7 Global Climate Change from a Pacific Islands' Perspective

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Overview

Pacific island countries and people have many, mutually reinforcing perspectives on global climate change[1]. Pacific island countries and territories (PICTs) are minor emitters of greenhouse gases[2], but they are on the frontline to experience the many, and serious, adverse consequences of the increasing concentration of greenhouse gases in the Earth's atmosphere.

Since Pacific islands and communities have survived environmental variations and extremes in the past, they are generally considered to be resilient to change. But many PICTs have limited land resources and high population densities, with economic activities concentrated in low-lying coastal areas. Together with recent changes in PICT societies, economies and environments, the islands are experiencing increased vulnerability to change, and especially the new challenges that climate change poses. However, modernization has also given rise to new and better ways of coping with change, as a result of improvements in transport and communications, for example.

As an 'ocean of islands', the Pacific islands region is generally vulnerable because of the high frequency of, and exposure to, a wide variety of weather- and climate-related hazards (cyclones, droughts, electrical storms, extreme winds, floods, landslides, and storm surges), along with geographical remoteness and isolation, and dispersion across the vast Pacific Ocean. In recent decades the region has experienced increases in temperature, sea level, the variability of rainfall, and in some extreme weather and climate events such as extreme heavy rainfall and high wave events. Continuing changes are expected to have even more serious consequences for the region's water and land resources, as well as its agriculture, health and tourism sectors, among others. These threats to economic prosperity, political stability, and human well-being and security have been recognised by the region's leaders and policymakers. PICTs are now taking concerted action to reduce these impacts and also take advantage of the few benefits climate change brings to the region.

PICTs are becoming increasingly concerned about the loss and damage resulting from slow onset or extreme weather and climate events that cannot be prevented by even the most ambitious actions to reduce greenhouse gas emissions, or adequately addressed through more conventional adaptation initiatives that reduce the adverse consequences of climate change. Despite being small emitters, PICTs are also making serious attempts to slow the rate of climate change by reducing emissions. Not only do they wish to be seen as good environmental citizens, but the co-benefits of increases in local air quality and hence human health, and in energy security, self-sufficiency, efficiency and conservation are also highly appealing.

The Science

Meteorological and climatological hazards prevalent in the region include tropical cyclones and other intense storms, landslides, river and coastal flooding including storm surges and other high wave incidents, droughts and heat waves. Substantial parts of the region experience a relatively high frequency of tropical cyclones. This is especially the case for countries to the west of the dateline, though the zones of higher frequency move eastward during El Niño conditions.

The Pacific has warmed over the past 50 years, with trends mostly between 0.08 to 0.20°C per decade, consistent with global trends. But unlike temperature, rainfall across the Pacific islands region exhibits large year-to-year and decade-to-decade changes. Over the past 50 years rainfall has increased north-east of the South Pacific Convergence Zone (SPCZ), and declined to the south. Sea-surface temperatures in the Pacific Ocean have generally increased since 1950. While the El Niño–Southern Oscillation (ENSO) results in significant interannual variability of sea level in the region, there has been a general increase, contributing to an increase in extreme high sea levels. As a consequence of higher carbon dioxide (CO_2) concentrations in the atmosphere, and increased uptake by the oceans, the resulting ocean acidification is causing a decline in the growth rates of coral, shells and skeletal material formed of carbonate minerals[3].

As is the case for the whole world, increased concentrations of greenhouse gases (GHG) in the atmosphere, as a result of human activities, are expected to result in significant further changes in the region's climate. Recent work has reduced uncertainties in the climate projections for the Pacific islands region, while increasing the relevance of the available information[4].
It is expected that:

- By 2030, regional warming will be around +0.5 to 1.0°C, regardless of the GHG emissions scenario; by 2055 warming will be +1.0 to 1.5°C, with regional differences depending on the emissions scenario; and by 2090 it will be around +1.5 to 2.0°C for a low emissions scenario and +2.5 to 3.0°C for a high emissions scenario;
- There will be large increases in the occurrence of extremely hot days and warm nights;
- Increases in annual mean rainfall will occur near the SPCZ and the Inter Tropical Convergence Zone (ITCZ), with little change elsewhere in the region;
- In the wet season (November-April), the SPCZ is not expected to shift position, but there is some evidence for a projected equator-ward shift in the dry season (May-October); increased rainfall is projected within the SPCZ in the wet season in particular; there is also evidence that islands located near the eastern edge of the SPCZ will become drier in the wet season, due to a strengthening of the trade winds in the south-east Pacific;
- The annual numbers of rain days (over 1 mm), light rain days (1–10 mm) and moderate rain days (10–20 mm) will increase near the equator, with little change elsewhere in the region;
- There will be a widespread increase in the number of heavy rain days (20–50 mm), such that extreme rainfall events which currently occur once every 20 years on average will occur four times per year, on average, by 2055 and seven times per year, on average, by 2090 under a high emissions scenario.
- While not uniform across the region, sea-level rise will generally be similar to the global average, projected to be between 0.3 to 1.0 m by 2100 relative to 1986–2005.
- Due to further ocean acidification, aragonite saturation values below 3.5 will become more widespread and have the potential to disrupt the health and productivity of reef ecosystems; lowest values of aragonite saturation in the region are projected to occur in the eastern equatorial Pacific, affecting the easternmost islands of Kiribati; and
- In the south Pacific sub-basins there will be a decrease in the frequency of tropical cyclones by the late 21st century, but an increase in the proportion of more intense storms; in the North Pacific sub-basin a decrease in both the frequency of tropical cyclones and the proportion of more intense storms is expected.

While year-to-year climate variability in the region will continue to be strongly affected by the ENSO, climate projections show that, by the mid- to late twenty-first century, there will be an intensification of both El-Niño-driven drying in the western Pacific Ocean and rainfall increases in the central and eastern equatorial Pacific[5].

Assessment of Risks, Risks and Vulnerabilities

While the consequences of climate change will vary across the region, in part due to variations in the capacity to respond, some general features can be described. Anticipated changes in the Pacific's climate are expected to negatively impact crop productivity, with rainfed agriculture being particularly vulnerable to future changes in climate. Fisheries are also likely to be adversely impacted, with the total catch projected to decrease by 10% to 30% for many PICTs under a high emissions scenario by 2100. Mass coral bleaching is expected to recur as a result of further increases in ocean temperature, with the coral area declining from 88% in the base year (1995) and 80% in 2000, to 55% in 2050 and 20% in 2100. The attractiveness of the Pacific region to tourists is likely to decline for this and related reasons. By the end of the century tourist numbers are projected to decline by approximately one third, reducing tourism revenues by 27% to 34% for the Pacific region as a whole[6]. Climate change will also adversely impact human health, though studies to date have been dominated by efforts to model the future health impacts of processes such as heat waves and other extreme weather events, patterns of infectious disease, and food yields. Many of the anticipated health effects of climate change in the Pacific are anticipated to be indirect, connected to the increased stress and declining well-being that comes with property damage, loss of economic livelihood, and threatened communities[7].

Under a business-as-usual scenario total climate change costs in the Pacific are estimated to reach 12.7% of annual GDP by 2100. Even under a low emissions scenario the economic loss would still reach 4.6% of the region's annual GDP by 2100. Losses by the agriculture sector dominate, followed by increased cooling costs and economic impacts in the coastal areas – dryland loss, wetlands loss, and forced migration[8].

The majority of disasters In the Pacific islands region are caused by severe storms, including tropical cyclones[9]. The total value of the infrastructure, buildings and cash crops in the Pacific islands region that is at risk from tropical cyclones, earthquakes and tsunami[10] is estimated to be over USD 112 billion (Table 1). This translates into annual average economic losses suffered by PICs being as high as 7% of GDP, with natural disaster losses in any single year sometimes exceeding the GDP. Of the 20 countries with the highest average annual disaster losses scaled by GDP, eight are Pacific island countries: Vanuatu, Niue, Tonga, the Federated States of Micronesia, the Solomon Islands, Fiji, the Marshall Islands, and the Cook Islands[11].

Outputs from 11 global climate change models were used to calculate projected financial losses from cyclone damage to buildings, infrastructure and crops in 14 Pacific island countries, for both mid-century and end-of-century. No adjustment was made for future changes for any of these assets[12]. Losses will increase, largely as a result of the projected increase in the strongest cyclones. For the region as a whole the increase in average annual losses is relatively small – from USD 178 million to USD 180 million (1%) by mid-century, and to USD 185 million (3.9%) by end-of-century. But the end-of-century increases for many individual countries are considerably larger, notably 25.4% for Samoa, 14.8% for Niue and 7.6% for Vanuatu. In contrast, decreases are projected for Palau (-10.6%), Solomon Islands (-8%) and Kiribati (-50%), though the last change is small in absolute terms. Changes in loss are greater for buildings than for infrastructure and crops. Wind is the main contributor to building loss, while flooding mainly contributes to infrastructure loss. The climate projections indicate a slight increase in wind contribution and a slight decrease in flood contribution for both buildings and infrastructure.

Country	Assets Replacement Cost	Annual Average Economic Losses		Losses From 100 Year Event	
	USD million	USD million	% GDP	USD million	% GDP
Cook Is	1,422	4.9	2.0	101.4	41.5
Fiji	22,175	78.2	2.6	829.6	27.7
FSM	2,048	8.6	3.0	147.1	57.3
Kiribati	1,182	0.9	0.6	0.6	0.3
Marshall Is	1,696	3.3	2.1	71.0	48.7
Nauru	453	0.01	0.03	0.1	0.3
Niue	249	0.9	5.8	22.2	140.4
Palau	1,501	2.7	1.6	43.6	20.3
PNG	49,209	86.8	0.9	853.1	13.4
Samoa	2,611	7.2	1.3	134.8	24.3
Solomon Is	3,491	20.3	3.0	288.5	60.3
Timor L'Este	20,145	6.1	0.9	142.8	20.0
Tonga	2,817	15.8	4.4	219.1	81.0
Tuvalu	270	0.2	0.5	3.2	11.7
Vanuatu	3,334	48.0	6.6	366.5	74.8
TOTAL	**112,602**	**283.9**		**341,375.5**	

Table 1: Asset Replacement Costs and Economic Losses due to Tropical Cyclone, Earthquake and Tsunami[13]

Vanuatu has the highest score on the World Risk Index. Four other Pacific island countries, out of only seven assessed, are in the top 15 of 173 countries measured (Table 2). The Index assesses exposure to natural hazards; susceptibility as a function of public infrastructure, housing conditions, nutrition and general economic framework; coping capacities; and adaptive capacities to future natural events and climate change. Although the Index is focussed on suddenly occurring hazards such as earthquakes and floods, it also includes chronic hazards such as droughts and sea-level rise. As a whole, the Pacific region is amongst the most vulnerable in the world as it combines high exposure to frequent and damaging natural hazards on the one hand, with low capacity to manage the resulting risks and outcomes on the other hand. As shown above, this situation will be exacerbated by climate change. For example, the subsistence lifestyles common in the Pacific region are highly vulnerable to the impact of inter-annual and longer-term variations in climate[14].

Table 2: The Top 15 Countries in the World Risk Index[15]

Rank	Country	WorldRiskIndex
1.	Vanuatu	36.31 %
2.	Tonga	28.62 %
3.	Philippines	27.98 %
4.	Guatemala	20.75 %
5.	Bangladesh	20.22 %
6.	Solomon Islands	18.15 %
7.	Costa Rica	17.38 %
8.	Cambodia	17.17 %
9.	Timor-Leste	17.13 %
10.	El Salvador	16.89 %
11.	Brunei Darussalam	15.92 %
12.	Papua New Guinea	15.81 %
13.	Mauritius	15.39 %
14.	Nicaragua	15.36 %
15.	Fiji	13.69 %

The Responses – Disaster Management, Disaster Risk Reduction, Adaptation to Climate Change and Emissions Reduction

Since 1950 natural disasters have cost Pacific island countries around USD 3.2 billion, in nominal terms, in associated damage. The cost of restoring infrastructure, maintaining access to basic social services, providing social safety nets to the affected population, and investing in disaster risk reduction is expected to be around USD 120 million. This equates to 22 per cent of GDP over the next three to four years[16].

Under a business-as-usual scenario, the Pacific region would require USD 447 million on average every year until 2050 (approximately 1.5% of GDP) to prepare for the worst case (95th percentile) of climate change. Annual adaptation costs could be as high as USD 775 million, or 2.5% of GDP per annum. Costs would be significantly reduced under lower emissions scenarios. For example, if the atmospheric CO_2 concentration can be kept below 450ppm, annual adaptation costs are expected to be as low as USD 158 million, or 0.5% of GDP per annum until 2050[17].

Currently, actions related to disaster management, disaster risk reduction, adaptation and reduction of greenhouse gas emissions are guided by two regional policy frameworks - the Pacific Disaster Risk Reduction and Disaster Management Framework for Action (2005 – 2015) and the Pacific Islands Framework for Action on Climate Change (2006 – 2015). In light of the many synergies and overlaps between disaster risk management and the management of climate-related risks through both climate change adaptation and the reduction of greenhouse gas emissions, work is now underway to prepare a single regional strategy. This will come into effect in 2016[18]. The shared aim of managing disaster- and climate-related risks is to increase the resilience of societies and economies to the impacts of a full range of natural and other hazards, whether they are sudden or slow onset. This involves improving the ability to better anticipate, resist, prepare for, respond to and recover from their consequences.

Reversing the current trends of rising disaster and climate risk—which are outpacing gains in resilience[19]—will require a major shift in development planning and practice, by moving away from development initiatives that lead to the construction and accumulation of risk, to taking well-informed, firm and timely action to reduce vulnerability and strengthen resilience in order to protect lives and built and natural assets. This requires strengthened risk management, low carbon development, strengthened preparedness, response, relief and recovery, and improved ability to manage new and emerging drivers of risk. Building and maintaining the capacity to manage climate and disaster risks in an effective and efficient manner is also a priority for the region. This means that operational decisions must be well informed, and supported by sound policies and plans, including targetted and user-friendly information and knowledge. Procedures must be in place, and there must be capacity, to act on the decisions.

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While the reviewers have provided comment on drafts of this article, they do not necessarily endorse it in its final form. The author is solely responsible for any errors and judgements that may exist in the published article

End Notes

[1] For a general discussion on global climate change see the following Climate Change Discussion Sheets - Climate Change and Global Warming Risks; and Responses and Climate Change: Living in a Warmer World.

[2] SPREP, 2012: Pacific Environment and Climate Change Outlook. Secretariat of the Pacific Regional Environment Programme (SPREP), Apia, Samoa, 232pp.

[3] Johnson, Johanna. Bell, Johann and Gupta, Alex Sen, 2016 Pacific Islands Ocean Acidification Vulnerability Assessment. Secretariat of the Pacific Regional Environment Programme (SPREP), Apia, Samoa, 40pp.

[4] Australian Bureau of Meteorology and CSIRO, 2011: Climate Change in the Pacific: Scientific Assessment and New Research. Volume 1: Regional Overview. Volume 2: Country Reports. IPCC, 2013: Working Group I Contribution to the IPCC Fifth Assessment Report, Climate Change 2013: The Physical Science Basis. Intergovernmental Panel on Climate Change (IPCC), Geneva, Switzerland, 2216pp. Asian Development Bank, 2013: The economics of climate change in the Pacific. Mandaluyong City, Philippines: Asian Development Bank, 103pp.

IPCC, 2013: Working Group I Contribution to the IPCC Fifth Assessment Report, Climate Change 2013: The Physical Science Basis, Summary for Policymakers, Intergovernmental Panel on Climate Change, Geneva, 36pp.

[5] Power, S., Delage, F., Chung, C., Kociuba, G. and K. Keay, 2013: Power Robust twenty-first-century projections of El Niño and related precipitation variability. Nature 502, 541–545.

[6] Asian Development Bank, 2013: The economics of climate change in the Pacific. Mandaluyong City, Philippines: Asian Development Bank, 103pp.

[7] World Health Organization Regional Office for the Western Pacific, 2015: Human Health and climate change in Pacific Island Countries. World Health Organization, Geneva, Switzerland, 172pp.

Lovell, S.A., 2011: Health governance and the impact of climate change on Pacific small island developing states. International Human Dimensions Programme on Global Environmental Change (IHDP) Update Issue 1, 2011, 50-55.

[8] Asian Development Bank, 2013: The economics of climate change in the Pacific. Mandaluyong City, Philippines: Asian Development Bank, 103pp.

Burson, B., 2010: Climate Change and Migration - South Pacific Perspectives. Institute of Policy Studies, School of Government, Victoria University of Wellington, Wellington, 197pp.

[9] Hay, J.E. and C. Pratt, 2013: Regional Situation and Needs Assessment of Programming Priorities for Australia's Pacific Disaster Risk Management, Environment and Climate Change (DEC) Development Agenda and Delivery Strategy. Report to the Australian Agency for International Development (AusAID), Canberra, 58pp.

[10] Earthquakes and tsunami are not related to climate change, at least in the short term.

[11] World Bank, 2012: Acting Today, for Tomorrow: A Policy and Practice Note for Climate and Disaster Resilient Development in the Pacific Islands Region. World Bank, Washington, D.C, 28pp.

[12] PCRAFI, 2013: Current and Future Tropical Cyclone Risk in the South Pacific. Pacific Catastrophe Risk Assessment and Financing Initiative (PCRAFI), World Bank, Washington DC, 12pp.

[13] PCRAFI, 2012: Risk Assessment - Summary Report. Pacific Catastrophe Risk Assessment and Financing Initiative (PCRAFI), World Bank, Washington, DC, 95pp.

[14] SPREP, 2012: Pacific Environment and Climate Change Outlook. Secretariat of the Pacific Regional Environment Programme (SPREP), Apia, Samoa, 232pp.

[15] Alliance Development Works, 2012: World Risk Report 2012. United Nations University Institute for Environment and Human Security (UNU-EHS), the Alliance Development Works/Bündnis Entwicklung Hilft and The Nature Conservancy (TNC), 74pp.

[16] PCRAFI, 2012: Risk Assessment - Summary Report. Pacific Catastrophe Risk Assessment and Financing Initiative (PCRAFI), World Bank, Washington, DC, 95pp.

[17] Asian Development Bank, 2013: The economics of climate change in the Pacific. Mandaluyong City, Philippines: Asian Development Bank, 103pp.

[18] SPC, SPREP and UNISDR, 2013: Roadmap towards a Strategy for Disaster and Climate Resilient Development in the Pacific (SRDP) by 2015. Secretariat for the Pacific Community, Suva, Fiji, 4pp.

[19] Hay, J.E. and C. Pratt, 2013: Regional Situation and Needs Assessment of Programming Priorities for Australia's Pacific Disaster Risk Management, Environment and Climate Change (DEC) Development Agenda and Delivery Strategy. Report to the Australian Agency for International Development (AusAID), Canberra, 58pp.

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