4

THE CURRENT STATE OF THE PACIFIC

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4.1 Introduction

Climate change poses serious and considerable threats to the environment and livelihood of Small Island Developing States (SIDS), including the Pacific Island Countries and Territories (PICTs). It is expected to exacerbate the magnitude and intensity of natural hazards frequently experienced by the region. Hot temperatures and prolonged drought periods are felt throughout the region, threatening food security and reducing the availability of water resources. Intense rain events and severe flooding have resulted in environmental and ecosystem damage, population displacement both in-country and overseas as well as psychological stress to indigenous communities. Water-borne diseases are becoming more prevalent as vectors increase their habitat range due to warming. Low-lying atolls and coastal communities are already facing sea level rise with the possibility of being fully immersed if greenhouse gas emissions continue to be poorly controlled.

The future of the Pacific depends on how leaders and policy-makers, experts and local communities respond to these changes. This chapter discusses the current state of knowledge of climate change in the Pacific and how the region is addressing present and predicted impacts.

4.2 The Pacific

The Pacific Island region (Figure 1) extends from latitudes 70°W to 100°W and longitudes 66°N to 80°S. It covers an area of over 27 million km^2 with a landmass of about 551,312 km^2 and the rest being the ocean. The region includes 22 PICTs, with about 200 high islands of mostly volcanic origin and 2,500 low islands and atolls. Except for Papua New Guinea, land area is small with countries of Micronesia and 80 per cent of the countries in Polynesia having land areas of less than 1,000 km^2 and with some countries existing as coral atolls and with elevations of less than two metres above sea level. The population in 2016 was estimated to be about 11,328,400, which is about 0.15 per cent of the global population (Nunn, Kumar, Eliot and McLean, 2016) and with an estimated rural to urban distribution of 60 per cent and 40 per cent respectively. This number is projected to increase to over 15 million in the year 2035 and over 19 million in 2050 (SPC, 2016).

There is no doubt that climate conditions have changed since the pre-industrial period, are currently changing and will continue to change into the future. Global and regional assessments of climate conditions conducted by the Intergovernmental Panel on Climate Change (IPCC) over several decades have indicated a daunting future for the region (IPCC, 2018).

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Costi & Renwick (eds) *In the Eye of the Storm–Reflections from the Second Pacific Climate Change Conference* (SPREP, Te Herenga Waka—Victoria University of Wellington and NZACL, 2020)

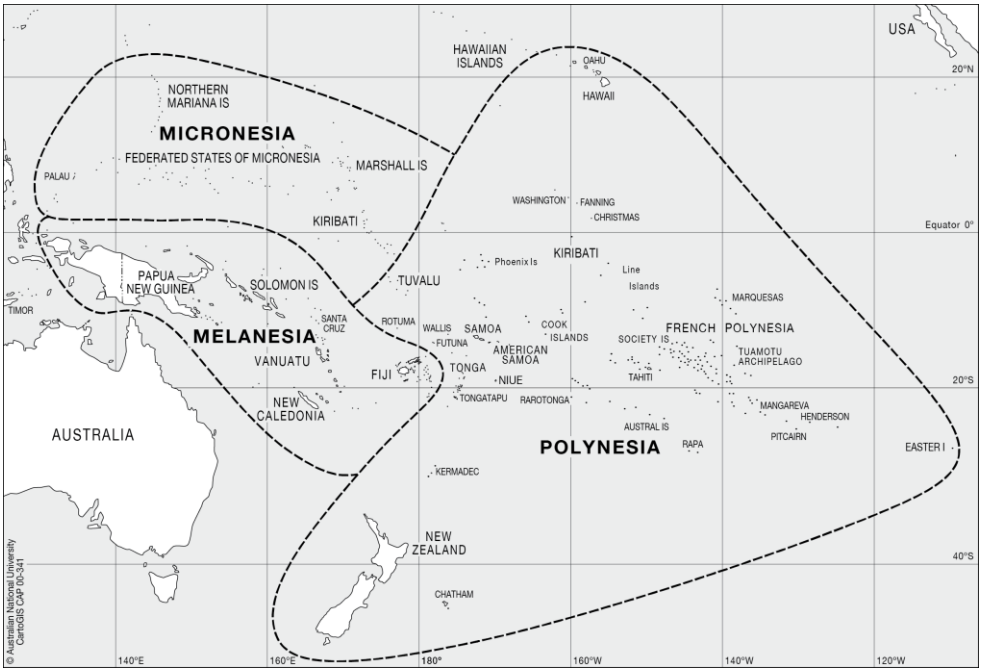

Figure 1: map of the southwest Pacific showing the location of PICTs. Source: <https://iusboverseas.files.wordpress.com/2015/06/00-341_micromela-polynesia.png>.

The leaders of the Pacific envision the region as a place of "peace, harmony, security, social inclusion, and prosperity, so that all Pacific people can lead free, healthy, and productive lives".[1] However, the environment and livelihood of the region and its people are threatened by the impacts of climate change despite its minute contribution of < 0.003 per cent to the global carbon budget (Betzold, 2015). PICTs share common characteristics and environmental challenges due to their size, geographical isolation and economic status, which contribute to their high vulnerability and low adaptive capacity to deal with the impacts of climate change. The Working Group II report on Small Islands (Nurse et al, 2014) forecasts continuing problems that were identified in previous reports, including sea level rise, rising temperatures and more hot days, changing rainfall patterns, ocean acidification, and less frequent but more intense cyclones. These impacts subsequently lead to indirect problems such as erosion, coastal inundation, contamination of freshwater and marine environments, food security, health and settlement patterns, to name a few. Climate change increasingly threatens the viability of agriculture and forestry sectors and food reserves may become inedible due to cyclones and hurricanes.

1 Pacific Islands Forum *The Framework for Pacific Regionalism* (Pacific Islands Forum Secretariat, Suva, 2014) at 3 [*Framework for Pacific Regionalism*].

4.3 Climate change trends in the Pacific

The Pacific currently faces climate-related challenges that are seen globally although the levels of exposure, vulnerability, impacts and coping capacities may vary across countries in the region. This section summarises trends that have been measured or estimated for the region as indicated in technical reports and previous research conducted in the region.

4.3.1 Temperatures

The Pacific is expected to face similar trends in atmospheric temperature as the global situation. Anthropogenic activities have contributed an estimated one degree Celsius increase above pre-industrial levels with global warming potentially raising temperatures by up to 1.5 degrees Celsius between the years 2030 and 2050 (IPCC, 2018) if current patterns of greenhouse gas emissions persist. This increase echoes similar predictions noted in previous IPCC reports (IPCC, 2007) for SIDS. Regional warming is projected to rise above to ~ 0.5-1.0 degree Celsius by 2030 and ~ 1.0-1.5 degrees Celsius by 2055 (Australian Bureau of Meteorology and Commonwealth Scientific and Industrial Research Organisation (CSIRO), 2011). Land-surface temperatures in the region have increased slightly over the global level by about 0.17 degree Celsius per decade since the 1980s (State of Environmental Conditions in Hawaii and the US Affiliated Pacific Islands under a Changing Climate, 2017).

In an assessment of 15 countries in the western tropical Pacific using data as far back as the late 1800s and with available data up to 2011 (Australian Bureau of Meteorology and CSIRO, 2011), temperatures have increased in the range of + 0.08 to 0.22 degree Celsius per 10 years with projected increases in surface air temperature of 0.5-0.7 degree Celsius by the year 2030 under very low emission scenarios. Increased temperatures coincided with increased warm days and nights in all countries: with Palau showing the highest average number of warm days per decade at 21; and Tuvalu and the Solomon Islands with the highest number of warm nights per decade at about 12. The implications of these changes on the Pacific environment and its people tend to point to the negative end of the spectrum. Warmer temperatures increase evapotranspiration, broaden the habitat of vectors for water-borne diseases and can lead to the development of a tropical cyclone.

4.3.2 Rainfall

The equatorial Pacific is likely to experience an increase in annual mean precipitation by the end of this century (Nurse et al, 2014). Based on a 50-year record from 1951-2011, annual rainfall levels dropped in most countries by - 4.9 to - 77.4 mm/10 years (Australian Bureau of Meteorology and CSIRO, 2011). Palau, Papua New Guinea, Niue, Samoa and Vanuatu had increases in annual rainfall levels with estimates for the latter three countries based on at least a 100-year record. Figure 2 gives an outlook to the rainfall situation in the Pacific for the first three months of 2020. Of concern are countries that are expected to have below normal rainfall during this wet season. These changing rainfall patterns are attributed to climate change.

Severe flooding is occurring more frequently across the Pacific due to intense rainfall events brought about by tropical cyclones. Category 2 Tropical Cyclone Evan which struck Samoa in 2012 brought with it one of the highest rainfall levels ever recorded in Samoa, which caused massive

flooding and damage, including fatalities. The Solomon Islands up to the beginning of 2019 also faced life-threatening flooding associated with severe depressions and tropical cyclones which affected more parts of the country that did not usually flood. Fiji has faced similar devastations as has Vanuatu, resulting in mass relocation of flood-prone populations to safer grounds. In addition to intense rainfall, prolonged dry periods also affect the region as a consequence of climate change.

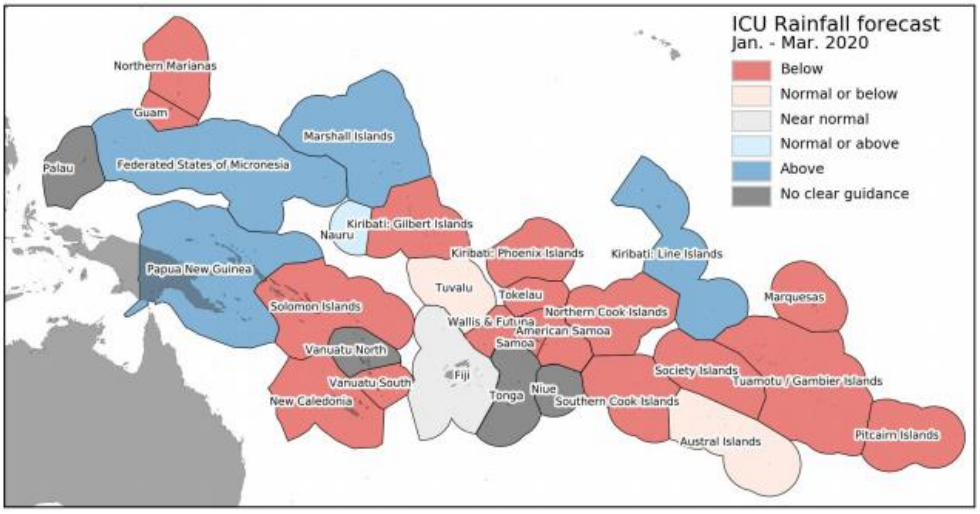

Figure 2: rainfall forecast for the Pacific for January-March 2020. Source: NIWA.[2]

4.3.3 Cyclones

The wet season running from November to April usually sees a spike in strong weather conditions which have included tropical cyclones normally at lower categories. However, the region was hit by two Category 5 cyclones, with Cyclone Pam generating massive destructions in Vanuatu in 2015, followed by Cyclone Winston in Fiji in 2016. Based on the IPCC AR5, intense tropical and subtropical cyclones are forecast for the region. This forecast has generated fears amongst the region with an estimated seven to eleven tropical cyclones predicted for the period November 2018 to April 2019 (SPREP, 2018). This estimate was quite close to an average of nine tropical cyclones per year for the 30-year period from 1977 to 2007 (Sinclair, 2002) with the peak of the cyclone season from January to March (Diamond, Lorrey, Knapp and Levinson, 2012). A tropical cyclone outlook for the 2019-2020 period (Figure 3) estimates a maximum of four events in the region with an intensity of as high as Category 3. Already, Fiji and Tonga were hit by Category 3 Cyclone Sarai in January 2020.

2 "The Island Climate Update ENSO Watch January 2020" NIWA <https://niwa.co.nz>.

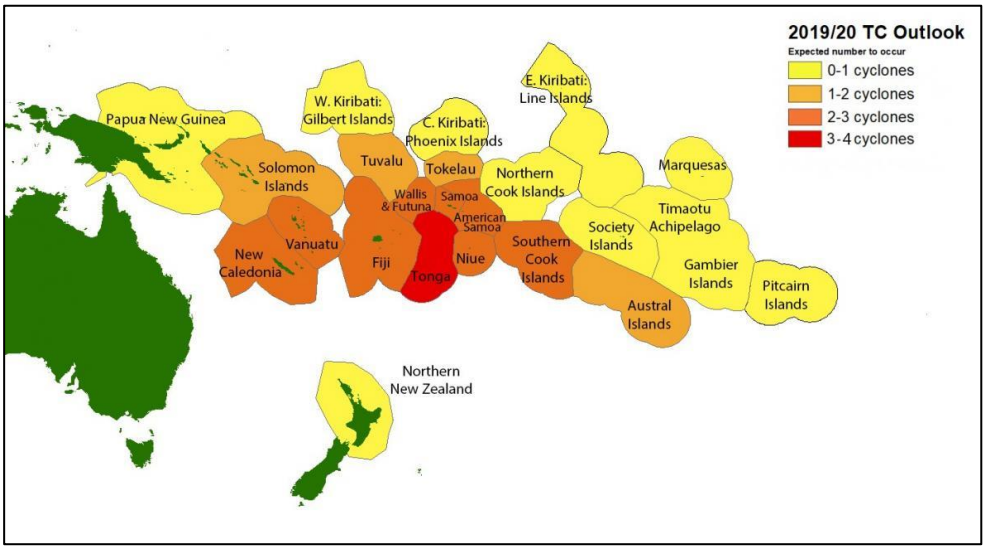

Figure 3: tropical cyclone outlook for the Pacific for 2019-20. Source: NIWA.[3]

4.3.4 Sea level rise

Global sea levels are rising now and are projected to continue to rise into the latter parts of the 21st century. Based on in situ data dating back to 1880, the rate of rising was estimated at 2.8 ± 0.8 mm year^{-1} with a global average sea level rise of about 210 mm (Church and White, 2011). Since 1993, global mean sea level rose at a rate ranging from 2.8-3.6 mm year^{-1} (Nurse et al, 2014). The rates of sea level rise can vary amongst regions and from the global mean sea level rise at different magnitudes, due to fluctuations in ocean circulation. Since 1993, the regional rates for the western Pacific are up to three times larger than the global mean, while those for much of the eastern Pacific are near zero or negative (Nurse et al, 2014). One of the highest recorded rates in the region, around Tuvalu, is about 5.1 mm per year (Connell, 2016).

Rising sea levels have critical direct impacts on the Pacific people as the majority of populations in the region live along the coast and for small atolls, the ocean is both their front and back yards.

Countries already impacted by sea level rise include Federated State of Micronesia, Kiribati and parts of Papua New Guinea and Vanuatu. In addition to sea level rise, king tides, associated with warm water mass and maybe as high as three metres (Lin, Ho and Cheng, 2013), are inundating further inland and saturating coastal aquifers, groundwater and freshwater springs with high salinity seawater. As recent as 2014 and 2019, king tides have struck the Kiribati islands resulting in damage to infrastructure and properties. In the latter year and despite coastal infrastructure developments, Samoa

3 "Southwest Pacific Tropical Cyclone Outlook - October 2019" NIWA <https://niwa.co.nz>.

was also struck by strong king tides on both big islands, an unusually obvious phenomenon in the country.

Sea level rise has also induced forced migration in the region, with residents either relocating to higher grounds or other parts of the country or migrating out of the country. Residents of Tuvalu, Tegua Island in Vanuatu and the Carteret Islands in Bougainville, Papua New Guinea were considered the first climate change refugees (Connell, 2016).

4.3.5 Ocean acidification

The ocean is the livelihood of the Pacific people, being the major source of food for indigenous communities and a source of income at both household and commercial levels. The release of anthropogenic CO_2 has increased atmospheric CO_2 by about 40 per cent since pre-industrial times (IPCC, 2013; Zeebe, 2012). The ocean is a major sink of anthropogenic CO_2 with an estimated 25 per cent capacity to absorb atmospheric emissions (Doney, Bopp and Long, 2014; IPCC, 2013). The uptake of CO_2 can alter the chemistry of seawater, leading to a drop in pH and availability of carbonate ions for skeletal formation. CO_2 uptake that is coupled with a temperature rise of 1.5 degrees Celsius is expected to magnify the adverse effects of warming and to threaten the functioning and survival of various marine species (IPCC, 2018), including algae, coral, fish and molluscs. Based on measurements for the 1950-1960 decade, sea surface temperature is expected to increase by up to 0.8 degree Celsius by 2035. Concurrently, pH is expected to drop from pH 8.08 to ~ 7.98 by 2035 (Bell et al, 2011). In the equatorial Pacific, where CO_2 uptake is coupled with deep water upwelling, pH declines of - 0.0018-0.0026 per year were measured for the period 1997-2011 (Sutton et al, 2014).

The saturation state of aragonite (Ω_a), the calcium carbonate morph that is essential for skeleton formation in many marine species including corals, needs to be above 3.5 for calcification. Aragonite saturation state was estimated at 3.9 relative to the 1950-1960 period and is expected drop to ~ 3.3 by 2035 and 2.4 by 2100 (Bell et al, 2011). An average aragonite saturation state of 3.8 was determined in 2000 for the Pacific region with all countries in the western tropical Pacific showing decreases from Ωa of 4.5 in the late 18th century to 3.9-4.1 ± 0.1 (Kuchinke, Tilbrook and Lenton, 2014). Saturation states below 3.5 are projected to be more common in the region (Australian Bureau of Meteorology and CSIRO, 2011) with potential negative impacts not just on the skeletal organisms, but also at the ecosystem level.

Ocean acidification is a new concept in climate change dialogue in the Pacific and research by Pacific researchers in most of the region has been implemented in less than five years. This is a field of urgent need for capacity development in the Pacific region to enable its people to monitor their marine environment and resources as well as identifying potential strategies for an integrated approach to adaptation and resilience development to the acidification problem (Johnson, Bell and Gupta, 2016).

4.4 Challenges for the Pacific

The current challenges associated with climate change are expected to amplify or worsen, multiple stressors may interact to generate more harmful effects and new problems may emerge due to further changes in climate. There have been sporadic incidents of water-borne diseases such as cholera and

dengue fever in recent years as well as the emergence of the Zika virus and outbreaks of malaria. Increased sea surface temperatures, sea level rise and ocean acidification are changing the intrinsic characteristics of the marine environment that promote diverse and healthy ecosystems. Hot temperature extremes and marine heatwaves have resulted directly in coral bleaching events and fish mortality in parts of the region and indirectly on fisheries and marine biodiversity. Fisheries is a major income generating revenue not just at the local household level, but also at the national level. This is even more critical in small atolls like Kiribati and Tuvalu, with limited land for agriculture and huge exclusive economic zones for economic benefits.

Mangrove ecosystems are critical to the survival of marine species as habitats, sources of food and breeding grounds. They also function as carbon sinks to help in the removal of excess carbon dioxide from the atmosphere and as protective agents against storm surges and strong currents. When the rate of sea level rise exceeds the accumulation rate of fluvial sediment, mangroves may face substrate erosion, inundation stress and increased salinity.

The unprecedented rate of decrease in ocean pH and the high sensitivity of coastal ecosystems to such change (Ries, Cohen and McCorkle, 2009) raise serious concerns about the potential impacts of an increase in ocean acidity on the physico-chemical and biological characteristics of marine ecosystems. Currently, the open oceans are supersaturated ($\Omega > 1$) with respect to calcite and aragonite. However, greater reductions in saturation state are projected by the year 2100 in both low and high latitude regions, resulting in enhanced CaCO3 dissolution (Gangstø et al, 2008). Further declines in saturation states in the low-latitude regions of the south Pacific, where saturation values below equilibrium have already been measured (Bostock et al, 2011), will be quite detrimental to the survival of marine organisms. IPCC assessments indicate that it is highly likely that ocean acidification will continue into the future with significant consequences for coastal ecosystems (IPCC, 2018). Ocean acidification is expected to have a negative effect on livelihood opportunities in the pearl farming and shrimp farming industries (Johnson, Bell and Gupta, 2016). There is a high risk of reduced growth and reproduction under acidified conditions in marine animals such as sea urchins, bivalves and gastropods (Hendriks, Duarte and Álvarez, 2010) as well as respiration and other physiological processes in fish (Guinotte and Fabry, 2008). Corals are prone to drops in the saturation state of aragonite which is critical for the formation of their skeletons. Changes in the distribution and abundance of tuna, plus a decline in coastal fisheries and coral reefs, have also been observed (Bell et al, 2011). These findings are of great concern as fish is a significant revenue-generating export for the region, vital to food security and livelihood of local communities. Pacific Island nations have been identified as the most vulnerable in the world to the health impacts of climate change due to their demographic and limited socioeconomic qualities (McIver et al, 2016).

4.5 The Pacific response

With all the challenges generated by changes in climate and the high vulnerability of the Pacific community, the region is at the forefront of climate change (Lazrus, 2012) and should play a critical role in the dialogue and advocacy on strategies to adapt to, or mitigate impacts of, climate change. The Pacific is in the "eye of the storm", disproportionately facing the impacts of climate change that are generated mostly by factors outside its realm.

The Pacific countries have not only ratified international climate change conventions, protocols and agreement such as the United Nations Framework Convention on Climate Change (UNFCCC),[4] the Kyoto Protocol to the Framework Convention on Climate Change[5] and the Paris Agreement,[6] but they have also adopted laws and instruments to guide and prioritize regional attempts to address climate change with regard to reducing the vulnerability of countries through climate change resilience, mitigation and adaptation strategies and concurrently developing a resilient Pacific. This section summarizes some of these climate-related instruments that have been developed by the Pacific leaders.

4.5.1 The Framework for Pacific Regionalism

The Framework for Pacific Regionalism (FPR) was endorsed by the Pacific Islands Forum leaders in July 2014 and sets out a robust process to identify and implement regional priorities. The FPR outlined four major objectives, which focus on:[7]

- Sustainable development that combines economic, social, and cultural development in ways that improve livelihoods and well-being and use the environment sustainably;
- Economic growth that is inclusive and equitable;
- Strengthened governance, legal, financial, and administrative systems; and,
- Security that ensures stable and safe human, environmental and political conditions for all.

In the Pacific context, regionalism refers to:[8]

> The expression of a common sense of identity and purpose, leading progressively to the sharing of institutions, resources, and markets, with the purpose of complementing national efforts, overcoming common constraints, and enhancing sustainable and inclusive development within Pacific countries and territories and for the Pacific region as a whole.

This definition focuses on regional integration and collective action to gauge the contribution of more stakeholders from civil society, private sector and government to policy development at the national and regional levels to achieve the stated goals. The FPR thus provides a forum for coordinated advocacy and negotiations by Pacific Island countries on global climate policies. However, it is a process-focused document with narrowing priority issues for leaders' consideration (Slatter, 2015). The success of the FPR has been challenged through barriers to achieve its objectives, including

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4 United Nations Framework Convention on Climate Change 1771 UNTS 107 (opened for signature 4 June 1992, entered into force 21 March 1994).

5 Kyoto Protocol to the United Nations Framework Convention on Climate Change 2303 UNTS 162 (opened for signature 16 March 1998, entered into force 16 February 2005).

6 Paris Agreement 55 International Legal Materials 743 (adopted 12 December 2015, entered into force 4 November 2016).

7 *Framework for Pacific Regionalism*, above n 1, at 2.

8 Ibid. See Chapters 6 and 7 in this book.

different stages of country development, inclusion and exclusion of certain groups, geopolitics and encouraging member states to balance regional initiatives with their national priorities, particularly when a leader's national level political survival is at stake (Davidson, 2016). The importance of unified efforts was further captured in the Pacific Islands Forum leaders' endorsement in 2017 of the region's identity as the "Blue Pacific".[9] The "Blue Pacific" connotes the shared values and identities of Pacific people and their relationship with their natural resources, environment, culture and livelihoods.[10]

4.5.2 Declaration on Climate Change Action

During the 46th Pacific Islands Forum leaders' meeting held in Port Moresby, Papua New Guinea in September 2015, the Pacific leaders established the Declaration on Climate Change Action (DCCA) to pave the way forward for the region in advocating for a global agreement to limit warming to below 1.5 degrees Celsius above pre-industrial levels.[11] The DCCA stressed grave concerns on the adverse effects of a temperature increase above this value on the PICTs and climate change in its entirety, and spelt out 11 points that PICTs call for as part of the outcome of the Paris Climate Change Summit (Conference of the Parties to the UNFCCC (COP21)) in December of the same year.[12] These points include the disproportionate impacts on vulnerable and marginalized groups in the region including gendered impacts and gender-sensitive responses, the commitment of the region in reducing greenhouse emissions and the region's support on international efforts to develop and implement appropriate adaptation and mitigation actions. The concerns of this Declaration are still valid today as activities that contribute to global warming continue, especially the major contributors from industrial nations who, after the Conference of the Parties in Spain (COP25), have still not fully or only partially honoured the commitments stipulated in the Paris Agreement.

4.5.3 Framework for Resilient Development in the Pacific: 2017-2030

The Framework for Resilient Development in the Pacific (FRDP), aimed at addressing climate change challenges in the Pacific, was endorsed by the Pacific Islands Forum leaders in 2016. In contrast to the Pacific Islands Framework for Action on Climate Change (SPREP, 2011) which expired in 2015, the FRDP recognises the overlapping and common risks and threats posed by both climate change and disasters (SPC, 2017). Encompassing sustainable development needs in the Pacific, the FRDP stipulates an integrated approach to mitigation and adaptation strategies to build community resilience against climate change and disaster challenges.

The FRDP specifies three interrelated goals: (1) strengthening integrated adaptation and risk reduction to enhance resilience to climate change and disasters; (2) low-carbon development; and (3)

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9 Pacific Islands Forum "Forty-Eight Pacific Islands Forum Communiqué" PIF(17)10, Apia, Samoa, 5-8 September 2017.

10 Id, at [4]-[7].

11 Pacific Islands Forum "Pacific Islands Forum Leaders Declaration on Climate Change Action" (Annex 1 to the "Forty-Sixth Pacific Islands Forum Communiqué" PIF(15)7, Port Moresby, Papua New Guinea, 8-10 September 2015) at [6].

12 Id, at [3] and [11].

strengthening disaster preparedness, response and recovery. The implementation of actions and success in achieving these goals requires collaboration and partnerships amongst various stakeholders from the grassroots communities all the way up to the national government level. Concurrently, the efforts of each Pacific Island nation will also contribute to the implementation of global frameworks such as the Agenda for Sustainable Development 2015-2030, the Paris Agreement, the Sendai Framework for Disaster Risk Reduction 2015–2030 and the Small Islands Developing States Accelerated Modalities of Action (SAMOA) Pathway.[13]

4.5.4 The Kainaki II Declaration for Urgent Climate Change Action Now

The latest Pacific Islands Forum leaders' meeting in Tuvalu in 2019 gave an opportunity for all participants to observe first-hand the reality of the devastating effects of climate change on small island atolls and led to the establishment of the Kainaki II Declaration for Urgent Climate Change Action Now. A significant feature of this Declaration was the unanimous agreement of all members of the Pacific Islands Forum on the existence of a "climate change crisis" in the region.[14] The region continues to advocate for limiting the global average temperature rise to below 1.5 degrees Celsius above pre-industrial levels and with a long-term goal of "achieving net zero carbon by 2050".[15] It also reiterates the need for all state parties to the Paris Agreement to update and report by the end of 2020 on their efforts to reduce national emissions and adapt to the impacts of climate change or their Nationally Determined Contributions (NDCs).[16]

Additionally, the Declaration highlights the importance of the climate-ocean nexus and echoes the intricate value of an integrated approach to international negotiations for both climate and ocean challenges to maintain our "Blue Pacific".

4.6 Conclusion

The impacts of climate change have been increasingly felt by many communities in Pacific Island countries where adaptive capacities are mostly inadequate. These impacts are caused by either rapid-onset events such as tropical cyclones and heavy rainfall or slow-onset events like sea level rise and ocean acidification. The Pacific leaders have been pro-active in developing legislations and strategies to mitigate against, and adapt to, climate change as well as advocating and negotiating for climate challenges at the national, regional and international platforms.

Through an integrated and participatory approach, climate change principles are mainstreamed into national legislation and developments to ensure communities are well-protected against the

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13 Secretariat of the Pacific Community *Framework for Resilient Development in the Pacific: An Integrated Approach to Address Climate Change and Disaster Risk Management (FRDP) 2017-2030* (SPC, Suva, 2017) at 10-11.

14 Pacific Islands Forum "Kainaki II Declaration for Urgent Climate Change Action Now" (Attachment to the "Fiftieth Pacific Islands Forum Communiqué" PIF(19)14, Funafuti, Tuvalu, 13-16 August 2019) at [1].

15 Id, at [19].

16 Ibid.

impacts of climate change. Mitigation and adaptation projects are implemented across the region at various levels and climate change training and education programmes have been conducted to raise community awareness on impacts, mitigation and adaptation mechanisms. The current laws guiding the development of climate change initiatives acknowledge the importance of an all-inclusive sectoral approach to addressing climate change challenges which were not strongly highlighted in previous legislative measures. For example, health and gender are now recognised as important climate issues.

It is important to stress that Pacific people are extremely concerned about the consequences of climate change. The possibility of high category cyclones in the region, loss of land to sea level rise and potential submergence of small islands are terrifying. The aspirations of the region to combat climate change come with huge financial implications as structural and non-structural capacities are limited. Governments must continue to strengthen collaboration with development partners to secure funds for implementation of climate change adaptation programmes or projects and to build the capacity of Pacific people to continue to advocate for climate change issues.

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