversion for agriculture remains a major source of GHG emissions; however, there are no clearly articulated policies to address these competing priorities. Another key challenge is the lack of capacity – especially at the

[26] FAO. (2011). The state of food insecurity in the world: How does international price volatility affect domestic economies and food security? FAO Publications, Rome, Italy.

[27] World Bank Group. 2020. World Bank Development Indicators. Accessed from https://data.worldbank.org/indicator/NV.AGR.TOTL.ZS?

[28] Taylor, M., McGregor, A. and Dawson, B., 2016. *Vulnerability of Pacific agriculture and forestry to climate change*. Secretariat of the Pacific Community.

[29] Park, S., Howden, M. and Crimp, S., 2012. Informing regional level policy development and actions for increased adaptive capacity in rural livelihoods. *Environmental Science & Policy*, *15*(1), pp.23-37.

community-level – to use climate change information to make decisions about agricultural livelihoods, including which crops to grow and when.[30]

Actions Needed to Address Climate Risks

- **Invest in climate-smart agriculture.** Investments in climate-smart agriculture, i.e., agricultural practices that increase crop production while offering adaptation to climate impacts and reducing carbon emissions, are essential to ensuring the sustainability of the sector. Such initiatives could include agroforestry and coastal agriculture practices that promote mangrove growth.

- **Invest in climate services and access to information.** As the climate continues to change and weather patterns become erratic, farmers should have information on the appropriate time to plant specific crops. Therefore, investments in developing climate services for agriculture are essential.

- **Identify cross-sectoral synergies**. Finally, given that agriculture depends on access to water resources, it is important to identify synergies across these two sectors (see section on *Water Resources*).

4.4. Energy and Other Critical Infrastructure

Impacts and Vulnerabilities

The Pacific region faces unique energy challenges – the historical lack of domestic fossil fuel supplies has led to a dependence on imported diesel for energy generation. In 2017, around 80 percent of the region's commercial energy supply was derived from imported fuels – which is similar to the amount imported in 2000, indicating a continued reliance on imports.[31] Several governments in the region have started to diversify their energy mix away from fossil fuels to include renewable energy sources such as wind energy, hydroelectric power, and solar energy. In addition to ensuring energy resilience, the transition towards a more diversified energy system can have substantial climate change mitigation benefits. In fact, all twelve PIC have made pledges to reduce emissions from the energy sector over the next two decades through their NDC documents. However, despite these commitments progress towards ensuring access to renewable energy is inconsistent across the region: countries like PNG and Fiji are already producing more than 60 percent of their energy through renewable sources while countries like Nauru, Palau, and the Marshall Islands only obtain 2 percent of their energy from renewables.[32]

The most direct way in which climate change can affect the energy sector is through damage to energy (and related) infrastructure. For instance, fossil fuels are predominantly imported through ports and other coastal infrastructure which is projected to be especially impacted by rising sea levels and more intense cyclones.[33,34] Damage to coastal infrastructure can severely affect fuel imports and lead to serious

[30] Bruce, E., Boruff, B., Wales, N., Duncan, J. and Haworth, B., 2018. Using the Environmental Livelihoods Security (ELS) framework for developing climate-smart landscapes: a preliminary investigation for informing agricultural policy in the South Pacific. *ACIAR Final Reports*, (FR2018/22).

[31] SPC, 2021. Framework for Energy Security and Resilience in the Pacific (FESRIP) 2021–2030. shorturl.at/aimrY

[32] SPREP, 2020. State of environment and conservation in the pacific islands: 2020 regional report. https://pacific-data.sprep.org/system/files/SOEC-Indicator-27.pdf

[33] SPREP, 2020. State of environment and conservation in the pacific islands: 2020 regional report. https://pacific-data.sprep.org/system/files/SOEC-Indicator-27.pdf

[34] Bundhoo, Z.M., Shah, K.U. and Surroop, D., 2018. Climate proofing island energy infrastructure systems: Framing resilience based policy interventions. Utilities Policy, 55, pp.41-51.

disruptions in fossil fuel availability throughout the region. When typhoons damage ports, cargo vessels are docked off shore and goods are then ferried to shore on smaller vessels – a process that is rather fuel-intensive. Moreover, tropical cyclones can damage the infrastructure that produces (e.g., generators) or provides (e.g., transmission cables) electricity. In addition, cyclones can damage key infrastructure related to production of renewable energy (for example, through damage to solar panels or hydropower dams), so significant investments should be made to ensure new energy infrastructure is resilient to the impacts of climate change.

Other critical infrastructure is at high risk of climate change through impacts associated with tropical cyclones and storm surges. Tropical Cyclones Winston (2016) and Pam (2015) dramatically demonstrated the potential losses that intense cyclones can trigger in the Pacific. For instance, in Fiji, Tropical Cyclone Winston resulted in more than US$ 900 million in damage (primarily on infrastructure),[35] and Pam (2015) resulted in losses of 60 percent of the GDP and 90 percent of buildings in Vanuatu.[36]

Increased precipitation can also result in damage to critical infrastructure through multiple pathways. At the global level, there is evidence that rainfall-induced erosivity is one of the main causes for soil erosion,[37] which can lead to unstable land for infrastructure. Heavy rainfall events, which are projected to become more frequent under climate change, can also damage infrastructure. Aside from destruction of infrastructure from flood events, heavy rainfall can cause structural damage, wearing out, and aging quickly, thus increasing maintenance and replacement costs.[38]

The energy sector may also be indirectly affected due to changes in availability of water. On the one hand, hydroelectric dams require reliable water to ensure electricity generation. Erratic rainfall events, including more severe drought episodes, can threaten availability of water for hydropower generation. On the other hand, water is a key resource in power generation facilities, and is used in the cooling process. Reduced availability (or erratic availability) of water resources can compromise energy generation.[39]

Adaptive Capacity

Limited adaptive capacity exists in the energy sector, and energy infrastructure continues to be highly susceptible to the impacts of tropical cyclones. Recent storms such as Pam (2016) and Winston (2015) had devastating impacts on ports (where countries import fossil fuels) and electricity infrastructure, such as power lines and generators. Currently, NAPs in the region do not prioritize the energy sector and investments in energy are seen only as a mitigation solution. In addition, across the region, over 57 percent of the built infrastructure in the Pacific is located within 500 meters of the nearest coastline, and in eight of the 12 countries at least 50 percent of the national infrastructure is located in this critical space that is highly susceptible to climate impacts. Perhaps more worryingly, Kiribati, Marshall Islands and Tuvalu have

[35] ADB, 2020. Pacific Energy Update 2020. https://www.adb.org/documents/pacific-energy-update-2020

[36] OCHA, 2016. Fiji: Severe Tropical Cyclone Winston Situation Report No. 19 (as of 23 March 2016). https://reliefweb.int/report/fiji/fiji-severe-tropical-cyclone-winston-situation-report-no-19-23-march-2016

[37] Guerra, C.A., Rosa, I., Valentini, E., Wolf, F., Filipponi, F., Karger, D.N., Nguyen Xuan, A., Mathieu, J., Lavelle, P. and Eisenhauer, N., 2020. Global vulnerability of soil ecosystems to erosion. Landscape ecology, 35(4), pp.823-842.

[38] Currenti, R., Pearce, T., Salabogi, T., Vuli, L., Salabogi, K., Doran, B., Kitson, R. and Ford, J., 2019. Adaptation to climate change in an interior pacific island village: a case study of Nawairuku, Ra, Fiji. Human Ecology, 47(1), pp.65-80.

[39] Zhou, Q., Hanasaki, N., Fujimori, S., Masaki, Y. and Hijioka, Y., 2018. Economic consequences of global climate change and mitigation on future hydropower generation. Climatic Change, 147(1), pp.77-90.

over 95 percent of their built infrastructure located within 500 meters of their coastlines.[40] With tropical cyclones projected to become more intense, it is therefore important to invest in "climate-proofing" infrastructure to prevent severe damage to critical infrastructure. Stakeholders have also highlighted that the proliferation of regional energy centers could represent a hurdle to coordination in the energy sector, including in the context of addressing climate change impacts. USAID prefers to work with individual PIC to address energy needs.

Opportunities and Gaps

There are a number of ongoing projects focused on increasing energy access in the Pacific, mainly financed by the Asian Development Bank (ADB) and the European Union. In PNG, the United States is contributing to the country's goal to increase PNG's electricity access to 70 percent by 2030, up from 13 percent along with other partner countries such as Australia, Japan and New Zealand through the USAID-PEP (PNG Electrification Partnership) project through the use of clean energy. There is an opportunity to complement these existing initiatives and fill in major gaps. For instance, currently energy projects do not include investments in climate-proofing key infrastructure. Another gap is that existing initiatives focus on increasing supply of energy and increasing connectivity to electrical grids – but limited investments are made in reducing demand for energy,[41] and explore opportunities for energy efficiency and conservation.

Recommended Actions to Address Climate Risk

A large proportion of energy and other critical infrastructure are located in low elevation coastal zones that are vulnerable to the impacts of sea-level rise and storm surges. Adaptation measures may include relocating infrastructure further inland (or to higher lands where possible). It is necessary to "climate-proof" critical infrastructure (including ports and energy infrastructure) to withstand more severe storms. For example, ports that import fuel oil should be built with appropriate technology and materials. It will be important to promote practices to reduce demand for electricity.

Stakeholders highlight the importance of increasing self-sufficiency at the island level. Given the low population numbers and low industrial activity in some of the outer islands – as well as the difficulty of connecting these islands to central electrical grids – there is a unique possibility to test the feasibility of ensuring electricity through renewable sources to meet local needs.

4.5. WATER RESOURCES

Impacts and Vulnerabilities

Access to freshwater is highly limited in the Pacific, and therefore water security is one of the greatest concerns in the region.[42] Atoll islands such as Tuvalu, Marshall Islands, and Kiribati, are especially vulnerable due to the lack of groundwater resources. In these islands, there is a risk of overusing the main source of freshwater – rainfall. Climate change poses a serious threat to water security through more

[40] Kumar, L. and Taylor, S., 2015. Exposure of coastal built assets in the South Pacific to climate risks. *Nature Climate Change*, *5*(11), pp.992-996.

[42] Carpenter, C & Jones, P. "An Overview of Integrated Water Resources Management in Pacific Island Countries: A National and Regional Assessment Status Report for GWP – Integrated Water Resources Management (IWRM) Prepared for the South Pacific Applied Geoscience Commission (SOPAC), January 2004". URL: http://www.pacificwater.org/userfiles/file/MR0554.pdf [Accessed 27 May 2022]

frequent and intense hazards. Drought can limit access to water, and sudden-onset hazards like tropical cyclones and floods can damage infrastructure to collect rainwater.

In volcanic islands there is greater access to freshwater through rivers and streams, as well as through surface and groundwater. However, coastal and river flooding can degrade water quality. Droughts affect the availability and quality of freshwater, especially for domestic and agricultural use. In addition, sea-level rise can result in saltwater intrusion which decreases the quality of existing freshwater. Finally, evidence suggests that women and girls are often designated to fetch water (usually within walking distance from their homes), but the threats associated with droughts and floods may result in longer walking time required to collect safe water.[43]

Cities may also face unique vulnerabilities under climate change. As cities in the PIC continue to grow, there is increasing infrastructure being built – some of which may not withstand the effects of climate. For instance, concrete does not allow water to permeate soils and therefore can increase the risk of flooding. This, in turn, may result in clogged sewers and lower access to clean water resources overall.[44]

Adaptive Capacity

Water resources are threatened by both drought (which limit the availability of water for agriculture and own consumption) as well as floods and tropical cyclones (which can damage key water infrastructure, including containers and treatment plants). Only Nauru, Tonga and Vanuatu have explicit commitments to invest in adaptation efforts for the water sector. Another major challenge is that key stakeholders in the water sector lack the capacity or knowledge to use climate data in their project management cycles.[45]

Opportunities and Gaps

Water security is a fundamental part of climate resilience in the Pacific; and while several governments have committed to improving access to water resources in their national policies, the sector is only featured prominently in two NDC documents (Kiribati and Vanuatu). The sector faces similar gaps as other sectors, including limited investment in climate-proofing key water infrastructure to withstand the effects of tropical cyclones and sea-level rise, limited capacity of stakeholders to interpret and use climate information, limited engagement from the private sector in some countries, and limited efforts to promote community-based sustainable water resource management solutions.

Recommended Actions to Address Climate Risk

Adaptation measures should focus on sustainably improving access to freshwater. For instance, rainwater harvesting techniques can be used to recharge aquifers and simultaneously prevent saltwater intrusion into groundwater. Similarly, small-scale local desalination plants can improve access to freshwater access without requiring large infrastructure.

[43] Hadwen, W.L., Powell, B., MacDonald, M.C., Elliott, M., Chan, T., Gernjak, W. and Aalbersberg, W.G., 2015. Putting WASH in the water cycle: Climate change, water resources and the future of water, sanitation and hygiene challenges in Pacific Island Countries. *Journal of Water, Sanitation and Hygiene for Development*, *5*(2), pp.183-191.

[44] White, I. and Falkland, T., 2015. Integrated management of urban water supply and water quality in developing Pacific Island countries. In Understanding and Managing Urban Water in Transition (pp. 489-526). Springer, Dordrecht.

[45] Piesse, M., 2019. Climate change threats to food and water security on Pacific atolls.

Investments should focus on improving the capacity of stakeholders to use and understand climate information. For instance, climate projections could indicate decreases of rainfall in certain regions; water stakeholders should then focus adaptation solutions in these areas.

4.6. DISASTER MANAGEMENT

Impacts and Vulnerabilities

Annually, direct economic losses from climate-related hazards – through damage to infrastructure, crop losses and destruction of livelihood assets – are estimated at US$284 million in the PIC.[46] In recent years, strong storms have demonstrated the high vulnerability of PIC to extreme weather events: Cyclone Winston (2016) resulted in losses of US$0.9 billion in Fiji, equivalent to more than 20 percent of the GDP. In Vanuatu, estimates suggest that cyclones cause average annual damages equivalent to 6.6 percent of the GDP.[47] Droughts have devastating impacts through water shortages and crop losses. For example, during the 2015-2016 ENSO event, 40 percent of communities in Vanuatu experienced water shortages while in the Solomon Islands, 100 percent of water tanks were depleted, and most communities used coastal brackish water for at least one month. Given the proximity of most cities and major population centers to coastal areas in PIC, urban areas are particularly vulnerable to extreme weather events.

The magnitude of extreme weather events including tropical cyclones, floods, and droughts are projected to increase. In the South Pacific, tropical cyclones are projected to become slower and more frequent – so even with reduced intensity such storms will result in heavy rainfall events. Floods are projected to become more frequent and severe due to shorter but more intense rainy seasons. Forecasts suggest that droughts could become longer and more severe due to higher temperatures and lower rainfall in the dryer months. In addition, the region will experience new risks such as higher sea surface temperatures (which can affect coral health and the ability of corals to buffer the effects of storms), and sea-level rise (which could exacerbate the effects of storm surges and coastal flooding). These risks will pose additional threats to disaster management.

Adaptive Capacity

Across the region there are well-developed strategies for disaster management which often incorporate climate change considerations. At the same time, several adaptation programs have a strong disaster management component. Overall, the trend in the last decade has been to promote development that proactively integrates the management of disaster and climate related hazards by investing in disaster risk management, climate change adaptation and GHG emissions reduction. However, there is often limited capacity to implement these ambitious plans with multiple co-benefits at the local level, especially in the more remote outer islands.[48]

[46] World Bank. 2011. Pacific Catastrophe Risk and Financing Initiative. Pacific Disaster Risk Financing and Insurance Program Briefing Note. Washington DC.

[47] Mansur, A., Doyle, J., and Ivaschenko, O. "Social Protection and Humanitarian Assistance Nexus for Disaster Response: Lessons Learnt from Fiji's Tropical Cyclone Winston". World Bank Group. Discussion Paper No. 1701. URL: https://documents1.worldbank.org/curated/en/143591490296944528/pdf/113710-NWP-PUBLIC-P159592-1701.pdf [Accessed 27 May 2022].

[48] Fletcher, S.M., Thiessen, J., Gero, A., Rumsey, M., Kuruppu, N. and Willetts, J., 2013. Traditional coping strategies and disaster response: Examples from the South Pacific region. *Journal of environmental and public health*, *2013*.

Opportunities and Gaps

Recognizing the high vulnerability of small island states to more frequent and intense climate hazards, several governments in the Pacific have prioritized disaster management approaches that consider climate projections. The disaster management approaches provide an opportunity to strengthen the linkages between disaster management, preparedness and climate change adaptation to enhance resilience. Tuvalu, for instance, has established a National Strategy for Sustainable Development (2016-2020), which has an ambition to implement a 'build back better' approach to disaster recovery, particularly following cyclones. Despite these ambitions, there is still limited capacity among emergency responders to include climate science in their plans. In addition, disaster management efforts in the region do not focus on particularly marginalized groups, such as women and people living with disabilities.

Recommended Actions to Address Climate Risk

The disaster management sector should include climate science more explicitly in its processes. Climate change projections indicate that tropical cyclones are likely to become more intense under future climate. In addition, sea-level rise will exacerbate the risk of catastrophic storm surges. The disaster management authorities should update their plans to consider these additional risks.

Similar, disaster management should consider the needs of marginalized groups, especially women, youth and people living with disabilities. For example, people with disabilities may not be able to reach evacuation centers. In such cases, evacuation centers should be built in such a way that people with disabilities can easily access them.

4.7. Economic Development and Livelihoods

Impacts and Vulnerabilities

The majority of rural areas in the PIC rely on subsistence agriculture and fishing for their livelihoods and food security; however, these are highly sensitive to climate change impacts.[49] The main climate risks affecting rural livelihoods are increased risk of climatic hazards due to sea-level rise and more intense rainfall events; degradation of coastal ecosystems due to increases in sea and air temperature, sea-level rise, and ocean acidification; more severe tropical storms; more frequent and intense floods; and concomitant effects on other sectors including agriculture, water security, and health[50] (see relevant sections).

In addition, the region critically depends on tourism and activities such as diving and snorkeling. Under climate change, the risk of coral bleaching could reduce reef health and therefore the quality of fish populations, which in turn reduces the touristic appeal of the region. Further research is needed to quantify the severity of a coral bleaching risk on overall economic output.[51]

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[49] WFP (2018) Food Security in Vulnerable Islands - A Regional Food Security Atlas of the Pacific. Available at: https://www.wfp.org/publications/food-security-vulnerable-islandsregional-food-security-atlas-pacific-may-2018 (Accessed 03 July 2022).

[50] Intergovernmental Panel on Climate Change (ed.) (2014) 'Small Islands', in Climate Change 2014 – Impacts, Adaptation and Vulnerability: Part B: Regional Aspects: Working Group II Contribution to the IPCC Fifth Assessment Report: Volume 2: Regional Aspects. Cambridge: Cambridge University Press, pp. 1613–1654. http://doi.org/10.1017/CBO9781107415386.009.

[51] Wong, E.P., de Lacy, T. and Jiang, M., 2012. Climate change adaptation in tourism in the South Pacific—Potential contribution of public–private partnerships. *Tourism Management Perspectives*, *4*, pp.136-144.

Finally, because the region covers a large area, major trade routes include the exclusive economic zones of the PIC.[52] Economic development therefore critically depends on facilitating trade, even though the region is a net importer of goods. Climate change could threaten trade through destruction of ports and other critical infrastructure required for trade.

Adaptive Capacity

The region has experienced consistent but slow economic growth in the last 20 years, except for a recession induced by the COVID-19 pandemic. Exports of the PIC have increased by 169 percent in the past 20 years. The PIC are relatively small, and therefore reaching economies of scale at the local level are limited. Therefore, the countries of the region need to identify "niche markets," targeting high-end products or services. Lack of interconnectivity in the region, due to inefficient transport infrastructure and a dearth of skilled labor remain key concerns in developing these niche markets. Over 10 percent of the PIC population is either unemployed or underemployed, prompting them to seek work elsewhere (mainly in Australia, New Zealand, and the neighboring countries).[53] Livelihoods continue to heavily dependent on fisheries, agriculture, and natural resources, all of which are sensitive to climate change and variability. As a result, the adaptive capacity with respect to economic growth is relatively low.

Opportunities and Gaps

Economic development and climate change considerations often compete with each other. Land use change (in PNG and the Solomon Islands, particularly) and the tourism sector have driven the majority of economic growth. Land use change is a major contributor to GHG emissions, so there is an urgent need to work with governments, communities, and the private sector to find solutions that allow for continued economic growth without compromising forests and ecosystems. The tourism sector is sensitive to climate due to coral bleaching which may impact coral health and fish diversity – the major drivers of tourism in the region. Beyond these sectors, livelihoods that depend on fishing and agriculture are highly sensitive to climate trends. Opportunities to train the workforce and diversify away from climate-sensitive activities should therefore be explored.

Recommended Actions to Address Climate Risk

In order to promote economic development, both at the macro-level and at the community level, there is a need to safeguard key sectors from future climate change while diversifying economic activity. To illustrate, a large proportion of the region's economy depends on tourism – which in turn is susceptible to the impacts of coral bleaching. Climate solutions should focus on preventing deterioration of coral health, while exploring new economic opportunities under climate change. Greater investments in new skills, especially those that are relevant in the green economy, can foster economic growth in the PIC.

4.8. Digital Connectivity

Impacts and Vulnerabilities

Digital connectivity is essential to ensure better access to services such as remittances, mobile money, insurances, and online education in areas with limited school infrastructure, especially in historically underserved communities. However, PIC lag behind other regions in terms of access to basic internet

[52] Weber, E., 2017. Trade agreements, labour mobility and climate change in the Pacific Islands. *Regional environmental change*, *17*(4), pp.1089-1101.

[53] Juswanto, W. and Ali, Z., 2016. Economic growth and sustainable development in the Pacific Island countries.

services: indeed, as of 2018, the Pacific region had the lowest rate of internet penetration, at only 18 percent. Cities tend to be more connected than rural areas. In addition, there are, as expected, large differences in internet access across the region, with Fiji having the greatest internet penetration rates (over 66 percent as of 2017) and countries like the Solomon Islands lacking access to internet (only 12 percent of the population had internet access in 2017). Recent initiatives like *Future Pasifika* have therefore focused on enhancing access to digital connectivity and improving access to digital finance services.

Climate change threatens to disrupt progress towards ensuring universal access to digital technologies. Extreme weather events such as floods and tropical cyclones can damage and destroy energy infrastructure; the research team discusses possible impacts in greater detail in the *Energy and other critical infrastructure section* but, in brief, climate events can destroy generators and transmission lines, rendering entire populations unable to use the technology required to access the internet. Damage to communication (and digital) infrastructure after a tropical cyclone can have serious ramifications: for instance, after Cyclone Pam (2015), it was impossible to determine the extent of damage outside of Port Vila due to lack of communication with the outer islands as well as the lack of digital technologies to assess damage on the ground. In the aftermath of Pam, it took three weeks to reconnect the outer islands. Under climate change, more intense cyclones could affect digital connectivity and hamper adaptation efforts, as well as efforts to manage loss and damage resulting from climate events.

Adaptive Capacity

Digital connectivity is relatively low in the region, with some countries such as PNG, the Solomon Islands, and Kiribati having some of the lowest internet penetration rates globally. Connectivity is especially low in the outer islands. Energy and other critical infrastructure required to maintain stable digital connectivity is not installed with climate change risks in mind; and therefore, progress to improve digital connectivity could be hindered by future climate change.[54]

Opportunities and Gaps

The importance of improving digital connectivity is gaining traction in the Pacific, with increasing investments from various donors and implementing partners, most notably ADB, SPC, and the World Bank. Significant opportunities exist to leapfrog technological advancement in the Pacific and use the latest low-cost technologies to improve internet penetration. However, there are several key gaps that should be addressed. The most significant is perhaps the lack of digital literacy, particularly in the outer islands and in more remote rural areas. At the same time, digital connectivity requires energy and other critical infrastructure; however, investors have directed limited investments to climate-proof the necessary digital infrastructure.

Recommended Actions to Address Climate Risk

Digital connectivity should prioritize two streams of work. The first is based on training efforts: information and communication technology literacy, good cybersecurity practices and cyber hygiene, especially for communities that are generally skeptical of digital technologies (mostly those living outside urban centers) and older generations. The second set of activities should focus on ensuring that the infrastructure needed to maintain internet access is sustainable, including energy infrastructure (see section on Energy and Other Critical Infrastructure).

[54] Ray, T., Jain, S., Jayakumar, A. and Reddy, A., 2021. The Digital Indo-Pacific: Regional Connectivity and Resilience.

4.9. Democracy, Governance and Human Rights

Impacts and Vulnerabilities

The relationships between climate change, democracy, and governance are complex and not well documented in the context of PIC. However, initial analysis suggests that climate change can impact the effectiveness of local decisions (and therefore local governance and overall trust in the government).[55] For instance, a decision to install infrastructure to support marginalized communities may not yield benefits if heavy rainfall events damaged the proposed infrastructure. Given the large uncertainties in current climate models – and especially so in the Pacific region – the impact on local governance is a serious concern. A solution to this challenge may be to invest in "no-regrets" adaptation options, i.e., investments which are likely to provide benefits regardless of climate trends. However, these interventions tend to be expensive and are therefore not always feasible.

In addition to potential impacts on democracy and governance, climate change poses serious risks to human rights, including the rights to life, self-determination, development, food, health, water, sanitation, and housing (see Table 2 for a non-exhaustive list of examples). This discussion has led to concerns about climate justice, i.e., the need for equitable distribution of benefits from climate as well as burdens resulting climate impacts. Various PIC have stated that climate change poses an existential threat to the survival of their populations, especially for those living in atolls that are only a few meters above sea level. There is currently no legal framework that allows affected populations to seek refuge on environmental and climate change grounds. As a result, current efforts should focus on ensuring that populations that are especially vulnerable to climate change can continue to enjoy their full human rights even under a changing climate by investing in initiatives that ensure access to basic needs.

Table 2. Examples of Human Rights that Climate Change May Impact (not an exhaustive list).

Human right	Example of climate impact
Right to life	A heavy rainfall event, induced by climate change, could kill thousands of people living on vulnerable locations.
Right to self-determination	Sea-level rise could destroy the ancestral home of Pacific Islander populations, rendering them unable to choose their sovereignty because their preferred homeland is no longer habitable. This could potentially result in climate change migrants.
Right to development	Tropical cyclones are expected to become more intense, potentially destroying infrastructure and hindering development progress in coastal areas.
Right to food	More erratic rainfall patterns and severe droughts will likely affect agricultural production and availability of food in the Pacific Islands.
Right to health	Changes in temperature and rainfall conditions could affect the distribution of vector-borne diseases such as dengue and malaria, resulting in a greater number of people experiencing health problems.

[55] LGNZ, 2017. How climate change affects local government. https://www.lgnz.co.nz/assets/Uploads/b1225adc8d/44476-LGNZ-How-climate-change-affects-local-government.pdf

Human right	Example of climate impact
Right to water	Changes in rainfall patterns are likely to affect the availability and quality of water, especially in areas with limited water infrastructure.
Right to housing	Heavy rainfall events and more intense tropical storms could severely damage and even destroy housing infrastructure, reducing access to safe housing.

Adaptive Capacity

Government effectiveness varies across the region. Relatively low government effectiveness in PNG and the Solomon Islands is of particular concern. In these countries there is an added risk of separatist movements that can hinder democracy and investments in climate change. There is limited government capacity to produce climate information; often the islands of the Pacific region depend on data from Australian or international climate service providers. Local-level capacity is limited for using climate data to inform decisions and manage climate risks.

Opportunities and Gaps

Democratic institutions in the Pacific are at different levels of maturity and governance mechanisms are deep-rooted in traditional structures. There is a unique opportunity to strengthen government bodies with a focus on emerging challenges in the region (including climate change). To a large extent this is already happening. The Pacific region has been one of the leaders at the global level advocating for greater consideration of climate change implications on human rights. Tuvalu, for instance, has recognized the possibility of total loss of land due to sea-level rise and has negotiated agreements with neighboring countries to receive Tuvaluan migrants. Additional work, however, is needed to articulate the implications of climate change on democracy in the region. There is an urgent need to build the capacity of local governments to interpret and use climate information in their local decisions.

Recommended Actions to Address Climate Risk

Climate risk management efforts should focus on strengthening partnerships at all levels, but especially at the local level. Community-ownership of different climate risk management efforts is critical to the success of these initiatives. Projects should continue to identify appropriate mechanisms to engage communities (and community leaders) in the design and implementation of climate change activities.

Marginalized groups, especially women, youth, and people living with disabilities, are not always included in the design and implementation of climate solutions. Their unique vulnerabilities should be more explicitly considered in the design of programs and projects.

4.10. HEALTH AND WELL-BEING

Impacts and Vulnerabilities

The health sector is particularly vulnerable to the impacts of climate variability and extreme weather events. The most direct health impacts include death, drowning, injury, and psychological stress due to floods and tropical cyclones. Increases in temperature, too, can affect health. In addition, extreme heat and more frequent heatwaves caused by rising temperatures and stagnate air currents can lead (among

others) to heat stroke, heat stress, heat exhaustion and dehydration, with children and the elderly being particularly sensitive.[56] People working outside (fisherfolk, farmers, and construction workers) on hot days are especially vulnerable and at greater risk of heat stress.

Additionally, rising temperatures and changes in precipitation patterns can create ideal conditions for vector-borne diseases. Higher temperatures and more frequent heavy rainfall events are linked to outbreaks of vectors like mosquitos that spread malaria, dengue and zika to areas where they could not in the past.[57]

Indirectly, changes in climate patterns can affect health through reduced availability of water and crops. For example, extreme precipitation, storms and floods can compromise clean water supplies leading to outbreaks of waterborne illness, such as diarrhea. Evidence suggests that higher atmospheric carbon dioxide concentrations affect the quality of crops, which can result in micronutrient deficiencies, and therefore higher incidence of health problems among vulnerable groups.[58]

Adaptive Capacity

Health infrastructure is generally not set up to absorb the additional health risks that climate change can exacerbate (e.g. higher incidence of vector-borne diseases, diarrhea, and malnutrition). There are few national plans that incorporate climate change considerations into the health planning processes. Fiji, PNG, Kiribati, and Nauru have included health as a priority in their NDC document. Some investments at the regional level to increase climate resilience in the health sector exist, but there is a need for additional investments (and government budgets to specifically address health and climate considerations.)[59]

Opportunities and Gaps

Only a handful of countries (Fiji, Nauru, Kiribati, and PNG) have prioritized the health sector in their NDC. Commitments generally focus on improving access to healthcare for specific climate-sensitive diseases (e.g., malaria, dengue) but Fiji's NDC document includes a specific component on improving critical infrastructure related to health systems. The diversity of solutions in the NDC documents offers a roadmap for ensuring the resilience of health systems of PIC in a context of climate change. The health sector, however, faces similar gaps as other sectors – limited capacity of stakeholders to use climate information and limited resources available to climate-proof health infrastructure. Additional work is needed to identify the causal pathways between climate variables and diseases in the region.

Recommended Actions to Address Climate Risk

- **Integrate climate information into health work.** The health sector should include climate science more explicitly in its planning processes. Information on increased prevalence of certain

[56] McIver, L., Bowen, K., Hanna, E. and Iddings, S., 2017. A 'Healthy Islands' framework for climate change in the Pacific. *Health promotion international*, *32*(3), pp.549-557.

[57] Filho, W.L., Scheday, S., Boenecke, J., Gogoi, A., Maharaj, A. and Korovou, S., 2019. Climate change, health, and mosquito-borne diseases: Trends and implications to the pacific region. *International journal of environmental research and public health*, *16*(24), p.5114.

[58] McIver, L., Kim, R., Woodward, A., Hales, S., Spickett, J., Katscherian, D., Hashizume, M., Honda, Y., Kim, H., Iddings, S. and Naicker, J., 2016. Health impacts of climate change in Pacific Island countries: a regional assessment of vulnerabilities and adaptation priorities. *Environmental health perspectives*, *124*(11), pp.1707-1714.

[59] World Health Organization, 2019. Meeting of the Informal Working Group to Discuss the Implementation of the Pacific Islands Action Plan on Climate Change and Health (2019-2023).

diseases, or the potential damage to health (or other critical) infrastructure can help prevent disruptions in health services under climate change. In order to achieve this, health sector stakeholders should receive training on using and interpreting climate information for their decision-making processes. The sector should receive funding to climate-proof infrastructure and manage future climate impacts on health.

ANNEX I. CLIMATE RISK SCREENING

Table 4. Climate Risk Screening

Development Objective (DO) and/or Intermediate Result (IR)			
Risk Rating of DO and/or IR *Based on the screening, rate the potential climate risk to each DO or IR and describe the risks and adaptive capacity. Indicate the timeframe applied in the analysis.*	**Integration into Strategy** *How does the strategy address the climate risks? Reference the page number in the strategy. Note in particular if a Goal, the DO, or an IR or sub-IR specifically addresses the risks.*	**Next Steps** *Is monitoring and/or further analysis of risks needed to inform project planning, design, and implementation?* *What needs to be done at the project and/or activity levels to address the risks?*	**Accepted Risks** *What climate risks does the Mission accept? Why?*
DO1. Community Resilience Strengthened IR1.1. Capacity to adapt and respond to climate and disaster impacts strengthened IR1.2. Sustainable management of natural resources strengthened IR1.3. Access to sustainable energy services increased IR1.4. Vulnerable health systems strengthened			
Rating: High Risk ***Adaptive Capacity*** *Environment* • The islands of the Pacific have unique biogeographies as well as landscapes. PNG, in particular, is a country of megabiodiversity. However, resources are often mismanaged and over-utilized/extracted, which can limit the ability of the ecosystems to regenerate. As a result, the overall environmental	DO1 explicitly recognizes the high levels of vulnerability to climate risk in the Pacific region. DO1 also highlights the vulnerability of specific sectors: water and food security, fisheries, forestry, livelihoods, biodiversity, infrastructure, and health care (pages 23-25). IR1.1 (Capacity to adapt and respond to climate and disaste5r impacts strengthened) includes climate considerations and mentions the high vulnerability of coastal communities (page 24)	New and updated project appraisal documents (PADs) should consider the risk of additional climate challenges (more intense tropical storms, sea-level rise, more frequent droughts) as well as potential GHG mitigation options. Mission targeting of resilience building activities should focus on the most vulnerable islands and groups, especially women, youth, and people living with disabilities.	Increased prevalence of extreme weather events such as droughts (especially in El Niño years), floods, and storms. As a result of sea-level rise, more severe impacts associated with sudden onset hazards are expected. The Mission should accept these risks, understand operational implications, and modify its program accordingly.

Development Objective (DO) and/or Intermediate Result (IR)			
and community resilience diminishes. • The majority of climate-related projects in the Pacific focus on the larger countries: PNG, Solomon Islands, Fiji, Vanuatu. Other countries face major challenges in accessing sufficient funds to implement climate change adaptation and mitigation projects. • Key stakeholders in the region lack financial resources to adopt technologies that can reduce the impacts of climate change. • Key stakeholders lack capacity or knowledge to use climate data into their project management cycles. • At the regional level, there is limited engagement with the private sector and therefore the potential to include private actors in climate change investments is untapped. *Energy* • Low electrification rates throughout the region, especially in rural areas.	while also recognizing the unique vulnerabilities of marginalized groups such as women (page 25). IR1.2. (Sustainable management of natural resources strengthened) addresses climate considerations in the forestry sector and can contribute to maintaining forest structure and distribution (pages 25-26). IR1.3 (Access to energy services increased) addresses energy needs for the PIC, with a focus on PNG – and if funding allows, other countries with low electrification rates such as Solomon Islands, Vanuatu, Kiribati, Federated States of Micronesia, and Marshall Islands (pages 26-27). The IR focuses on enhancing access to affordable and climate- smart energy by improving the performance of energy utilities. However, there are no specific activities related to climate proofing energy and related infrastructure. IR1.4 (Vulnerable health systems strengthened) focuses on ensuring health systems can respond to challenges, including climate events (pages 27-28).	The Mission should leverage regional initiatives such as SPC, SPREP and the Pacific Island Forum to establish community based sustainable natural resources management practices. At the same time, the Mission should prioritize enhancing the capacity of national governments to sustainably manage natural resources. Encourage and leverage public-private partnerships to implement joint management of forestry and fishing resources. Enhance the capacity of regional and national organizations to use climate information to improve decision-making. Seek opportunities to further engage with private sector organizations in disaster management, environmental management, and energy services delivery. Seek opportunities to increase carbon sequestration and reduce GHG emissions via improved forest management or forest restoration, especially in PNG, Solomon Islands, Fiji, and Vanuatu.	

Development Objective (DO) and/or Intermediate Result (IR)			
As such, the priority of many governments is to increase access to electricity without necessarily considering climate trends. • Limited regional and national government capacity to use climate data and estimate energy capacity. • Energy planners from the government and private sectors have limited capacity in using climate information in planning, siting, and monitoring energy projects. *Health* • There are few national plans that incorporate climate change considerations in the health planning processes. Only Fiji, PNG, Kiribati, and Nauru have included health as a priority in their NDC document. • Some investments at the regional level to increase climate resilience in the health sector exist, but additional investments (and government budgets to specifically address	The interventions focus on building government capacity for reform and structural changes in PNG, Solomon Islands, Federated States of Micronesia, Palau and Marshall Islands. Although climate is explicitly mentioned as a potential threat to health systems, the proposed interventions do not highlight potential measures to improve climate services for the health sector or the need to climate-proof health infrastructure.	Leverage regional priorities of increasing rural electrification to include climate change considerations and invest in renewable energy sources. Help build capacity for local actors to include climate considerations in their water, sanitation, and hygiene interventions, especially to reduce the impacts of climate hazards. Help build the capacity of health service providers to include climate considerations in their planning processes. Invest in research on the linkages between diseases and climate change to guide future investments. Develop health plans that focus on strengthening health interventions after disaster and/or climate events – especially tropical storms and floods. Seek opportunities to leverage climate investments to enhance delivery of health services.	

Development Objective (DO) and/or Intermediate Result (IR)			
health and climate considerations) are needed. ***Climate risks*** *Environment* • Warmer temperatures, shifting rainfall patterns, stronger droughts and storms that may lead to more frequent floods, and sea-level rise which potentially could undermine efforts to increase community-level resilience capacity. • Coral bleaching due to increase in ocean temperatures and changes in ecosystem structure and composition due to acidification. • Loss of reefs, seagrass, and mangrove habitats due to sea-level rise and changes in salinity and ocean biogeochemistry. • Loss of coastal land due to erosion (sea-level rise, more severe cyclones, storm surges). • Changes in fish distributions and reproduction, as a result of temperature increase, and other climate			

Development Objective (DO) and/or Intermediate Result (IR)			
stressors, potentially leading to reductions in fish stocks, and affecting fishing-dependent livelihoods. • Distribution of forest types, forest structure, and forest composition could all shift as temperatures warm and rainfall patterns change; some forests may become more vulnerable to conversion to agriculture. • Diversion of funds away from climate change adaptation/disaster management to fund competing priorities. *Health* • Disruptions in health systems strengthening activities (e.g., monitoring, training, coaching, documentation) as well as in health service delivery due to extreme weather events. • Potential increases in waterborne, food-borne, and vector-borne diseases (including malaria and dengue) as well as diarrheal disease and deaths in children under			

Development Objective (DO) and/or Intermediate Result (IR)			
15 due to temperature increases, rainfall changes, and floods. • Increases in cardiovascular and respiratory diseases, especially for at-risk groups including elderly and young children due to higher temperature and shifting rainfall patterns. • Increases in malnutrition resulting from the negative impact of rising CO_2 concentrations on the nutritional value of staple crops as well as from food scarcity (particularly fish) due to temperature effects. • Increasing scarcity of clean water due to temperature increases, drought, storms, and floods (which may damage water provisioning and sanitation systems). • Increased challenges with surveillance, diagnostic, and other health systems during and following extreme weather events. • Storm and flood damage to health facilities and records as well as disruptions to health care services.			

Development Objective (DO) and/or Intermediate Result (IR)			
DO2. Resilient Economic Growth Advanced IR2.1. Enterprise development strengthened IR2.2. Macroeconomic stability strengthened IR2.3. Regional integration advanced IR2.4. Human capital development for resilient economic growth improved			
Rating: *High Risk* ***Adaptive Capacity*** *Economic Growth* • There is limited government capacity to produce climate information; often the islands of the Pacific region depend on data from Australian or international climate service providers. There is limited capacity at the local level to use climate data to inform decisions and manage climate risks. • Some private sector stakeholders do not use climate data in their decision-making processes. • Low capacity of national and local governments to access climate finance. *Education*	IR2.3 (Regional integration advanced) includes specific recommendations on including climate change considerations throughout the life cycle of infrastructure projects, and that the procurement process is transparent and accountable (page 31).	New and updated PADs should consider the risk of additional climate challenges (more intense tropical storms, sea-level rise, more frequent droughts) as well as potential GHG mitigation options. If deemed necessary, Mission targeting should focus on the most vulnerable islands and groups, especially women, the youth, and people living with disabilities. Support use of public and private financial structure to incentivize investments in climate change interventions and technologies. Incentivize a transition to low-emissions strategies across all sectors to achieve a greener economy in the region.	Increased prevalence of extreme weather events such as droughts (especially in El Niño years), floods and storms. More severe impacts associated with sudden onset hazards can be expected as a result of sea-level rise. The Mission should accept these risks, understand operational implications, and modify its program accordingly.

Development Objective (DO) and/or Intermediate Result (IR)			
• Some countries (Vanuatu, Fiji, Tonga, Kiribati) include climate science in their school curricula, but coverage of climate change is highly variable across the region. Often, students are taught about climate change at the tertiary education level. • Only Kiribati has included education as a priority sector in its NDC. • While enrollment in basic education is relatively high in the Pacific, access to high quality education remains a major challenge. ***Climate risks:*** *Economic Growth* • More frequent and intense extreme weather events such as floods, droughts, and storms may strain regional and national budgets. Due to their remoteness, outer islands are especially vulnerable and may not receive sufficient timely funding to address disaster management needs. • Extreme weather events and sea-level rise may affect livelihoods and		Encourage investments in climate-resilient infrastructure that can withstand the effects of sea-level rise and more extreme weather events. Increase local and national capacities to access climate finance. Increase local and national capacities to use and interpret climate information as an input across various sectors. Seek opportunities to engage education stakeholders to integrate climate change into national curricula and train students in skills relevant to a climate-resilient economy. Explore opportunities to train communities in skills relevant to climate change adaptation. Prioritize livelihood diversification and protection in sectors that are especially sensitive to climate impacts and that contribute significantly to economic	

Development Objective (DO) and/or Intermediate Result (IR)			
family incomes across various sectors (agriculture, tourism, fishing). The impact on livelihoods could lead to a focus on disaster response and relief rather than investments in climate resilience. • Climate events may damage key infrastructure. *Education* • Reduced school attendance and learning possible due to more extreme heat events (which experts have proven reduce concentration in the classroom) or disruption in education due to storms and floods. • Damage to materials and facilities from floods caused by heavy rainfall and storms. • Skills and knowledge taught could be less useful/marketable than expected due to increasing temperatures, shifting rainfall patterns, sea-level rise, and extreme events rendering some entrepreneurship		output (such as fisheries, agriculture, and tourism). For example, rainfed agriculture could be protected through irrigation systems or water capture systems, and agricultural livelihoods could be diversified by training smallholder farmers to engage in other activities.	

Development Objective (DO) and/or Intermediate Result (IR)			
opportunities less viable and a need for the workforce to learn new skills.			
DO3. Democratic Governance Strengthened IR3.1. Civic engagement increased IR3.2. Government responsiveness to citizens improved			
Rating: *High Risk* ***Adaptive Capacity*** • There is low government effectiveness in PNG and the Solomon Islands and there is a risk of separatist movements that can hinder democracy and investments in climate change. • There is limited government capacity to produce climate information; often the islands of the Pacific region depend on data from Australian or international climate service providers. There is limited capacity at the local level to use climate data to inform decisions and manage climate risks. ***Climate risks*** • Reduced ability of people, especially marginalized populations (such as women and people living	Climate change is discussed throughout the entire document. The executive summary highlights the importance of addressing climate change to ensure resilience in the region (pages 4-6). The section on Regional Context indicates that climate change is one of the major environmental risks, and that failure to address climate change can hinder development progress (page 11).	New and updated PADs should consider the risk of additional climate challenges (more intense tropical storms, sea-level rise, more frequent droughts) as well as potential GHG mitigation options. If deemed necessary, Mission targeting should focus on the most vulnerable islands and groups, especially women, the youth, and people living with disabilities.	Increased prevalence of extreme weather events such as droughts (especially in El Niño years), floods and storms. More severe impacts associated with sudden onset hazards can be expected as a result of sea-level rise. The Mission should accept these risks, understand operational implications, and modify its program accordingly.

Development Objective (DO) and/or Intermediate Result (IR)			
with disabilities), to participate in democratic processes due to impacts of extreme events, temperature increase, and other climate stressors • Increased reliance of national governments on international support to provide basic services, local infrastructure, and manage natural resources due to increasing intensity and recurrence of cyclones. • Democratic processes and economic stability may be challenged especially as local and national governments struggle and fairly deliver services (e.g., water) in the context of more frequent and intense extreme weather events, especially in the outer islands. • Marginal populations which include women, girls, and people living with disabilities, may be further marginalized due to extreme weather events.			

ANNEX II. GREENHOUSE GAS (GHG) MITIGATION

Annex II answers the list of GHG mitigation questions required in ADS 201mat.

Table 5. Greenhouse Gas Mitigation

Theme/Question	Response
GHG Sources from Sectors	
What are the major sources of GHG emissions in the region?	According to CAIT Climate Data Explorer, the major emitters of GHG in the region are PNG, Solomon Islands, Fiji and Vanuatu – which collectively account for over 97 percent of all emissions in the region. The key sectors contributing to GHG emissions include land use change and forestry (accounting for 73 percent of all regional emissions), agriculture (5.3%), waste (4.8%) and transport (3.4%). The relative contribution of each sector to national GHG emissions differs from country to country. For example, Fiji has made substantial progress in reducing emissions through reforestation and afforestation initiatives, but PNG and Solomon Islands continue to contribute to emissions through land use change and deforestation. In the Solomon Islands, virtually all emissions come from the forestry sector (97%); in PNG, too, the forestry sector is a major contributor to national GHG emissions (63%). In Vanuatu and Samoa, agriculture is the key source of GHG emissions (53% and 24% respectively). In all other countries, the transportation and aviation sectors are the main contributors to emissions (>40%).
How has the distribution and composition of the GHG emissions profile changed over time historically and how is the profile expected to change in the future considering the major emitting sectors and/or sources?	The overall GHG profile in the region has not changed significantly since the 1990s. Since 1990, emissions have increased 160 percent - from 44,010,000 tons of carbon dioxide equivalent (tCO_2e) to 144,160,000 tCO_2e. The forestry sector has been the dominant source of emissions throughout the period 2000-2020. There was a reduction in emissions from the forestry sector in 2011, but the rate of GHG emissions has accelerated since 2016 – primarily due to deforestation in PNG and the Solomon Islands. Without significant efforts to reduce deforestation, the Pacific region may not be able to achieve its commitments to emissions reductions.
How are the sectors and sources that contribute to GHG emissions contributing to the growth and development of the economy and to meeting development objectives?	Forestry: Rapid deforestation in PNG and the Solomon Islands is driven by the logging industry. Because timber exports are not always regulated, it is difficult to obtain numbers on economic gains. To a lesser extent, forests are cleared for subsistence agriculture. Again, there are limited data on the economic gains achieved through subsistence agriculture in PNG and the Solomon Islands. Agriculture: By and large, the focus of agricultural policies in the region is on ensuring self-sufficiency. Some NDC documents mention the need to invest in climate-smart agriculture, but this does not appear to be a priority.
What climate change mitigation or low emission development plans, targets, commitments,	Despite the low contribution of the PIC to global GHG emissions (<0.03% of global emissions), many islands in the Pacific region have ambitious mitigation targets as articulated in their NDC documents. All of the 12 countries' NDCs include a mitigation component, with emissions reductions of 10-40 percent.

Theme/Question	Response
and priorities have the governments articulated?	These ambitious commitments will be achieved through renewable energy transitions, energy efficiency initiatives, improving efficiencies in the transport sector, and reforestation/afforestation projects. Kiribati has the least ambitious objectives, aiming to reduce emissions by 13 percent by 2025 through investments in renewable energy sources. On the other end of the spectrum, PNG has pledged to achieve carbon neutrality by 2030, and Vanuatu has a very ambitious goal of 100 percent renewable energy by 2030.
USAID Work in Sectors	
Which sectors is USAID planning to program in?	The mission plans to work in the forestry, fisheries, disaster management, energy, health, and democracy/governance sectors. The focus of the interventions is to increase the resilience capacity of the Pacific Islanders.
What opportunities exist to reduce emissions in those sectors?	Investments in the forestry sector can help reduce GHG emissions by around 20-30 percent in the region according to estimates by UNDP and the World Bank. Such investments would be needed in the Melanesian forest-rich countries of PNG, Fiji, Solomon Islands, and Vanuatu. There are potential mitigation benefits in the energy sector through investments in renewable energy sources (mainly solar panels, hydropower, and geothermal energy).
What opportunities exist to reduce emissions associated with USAID activities?	The mission's work in the forestry and energy sectors can contribute to GHG mitigation. Emission reductions and carbon sequestration benefits can be achieved through the mission's work on increasing the capacity of government institutions to strengthen and enforce environmental and social safeguards; and improving the governance of conservation areas by building capacity for environmental decision. Many of these entry points will focus on building resilience and enhancing the capacity of local governments to manage forest resources. USAID may consider a mechanism to quantify emissions reductions. The mission's work in the energy sector offers potential mitigation benefits via improvements in grid integration and efficiency, promotion of renewable energy sources, strengthening policies and regulations, and strengthening watershed management to ensure the viability of hydropower options.
Climate Mitigation in the Strategy	
Does the strategy incorporate ways to reduce GHG?	Yes. GHG mitigation opportunities are explicitly mentioned in IR1.2, which focuses on strengthening management of natural resources. Specifically, the IR highlights the potential to use forests (mainly in PNG and the Solomon Islands) as a resource to offset global carbon emissions. Additional mitigation opportunities could be explored in IR1.3, which aims to improve access to sustainable energy sources. Currently, IR1.3 is focused on enhancing infrastructure to provide reliable energy across the region with emphasis on clean energy transitions. Finally, the mission's work on enhancing democratic governance (DO3), fostering economic and political inclusion, and advancing social stability could

Theme/Question	Response
	include GHG mitigation via promotion of approaches and technologies that strengthen resilience and also reduce emissions.
Next Steps	
What are the next steps at the project/activity levels to reduce GHGs?	Under the Development Objective 1: Community Resilience Strengthened, reduction/sequestration/avoidance of GHG emissions may be done at the Project/Activity- levels through improving management and governance of natural resources and improving access to sustainable energy services.

ANNEX III. ADDITIONAL REQUIREMENTS FOR MISSIONS RECEIVING GLOBAL CLIMATE CHANGE (GCC) FUNDS

Section A. Clean Energy

1. How does the Regional Development Cooperation Strategy integrate mission programming support for host government-led activities for the development, analysis, planning, integration, and implementation of Low Emission Development Strategies (LEDS) into its DOs and/or IRs and support the host country to analyze, develop, articulate and ultimately achieve its domestic and international greenhouse gas mitigation-related targets and commitments?

The Mission will support emissions reduction through IR1.2 (Sustainable management of natural resources strengthened) and IR1.3 (Access to sustainable energy services increased).

The Strategic Framework highlights that deforestation and land use change remain one of the largest sources of GHG emissions in the region – primarily due to high deforestation rates in PNG and the Solomon Islands. IR1.2 will focus on building government capacity and commitment to advance environmental and social safeguards to limit deforestation. It will also reduce the illegal extraction of forest resources, thereby enabling competition from legitimate businesses. This approach further promotes financing for sustainable development as it will help ensure that the natural resource benefits accrue to communities.

The Strategic Framework recognizes that while many islands in the region have ambitious goals to achieve emissions reductions, they often lack a clear roadmap and resources to achieve these objectives. The Mission will increase access to affordable and climate-smart energy by improving the performance of energy utilities, increasing transparent private sector investments in the energy sector, and expanding off-grid energy systems in the region. The Mission will prioritize efforts in PNG, the country with the lowest rate of electrification – and if funding allows, Solomon Islands, Vanuatu, Kiribati, Federated States of Micronesia, and the Republic of Marshall Islands. Provincial centers, island communities, and other remote populations will be targeted for this assistance.

USAID will improve the institutional capacity of PNG's regulatory authorities to develop and implement effective energy policies and support PNG's energy utility to transform itself into a strong partner. USAID will enhance the ability of PNG's energy utility to provide reliable energy, better serve customers, expand electricity connections, and improve overall financial viability to undertake capital investments and partner with the private sector.

2. How does the RDCS incorporate attention to energy efficiency, renewable energy potential, and energy sector reforms throughout USAID's development portfolio?

The Strategic Framework includes a specific intermediate result focusing on energy efficiency and energy sector reforms: IR1.3 (Access to sustainable energy services increased). The document highlights the importance of increasing access to energy throughout, especially given the low rates of electricity access in the region.

3. How does the RDCS enable or promote a transformational change in the region's public, private, or civic sectors that will lead to better development and strong economic growth while affecting a shift to low emissions development and national-scale GHG emission reductions?

The Mission aims to promote transformational change in the region through DO2 (Resilient Economic Growth Advanced), and specific activities to reduce GHG emissions are included in DO1 (Community

Resilience Strengthened), specifically in IR1.2 (Sustainable management of natural resources strengthened) and IR1.3 (Access to sustainable energy services increased). IR1.2 includes a strong component focusing on protecting forest resources and reducing deforestation, particularly in PNG and the Solomon Islands. These interventions can help ensure the region, overall, acts as a carbon sink. IR1.3 includes interventions to improve access to climate-smart energy. The focus on climate-smart energy services will ensure a shift to low emissions development. While DO2 does not specifically address climate considerations, there is significant potential to train the next generation of skilled workers to engage in activities that promote climate-resilient development and a low emissions economy.

Section B. Sustainable Landscapes

1. How does the RDCS integrate planning and implementation of LEDS (see Footnote 10) into its DOs and/or IRs and support the host countries in meeting domestic and international GHG targets and commitments?

The Mission will support emissions reduction as a mitigation co-benefit under IR1.2 (Sustainable management of natural resources strengthened) and IR1.3 (Access to sustainable energy services increased). If the Mission continues to receive GCC - Sustainable Landscapes funding, it may continue to support mitigation priorities through:

- Engagement with government, civil society organizations, communities, and private sector to strengthen forest protection and conservation in PNG, Solomon Islands, Fiji, and Vanuatu.
- Engagement with government, civil society organizations, communities, and private sector to strengthen investments and ownership of climate-smart energy.
- Collaboration with governments to develop low emissions development strategies.
- Continue to seek emission reductions strategies throughout the USAID portfolio.

2. How does the RDCS incorporate the goal of reducing net emissions from deforestation or from other land uses such as agriculture, consistent with USAID's Climate Change and Development Strategy?

The RDCS positions its mitigation efforts within its resilience building interventions (DO1). IR.12 focuses on strengthening sustainable natural resource management, particularly forest resources. The Mission will support the implementation of sustainable natural resource management practices, mainly in PNG and the Solomon Islands by:

- Building government capacity and commitment to advance environmental and social safeguards.
- Promoting financing for sustainable development to ensure that the natural resource benefits accrue to communities.
- Improving incentives to increase private sector investments in conservation, create transparent and level market conditions, and demonstrate sustainable supply chains.
- Prioritizing the integration of gender considerations in natural resource management programs, work to increase the participation of women in decision-making processes and conservation-friendly livelihood programs and promote shared value co-benefits for women and men.

The Strategic Framework does not include a specific intervention focusing on agriculture, but its economic development and education programming could support efficiency gains across sectors including agriculture.

3. How does the RDCS enable or promote a transformational change to low emissions development?

The work noted under Question 2 will set the foundation for a shift towards low emissions development, especially in PNG which accounts for the majority of forest resources in the region. The Mission will leverage partnerships with government ministries, SPC's Fisheries, Aquaculture and Marine Ecosystems Division, Pacific Islands Forum Fisheries Agency, Secretariat of the Pacific Regional Environmental Programme, and CSOs and coalitions that are involved in community-based conservation. These partnerships can help ensure that sustainable natural resource management practices become mainstream in the region.

Section C. Adaptation

1. How is climate change a current stressor on key development priorities of the region? (For example: Is climate variability a current stressor driving food insecurity, water scarcity, communicable disease spread, conflict and political instability, or other negative effects?) How is climate change projected to be a stressor on development priorities in the future?

Climate change is a major stressor to development in the region, affecting all major sectors: agriculture, food security, fisheries, coastal zones, energy, health, and economic growth. The PIC recognize climate change as the greatest threat to the region's security. The 2020 World Risk Report indicates that five PIC are among the top fifteen countries with the highest disaster risk. Extreme weather events, particularly floods from heavy rainfall events and tropical storms, severely damage infrastructure and destroy crops, hindering development progress.

The countries' geographic location, isolation, and small size make them extremely vulnerable to the impacts of future climate change (sea-level rise, bleaching of corals, loss of wetlands, flooding, erosion, and endangerment of mangroves, among others) and natural disasters (typhoons, drought, earthquakes, tsunamis, and volcanic eruptions) that frequently hit the region. These events undermine development gains and force PIC into a vicious cycle of response and recovery. The negative consequences are tremendous – loss of life, economic deterioration, damage to infrastructure, threats to food security, and reduced access to freshwater are just a few of the dire consequences. The threat to water resources is of particular concern as a water insecure future can have far reaching impacts on health, economic growth, and food production.

2. What assessments and analyses have already been done to inform strategic planning around adaptation, and what additional analyses may be needed? What is the quality of the analysis? Are the documents publicly available? (Please consider not only analyses undertaken by USAID, but relevant national or regional analyses undertaken by host governments, other donors, or other stakeholders such as universities, think tanks, or other civil society and private sector organizations.)

Climate assessments and analyses are often produced in collaboration with UNDP (and other multilateral organizations) and submitted as National Communications to the UNFCCC. All of the 12 PIC considered in the Strategic Framework have submitted at least one National Communication and provided the foundation for adaptation planning. The quality of the analyses varies depending on the availability of information and climate data, which is generally very scarce in the region. Therefore, larger countries such as Fiji and Vanuatu tend to have more elaborate National Communications that smaller countries such as Nauru and Kiribati.

The Australian Bureau of Meteorology maintains a Pacific Climate Change Science data portal. The portal is intended as a user-friendly tool that allows the user to visualize historical climate data in the form of trends, running and long-term averages. As the largest web-based data source for the Pacific region, this

tool currently provides users access to more than 100 individual observation sites across the Pacific Islands and Timor-Leste, and includes trends in rainfall and temperature extremes. The portal includes a series of reports on the latest findings. The CSIRO's "Climate Change in the Pacific: Scientific Assessment and New Research" reports are another key source of climate information for the region.

Other regional analyses include the World Food Programme's 2018 Regional Food Security Atlas, which includes a summary of climate impacts on food security, and the Reef Resilience Climate Change Indicators and Impact Report, which focuses on impacts on coastal habitats.

3. Do the host governments have a national adaptation plan of action, national adaptation plan, or similar planning instrument that is high quality and thorough? To what extent are potential USAID adaptation programs aligned with this plan or plans?

Five countries (Vanuatu, Tuvalu, Kiribati, Samoa, and Solomon Islands) included in the Strategic Framework have submitted a national adaptation program of action (NAPA), and only three (Fiji, Tonga, and Kiribati) have prepared a NAP.

The documents vary in quality. For example, the NAP submitted by Fiji provides a thorough analysis of climate trends and impacts on different sectors – as well as key policy recommendations. In contrast, the NAPA submitted by Tuvalu only includes a summary of potential environmental stressors.

Overall, the priorities outlined in the NAPAs and NAPs align with the priorities set out in the Strategic Framework and the Mission's objectives. Additional investments in agriculture, food security, climate-proofing infrastructure, and ensuring water resources could ensure closer alignment with government adaptation priorities.

4. Based on available information, how is future climate change likely to impact both your programs and other key development priorities of the region? Consider alternative paths or programs to ensure enduring success of interventions.

Future climate change could result in sea-level rise, more erratic rainfall and unpredictable rainfall distribution, more extreme droughts, and higher magnitude of heavy rainfall events and storms. These issues will likely impact all DOs under the Strategic Framework. DO1 on community resilience could be impacted through destruction of critical infrastructure, forest fires, damage to energy infrastructure, and damage to critical health infrastructure. DO2 on resilient economic growth could be impacted through divestment of funds for long-term economic development due to more frequent and extreme weather events. DO3 on democratic governance could be negatively impacted through increased reliance on the international community to invest in climate resilience.

The Mission may consider additional investments in climate-proofing infrastructure and support to other sectors that will likely be negatively impacted; namely, agriculture, food security, coastal zones, and fisheries. The Mission may also consider mainstreaming climate considerations more explicitly across all IRs.