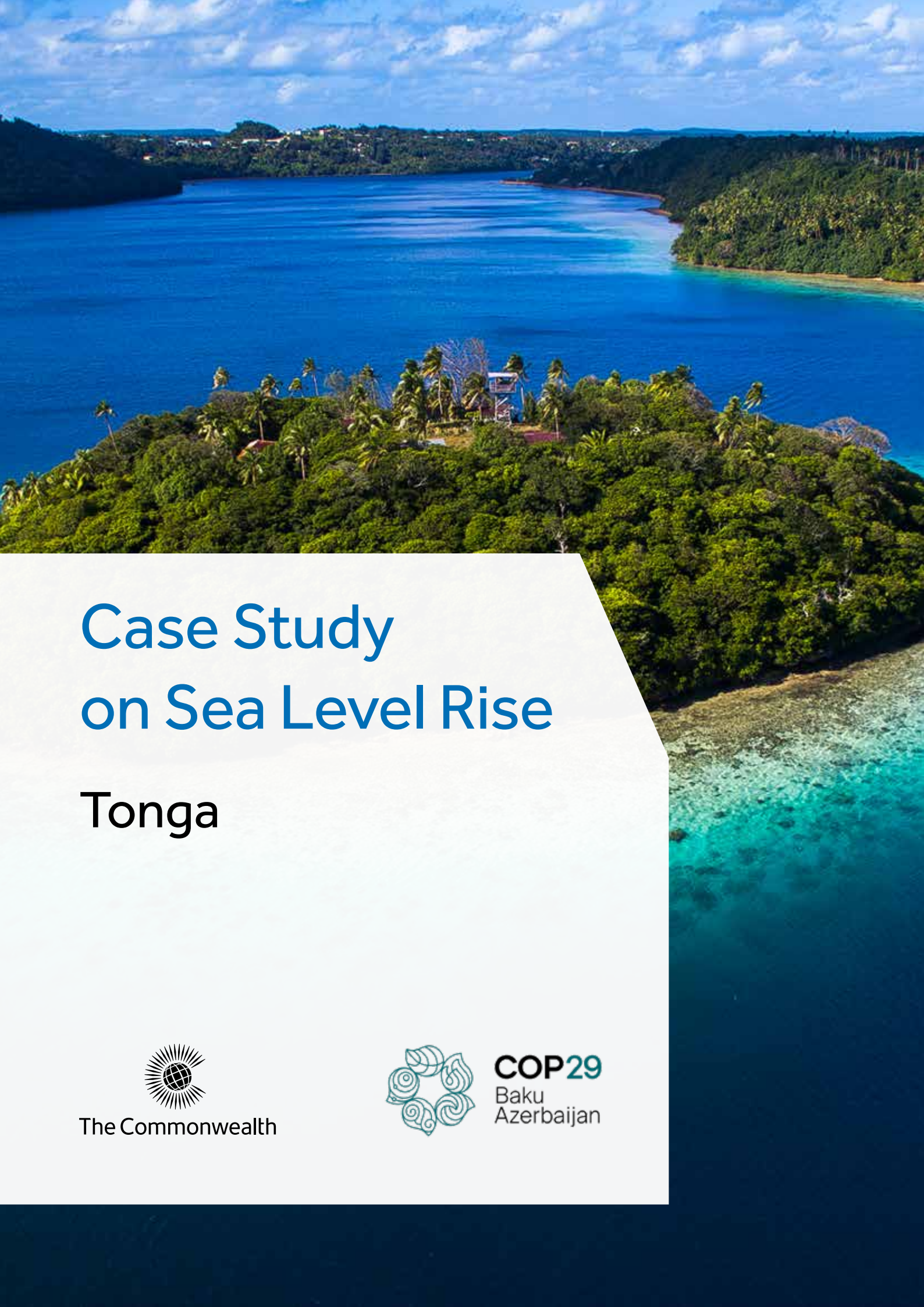




Case Study on Sea Level Rise

Tonga



The Commonwealth



COP29
Baku
Azerbaijan

Case Study on Sea Level Rise

Tonga

Financial support for the preparation of this report was provided by COP 29. The Commonwealth Secretariat gratefully acknowledges this contribution.

Suggested citation: Commonwealth Secretariat (2026), *Case Study on Sea Level Rise: Tonga*, <https://doi.org/10.14217/piqe6417>

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Published by the Commonwealth Secretariat.

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Acronyms and Abbreviations

ADB	Asian Development Bank
CCA	climate change adaptation
CCTF	Climate Change Trust Fund
CDP	community development plan
CSFT	Civil Society Forum of Tonga
DRM	disaster risk management
EEZ	exclusive economic zone
GEF	Global Environment Fund
GHG	greenhouse gas
GOT	Government of Tonga
INDC	Intended Nationally Determined Contribution
IPCC	Intergovernmental Panel on Climate Change
JNAP	Joint National Action Plan on Climate Change Adaptation and Disaster Risk Management
JNAP 2	Joint National Action Plan II on Climate Change Adaptation and Disaster Risk Management 2018–2028
MEIDECC	Ministry of Meteorology, Energy, Information, Disaster Management, Environment, Climate Change and Communications
MPA	marine protected area
NDCs	Nationally Determined Contributions
NGO	non-governmental organisation
SIDS	small island developing states
SLR	sea level rise
SMA	special management area
TREP	Tonga Renewable Energy Project
TSDF II	Tonga Strategic Development Framework II (2015–2025)
UNFCCC	United Nations Framework Convention on Climate Change

About the Commonwealth

The Commonwealth is a voluntary association of 56 independent and equal sovereign states and home to 2.7 billion people. The Commonwealth Secretariat is an independent organisation working with the 56 member countries and assists them together to promote prosperity, democracy and peace, amplify the voice of small states, and protect the environment.

The Commonwealth Secretariat's Climate Change and Oceans Directorate assists its member countries to sustainably manage their natural resources, in the ocean and on land, for the benefit of present and future generations. The Secretariat provides technical assistance and supports member countries in the development of policies, laws, and strengthening national institutions.

Executive Summary

This case study examines the impact of sea level rise on the Kingdom of Tonga and assesses the effectiveness of climate change adaptation measures implemented under the country's Joint National Action Plan 2 (JNAP 2) on Climate Change and Disaster Risk Management (2018–2028). Tonga, ranked as the second most at-risk country for natural hazards in the 2017 *World Risk Report*, has faced sea level rise of 7.3mm per year since 1993, more than twice the global average of 3.2mm per year. With 80 per cent of its population and critical infrastructure located within 1km of the shoreline, the urgency for effective adaptation is paramount.

The study finds that significant progress has been made in implementing adaptation measures, including the establishment of the Tonga Climate Change Trust Fund, the first such fund in the Pacific region, and the launch of the Climate Change Portal in March 2021. The JNAP 2 identifies six priority objectives centred on mainstreaming climate resilience, building response capacity, implementing on-the-ground resilience actions and securing sustainable climate finance.

However, challenges persist. Financing remains a significant barrier to the pace of implementation. Stakeholder feedback indicates gaps in public awareness, insufficient resources reaching local communities and limited private sector engagement. The COVID-19 pandemic and the catastrophic Hunga Tonga–Hunga Ha'apai volcanic eruption and tsunami of January 2022, which caused damages equivalent to more than 36 per cent of gross domestic product (GDP), have further compounded economic pressures and underscored the urgency of adaptation efforts.

Key recommendations arising from the study include strengthening education and awareness raising across all sectors, fostering active private sector participation, making greater use of technology for planning and monitoring, deepening meaningful community engagement beyond consultations, and promoting new livelihood opportunities through ecosystem-based adaptation measures such as mangrove nurseries and honey production.

Country Profile

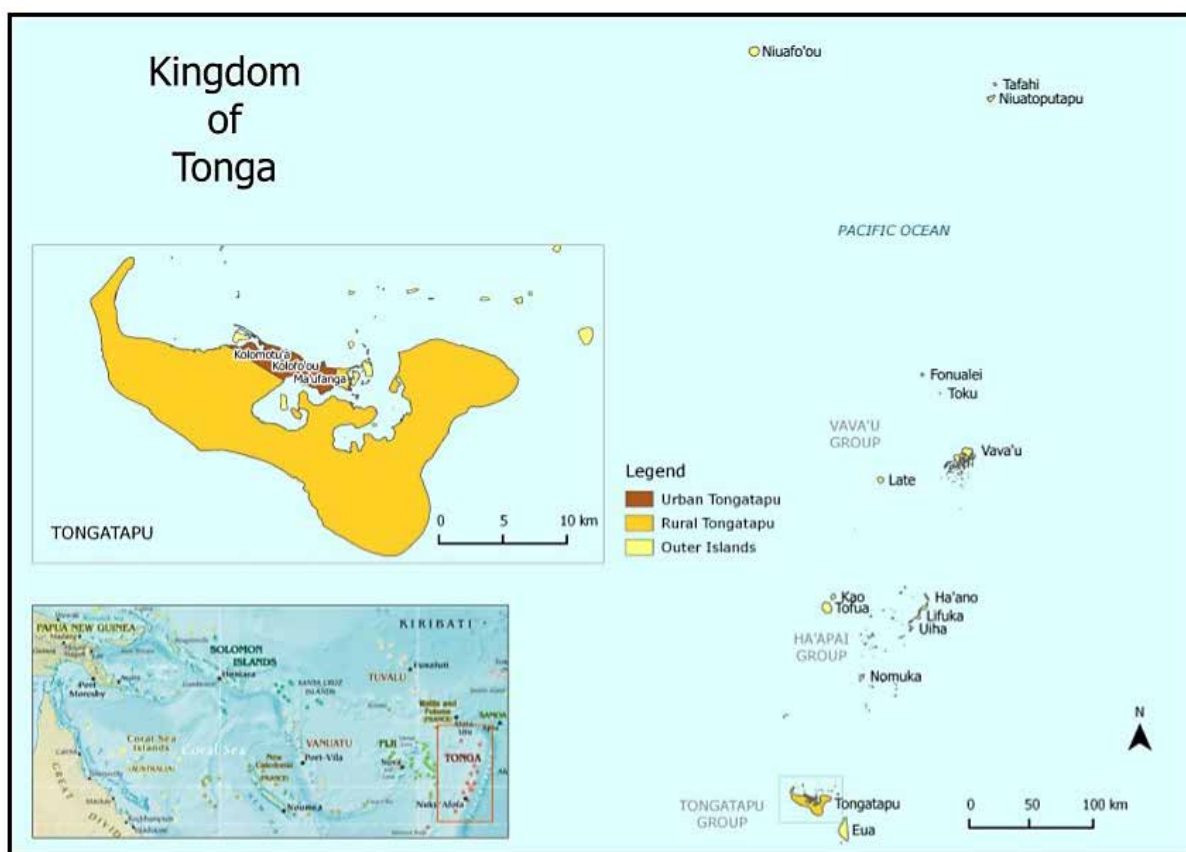
Geography, climate and natural hazard profile

The Kingdom of Tonga, a constitutional monarchy since 1875, was a protectorate of Britain from 1900 until it withdrew from the protectorate and joined the Commonwealth as a member country in 1970 (Pacific Adaptation to Climate Change 2009). A small island state in the South Pacific, Tonga was ranked in the 2017 *World Risk Report* as the second most at-risk country for natural hazards such as cyclones, El Nino Southern Oscillation (ENSO), flooding and sea level rise (Bündnis Entwicklung Hilft 2017). Factors contributing to the high 'at-risk' ranking of Tonga are geology, geography, weather, climatic and socio-economic indicators.

Tonga is an archipelago of 176 islands made of volcanic landscapes and low-lying coral areas spread over an area of 360,000 square kilometres

(km²) in the South Pacific (Figure 1). The country has a land mass of 718km² and sea area of 30km². In 2015, two newly formed volcanic islands (Hunga Tonga, Hunga Ha'apai) were identified. These islands were largely destroyed in the catastrophic eruption of January 2022. The Hunga Tonga–Hunga Ha'apai eruption of 15 January 2022 was the most powerful volcanic eruption globally in over a century, generating tsunami waves of up to 15 metres (m) that struck Tongatapu, 'Eua and Ha'apai. The eruption and subsequent tsunami caused over US\$90 million in damages, affecting approximately 85 per cent of the country's population (World Bank 2022; ReliefWeb 2022). Four of the six main islands in Tonga extend over a south to north axis of the country: Tongatapu (260km²) and 'Eua (87km²) are in the south, Ha'apai (109km²) is in the middle,

Figure 1. Map of the Kingdom of Tonga



Source: Department of Statistics, Tonga

and Vava'u (121km²) is in the north. In the far north are the islands of Niuatoputapu (71.7km²) and Niuafu'ou (15km²).

Tonga has five administrative divisions (Tongatapu, Vava'u, Ha'apai, 'Eua and Ongo Niua) and each division is further divided into districts. Nuku'alofa in the division of Tongatapu is the capital of Tonga. The capital is situated 2,000km northeast of Auckland, New Zealand, 890km south of Apia in Samoa and 750km southeast of Suva, Fiji (Tonga Statistics Department 2019).

Tonga has a tropical climate year-round with two seasons and the islands benefit from southeast trade winds at normal speeds of 10 to 16 knots (6 to 9 kilometres per hour). Between May and October, there is a dry season, and the wet season occurs between November and April (GOT 2020c). Islands in the north (Niuafu' and Niuatoputapu) receive more rainfall than islands in the southern region of Tonga. March is the wettest month and July the driest.

Rainfall and underground aquifers are the two sources of water for domestic, agricultural, industrial and commercial purposes.

During the dry season, rainfall levels in Tonga are 100.53mm to 145.87mm and temperatures (day and night) vary from 24.7°C to 28.1°C and 14.71°C to 22.33°C, respectively. Maximum and minimum temperatures in the wet season vary from 27.6°C to 30.3°C and 20.78°C to 24.34°C, respectively (GOT 2020c). Between November and April (wet season), weather conditions can bring tropical cyclones accompanied by strong winds from 22 to over 65 knots.

Land use is estimated as 43.1 per cent for agriculture, 44.4 per cent for settlements and infrastructure, and there is low forest cover at 12.5 per cent (Kingdom of Tonga 2018, 2020).

Like other Commonwealth small island developing states in the Pacific region, Tonga is threatened by the twin challenges of natural disasters such as cyclones, El Nino Southern Oscillation (ENSO), floods and coral reef bleaching, as well as sea level rise triggered by global climate change as a consequence of human activities. Recent major events include Tropical Cyclone Gita in February 2018, which affected 80 per cent of the population and caused an estimated US\$164 million in damages (38 per cent of gross domestic product (GDP)); Tropical Cyclone Harold in April 2020; and

the catastrophic Hunga Tonga–Hunga Ha'apai volcanic eruption and tsunami in January 2022, which caused damages equivalent to over 36 per cent of GDP (World Bank 2022; ADB 2018).

Population and demographics

According to UN Population Division estimates (2024 revision), Tonga's population is approximately 104,000. Overall, most people (77 per cent) live in rural areas. Tongatapu, described as an urban area, is home to 23 per cent of Tonga's population. It has a much higher population density (people per square kilometre) of 286 compared to the average of 155 across Tonga as a whole. In addition, an overwhelming majority of private households (88 per cent) have access to mobile phones, but less than one-fifth of households have internet access (at 18 per cent). As a country of many islands, boat ownership among private households in Tonga is low, at 4 per cent, with higher levels of ownership among households common in Vava'u, Ha'apai and Ongo Niua (Tonga Statistics Department 2017).

Life expectancy at birth in Tonga is 71.9 years (69.3 years for males and 74.6 years for females). The under-5 mortality rate is 9 per 1,000 live births, of which for males the rate is 11, for females it is 7. Disability prevalence in the population for people aged 10 years and over was 4.5 per cent (4.5 per cent for males, 4.6 per cent for females) at the time of the 2016 national census (Tonga Statistics Department 2019).

The most vulnerable groups in Tonga include the elderly, people with disabilities and other health conditions, as well as households with incomes lower than US\$1.90 per day, deemed as living below the poverty line (Government of Tonga 2020b).

Tonga's population is relatively young. The median age is 22 years and 39 per cent of the population is aged 15 years and younger. Among school age children (0 to 15 years), 98 per cent were in full-time education at the time of the national census in 2016; 73 per cent had the benefit of secondary education; and 10 per cent had university education qualifications. Educational attainment was similar between genders, although among females there was a higher proportion with tertiary qualifications (12 per cent for females relative to 10 per cent for males).

Eighty (80) per cent of Tonga's population have a religious affiliation, which may serve as a useful point of contact for engagement with Tongans on adaptation measures to climate change. The dominant religion is the Free Wesleyan Church (35 per cent of the population). This is followed by 19 per cent affiliated with the Church of Latter Day Saints, 14 per cent identifying as Roman Catholics and 12 per cent as members of the Free Church of Tonga (Tonga Statistics Department 2017).

Economic context

Agriculture, fisheries and tourism are the three key pillars of Tonga's economy, with the economy reliant on tourism and the export of agricultural produce and fisheries. Available data for 2015 reveal that exports accounted for just 3.3 per cent of the country's GDP, but remittances from overseas and budget support from development partners were higher at 26.5 per cent (GOT 2020b). The country's two main trading partners are New Zealand and Australia. Because of the reliance on natural resources, the country's economic health is affected by any adverse change in climate, including sea level rise caused by global climate change.

As stated in the Budget Statement for 2020/2021, at 52.7 per cent of GDP, the services sector in Tonga represents the largest contributor to the economy. Contributions to GDP by the primary sector (agriculture, forestry, fisheries) and secondary sector (mining, manufacturing, construction) were 17.4 per cent and 12.7 per cent, respectively (ibid.).

The consequences of human-induced climate change, including sea level rise, are already affecting Tonga by way of adverse impacts on development initiatives, deployment of financial resources to strengthen resilience to sea level rise as well, as the rebuilding of livelihoods in coastal and other communities negatively affected by sea level rise. Despite this backdrop, in its second report on its Nationally Determined Contributions (NDCs), the Government of Tonga reconfirmed a commitment to ensure that development of the country is not at the expense of either its natural environment or the livelihoods of current and future generations (GOT 2020c).

As a country, Tonga is focused on shifting its dependency on imported diesel, which accounts for approximately 90 per cent of electricity

generation, towards electricity generation from low-carbon renewable energy sources, including solar, wind and biomass. In 2018, the country secured approval from the Green Climate Fund for the Tonga Renewable Energy Project (TREP), with an estimated completion date of June 2025, now extended (Green Climate Fund 2018; Asian Development Bank 2019). As of 2023, renewable energy accounted for approximately 20 per cent of electricity generation, with 9,162 MWh (mega-watt hours) generated annually from renewable sources (ADB 2023). Components of the project, including the Vava'u hybrid mini-grid, were commissioned in March 2023. The Government of Tonga has set a target of 70 per cent renewables by 2030.

Governance and institutional structure

At the national level, Tonga's Strategic Development Framework II (TSDF II) for 2015 to 2025, now succeeded by TSDF III (2026–2036), endorsed by Cabinet in March 2026 (GOT 2015a), covers various policies and strategies of the country and informs the five-year Policy on Climate Change published in 2016 (Department of Climate Change 2016). This policy is considered most closely aligned with National Outcome F, which aims to create a more inclusive, sustainable and effective land administration and environment management, alongside greater resilience to climate and risk.

Having committed to climate change adaptation through its signing of the Paris Agreement in April 2016 (United Nations 2015; United Nations Treaty Collections, undated), the Government of Tonga (GOT) is determined to make 'Resilient Tonga' a reality by 2035 (Department of Climate Change 2016).

In the JNAP 2, the Government of Tonga identified six priority objectives as being integral to strengthening resilience and capacity alongside mainstreaming adaptation. These objectives are: 1) mainstreaming for a resilient Tonga; 2) research, monitoring, data, information; 3) resilience-building response capacity; 4) resilience-building actions; 5) finance; and 6) regional and international co-operation.

Sea Level Rise in Tonga

Local sea level rise observations (tide gauge data, satellite altimetry)

Sea level rise (SLR) of 0.007 metres has been recorded annually in Tonga since 1993 (Kingdom of Tonga 2019b). When adjustments are made for the effect of inverted barometric pressure and vertical movements at the observing platform, net rise of the sea in Tonga is given as 7.3mm per year. As another indicator of its vulnerability to rising sea levels, it should be noted that Tonga's rate of sea level rise is more than twice the average global estimate for SLR of 3.2mm per year during the period 1993 and 2010 (IPCC 2014, 2019).

Projected local sea level rise

SLR resulting from human-influenced climate change will be affected by the level of emissions of greenhouse gases (GHGs). In a high emissions scenario, projections suggest the sea levels could rise by 13–17cm by 2030 (Ministry of Meteorology, Energy, Information, Disaster Management, Environment, Climate Change and Communications (MEIDECC) 2019), thus increasing the occurrence of coastal flooding. Moreover, agricultural lands in low-lying coastal areas will be even more adversely affected should shorelines become submerged, seawater inundate the soil and seep into the water table, and consequently increase soil erosion and loss of arable land. Indeed, in worst case scenarios triggered by high emissions of GHGs, the sea may rise by up to 27cm by 2030, 51cm by 2055 (Kingdom of Tonga 2019b), and by 2090, much of the northern coasts of Tongatapu (in the south) and Nuku'alofa (the capital) would be inundated (GOT 2020c).

In Tonga, it has been projected that sea level rise combined with extreme weather events will exacerbate the inundation of low-lying areas with saline water and affect approximately 4–14 per cent of the population of Tongatapu (ibid.).

Contributing factors (subsidence, coastal erosion, land-use change)

Because of its vulnerability to SLR, there is an urgent need for the timely implementation of effective and appropriate adaptation measures that strengthen the island state's resilience and simultaneously protect lives, livelihoods, food security, biodiversity and infrastructure.

Tonga's vulnerability to natural disasters is exacerbated when combined with the adverse impacts of sea level rise on coastal areas of Tonga. Furthermore, the GOT has reiterated its position that important adaptation measures for resilience building also provide significant mitigation co-benefits. For example, reforestation and tree planting as nature-based adaptation measures will contribute to reducing atmospheric carbon emissions, which contribute to rise in global temperatures.

Impacts and Vulnerabilities

Coastal communities and human settlement

The consequences of this reality and implications for the country's communities, biodiversity and vulnerability to SLR have been acknowledged repeatedly by the GOT in several of its policy statements and reports, including submissions made to the United Nations Framework Convention on Climate Change (UNFCCC). Such documents include the Joint National Action Plan II (JNAP 2) on Climate Change and Disaster Risk Management, for the period 2018 to 2028 (Kingdom of Tonga 2018); the Third National Communication on Climate Change Report (Kingdom of Tonga 2019b); and the Second Nationally Determined Contribution (NDC), completed in December 2020 (GOT 2020c). Tonga's Intended Nationally Determined Contribution (INDC), submitted in 2015, also recognised the country's vulnerability to climate change and identified adaptation and resilience priorities (GOT 2015b).

In several policy statements and reports, the GOT reiterates the fact that despite the country being a negligible contributor to global greenhouse gases (GHGs), it is committed to the implementation of climate adaptation measures so as to strengthen resilience to climate change and disaster risk management (Kingdom of Tonga 2018, 2019a, 2019b; GOT 2020c). Moreover, as noted in its 2020 NDCs report (GOT 2020c): 'Irreversible loss and damage from extreme weather events and coastal erosions are putting the Government's poverty alleviation commitments and national development objectives at risk, and this risk is now compounded by the impacts of the COVID-19 pandemic.' For Tonga, therefore, timely implementation of appropriate and effective climate adaptation measures, and ensuring these can be sustained over time, are pivotal to the survival of the nation, its people and their livelihoods.

Agriculture and food security

Climate adaptation measures to which GOT is committed include ensuring 30 per cent of land in Tonga is under agroforestry and forestry by 2025. This will be done through integrating agroforestry

on lands earmarked for agriculture and replanting and/or rehabilitating cleared and degraded forests with tree species that are resilient to climate impacts (for example, saline water and flooding), ecologically suitable and socially appropriate.

Implementation of climate-smart agriculture and water management approaches is among the resilience-building actions identified under JNAP 2 Objective 4.

Fisheries and marine resources

Retaining existing stocks of fish and other marine species by way of expansion of marine protected areas (MPAs) and special management areas (SMAs), so as to achieve a target of 30 per cent of Tonga's exclusive economic zone (EEZ), is a key climate adaptation measure to which GOT is committed.

Strengthening resilience in management of fisheries and aquaculture resources by deepening of knowledge of fisher managers in fish aggregation devices (FADs), and training for communities in management and monitoring of special management areas (SMAs), is identified as a resilience-building action under JNAP 2.

Coastal ecosystems (mangroves, coral reefs, wetlands)

The Civil Society Forum of Tonga (CSFT) participates in initiatives to promote the replanting of mangroves and other trees as part of an ecosystem-based approach in reinforcing infrastructure as part of measures to stop soil erosion.

Through the Global Environment Fund (GEF) small grants programme, the Civil Society Forum of Tonga sought to encourage and facilitate empowerment in coastal communities. These initiatives led to implementation of special management areas (SMAs) and introduced alternative livelihoods for households. This work was done by working in partnership with the Ministry of Agriculture, Food and Forestry to implement economic projects in farming, fisheries and tree planting. People in coastal communities were

encouraged to rear livestock (for example, pigs, poultry) and fisherfolk (men and women) sold their catch to the project management committee. Those purchases in turn helped in restocking natural resources in the SMAs.

Infrastructure and critical services

Preventing the permanent loss of land on Tonga's four main islands (Tongatapu, Ha'apai, Vava'u and 'Eua) as a consequence of rising sea levels is a key climate adaptation measure.

Strengthening coastal infrastructure through implementation of the Coastal Resilience Project, in readily accessible area as well as the outer islands, and designing and implementing appropriate updated flood-sensitive management responses in low-lying areas, are identified as resilience-building actions under JNAP 2.

Integration of climate change adaptation measures, such as significant infrastructure projects and mangrove forest reforestation, can provide opportunities to mainstream digital tools, including e-government systems and satellite imagery. For example, in the Climate Resilience Transport Project co-financed by the World Bank (US\$427.8), aimed at improving roads and maritime facilities, can ensure that at the planning and design stages, cognisance is taken of the need for infrastructure that will be resilient to the rising sea levels and adverse impacts such as salinisation, flooding and erosion.

Economic costs and risks

Tonga's exposure to sea level rise carries significant economic consequences for a country whose narrow resource base rests on agriculture, fisheries and tourism, and which relies heavily on remittances and budget support from development partners (estimated at 26.5 per cent of GDP). Meanwhile, exports account for only around 3.3 per cent of GDP (GOT 2020b). With approximately 80 per cent of the population and the bulk of critical infrastructure located within one kilometre of the shoreline, the assets most central to national income and daily life are also those most directly threatened by rising seas, coastal flooding, salinisation and erosion.

The scale of potential losses is illustrated by recent disasters, whose costs have repeatedly amounted to a substantial share of national output. Tropical Cyclone Gita in February 2018 affected around 80 per cent of the population and caused an estimated US\$164 million in damage, equivalent to roughly 38 per cent of GDP, while the Hunga Tonga–Hunga Ha'apai volcanic eruption and tsunami of January 2022 caused damage equivalent to more than 36 per cent of GDP and affected an estimated 85 per cent of the population (World Bank 2022; ADB 2018). Because sea level rise increases the frequency and severity of coastal flooding and storm surge, slow-onset losses are expected to compound these episodic shocks over time.

Projections indicate that sea level rise combined with extreme weather events will affect approximately 4–14 per cent of the population of Tongatapu through the inundation of low-lying areas with saline water (GOT 2020c), placing agricultural land, water supplies and settlements at risk. The cumulative effect of repeated disasters and progressive coastal change is to divert scarce public resources towards relief and reconstruction, undermine development gains, and raise the cost of protecting an ever-larger stock of exposed assets. Each successive event is therefore likely to be more costly relative to GDP, even where defences are strengthened.

Managing these risks requires sustained and predictable financing for adaptation, yet the availability of finance remains one of the principal barriers to the pace of implementation in Tonga. This underlines the importance of mechanisms such as the Tonga Climate Change Trust Fund, alongside continued access to international climate finance, in spreading the economic burden of adaptation and reducing the long-term fiscal exposure of the state to sea level rise.

Policy and Governance Framework

National policies and strategies (NAPs, NAPAs, NDCs)

In preparation for the 2015 Conference of Parties (COP) in Paris, France, GOT had submitted its Intended Nationally Determined Contribution (INDC). Having ratified the Paris Agreement on Climate Change on 21 September 2016 (GOT 2020c), Tonga's INDC, submitted ahead of the Paris Summit, automatically became its first NDC when the Paris Agreement subsequently entered into force on 4 November 2016 (United Nations 2015; GOT 2020c). The INDC, the second NDC submitted in December 2020 and the Third National Communication on Climate Change report are among those submitted by GOT as part of meeting its obligations under the UNFCCC (Kingdom of Tonga 2019b; GOT 2020c).

Tonga has identified climate adaptation measures aimed at addressing the three main dimensions of adaptation, namely: a) reducing vulnerability, b) strengthening capacity and c) enhancing resilience. These dimensions are consistent with the observations of Leiter et al. in 2019, whose work reviewed metrics on climate change adaptation measures drawn from the experiences and data of several countries and across multiple sectors and industries.

Tonga's JNAP 2 is informed by lessons learnt from JNAP 1 (Kingdom of Tonga 2010). Underpinning JNAP 2 are relevant national frameworks and policies, including the National Policy on Climate Change that aligns with the Tonga Strategic Framework II, together with the Framework for Resilient Development in the Pacific between 2017 and 2030, as guidelines for the Pacific islands as a region (SPC, SPREP, PIFS, UNDP, UNISDR and USP 2016) and the international obligations under the UNFCCC.

Legal and institutional framework

GOT aims to mainstream resilience in support of climate adaptation and disaster risk management (DRM) through specific and practical actions that

can be monitored, evaluated and lessons identified and learnt. Such measures include the appointment of staff to designated positions in the JNAP Secretariat, capacity building in Parliament, capacity needs assessment and training for government ministries and departments, non-governmental organisations (NGOs), and the private sector.

The implementation of adaptation measures in Tonga will depend in part on the extent to which climate change adaptation and disaster risk management are mainstreamed into government legislation, policies and plans at all levels. Furthermore, guidance issued in 2013 on mainstreaming climate change adaptation in the Pacific remains relevant as of 2025.

Actions for implementation to enable the mainstreaming of climate adaptation measures in Tonga include: strengthening specific decision-making structures by the National Climate Change Coordinating Committee (NCCCC), JNAP Task Force and the Environment and Climate Change Standing Committee (ECCSCP) in the Tonga Parliament; creating and/or amending legislation, policies and sector resilient plans; enacting legislation on climate change management; and recruiting staff for monitoring, evaluation and learning (MEL) for the JNAP Secretariat.

Sub-national and local governance

Because various agencies and organisations have their own preferred approach, indicators and methods of engagement and data collection, a setback in enhancing collaborative partnership working has been inconsistency in the development of community-based plans for climate adaptation. Moreover, community development plans often lack a focus on vulnerabilities and resilience building of residents in the community. Therefore, efforts to foster meaningful cross-sector integration and mainstreaming adaptation to climate change and disaster risk management issues in Tonga has led to the JNAP 2 document identifying specific activities to be implemented through several groupings of stakeholders.

Implementing revised community development plans (CDPs) in at least 23 champion villages is among the resilience-building actions identified. Criteria will be developed for the selection of 23 champion villages. Development of a comprehensive and co-ordinated planning approach in which communities are engaged, integrating climate resilience into CDPs to include management of resources (water, environment, land use, coastal zone protection), is the intended benefit.

Adaptation Measures

Coastal protection (hard infrastructure)

Strengthening coastal infrastructure through implementation of the Coastal Resilience Project, in readily accessible areas as well as the outer islands, has been identified as a resilience-building action under JNAP 2 Objective 4.

Designing and implementing appropriate updated flood-sensitive management responses in low-lying areas is also among the actions for implementation.

Ecosystem-based adaptation

CSFT participates in initiatives to promote the replanting of mangroves and other trees as part of an ecosystem-based approach to reducing soil erosion and strengthening natural coastal protection.

Actions taken to implement the three main targets/dimensions of adaptation will contribute to strengthening adaptation to sea level rise as well as allowing for a more nature-based approach. Collectively, implementation of nature-based solutions can contribute to the creation of resilient livelihoods for the people of Tonga and retain natural resources for future generations of Tongans.

Capacity building for the establishment and management of nurseries in local communities to propagate mangrove seedlings, together with employing local people to plant the seedlings, could create opportunities for local enterprises and skills development. One such opportunity is training local people in the establishment and management of apiaries and beekeeping. Honey production could support the development of small enterprises serving both domestic and export markets, providing a value-added product that can contribute to sustainable livelihoods.

Accommodation and resilience building

There is a need to develop the capacity for resilience-building responses throughout government, the private sector and civil society organisations. Actions for implementation include:

establishing an umbrella framework document to enable co-ordination of resilience building across the public sector, private sector and civil society organisations; building capacity through the creation of online training courses for self-delivery; deepening understanding and ensuring the embedding of climate change resilience in education curricula at all levels; designing and implementing a fully co-ordinated approach to community awareness raising on climate change and resilience building; embedding behaviour change through engagement with all stakeholder groupings; and strengthening engagement with and support from the arts and media in fostering essential behaviour change across Tongan society.

Revision of all school and tertiary education curricula to raise awareness, deepen knowledge and embed parameters of climate resilience among teachers and students has also been identified as an adaptation measure to build capacity. The benefits include increased knowledge and greater understanding among multiple generations in all communities and fostering informed decision-making that will protect lives, livelihoods and marine resources.

Planned relocation and retreat

To date, Tonga's adaptation effort under JNAP 2 has centred on coastal protection, accommodation and ecosystem-based measures, with planned relocation or managed retreat not addressed as a specific measure within the plan. Yet with approximately 80 per cent of the population living within 1 kilometre of the coast, and with projections indicating that much of the northern coast of Tongatapu and the capital, Nuku'alofa, could be inundated by 2090 (GOT 2020c), the question of moving people and assets away from the most exposed areas is becoming increasingly difficult to defer.

Tonga's geography sharply constrains the options for inland retreat. As a low-lying archipelago of 176 islands with a total land mass of only 718km², the country has limited higher ground to which communities might relocate, and customary land tenure together with strong cultural attachment to

ancestral land make relocation socially and politically sensitive. Preventing the permanent loss of land on the four main islands of Tongatapu, Ha'apai, Vava'u and 'Eua has been identified as a key adaptation objective, but for the most vulnerable low-lying settlements, protection alone may not be sufficient over the longer term.

Implementation of adaptation measures for climate change in Tonga is funded by a combination of finance from Government of Tonga and external funding from foreign governments, development banks, multilateral institutions (including United Nations agencies) and NGOs (international, regional, local).

Climate finance and funding mechanisms

In February 2017, Tonga became one of the first small island developing states (SIDS) to establish a Climate Change Trust Fund (CCTF) dedicated to finance 'green' climate change adaptation and mitigation initiatives. Consultations and discussions had been taking place with government ministries, various stakeholders in Tonga, donors and development partners regarding funding modalities to be used in the country. A decision was subsequently made to establish the CCTF as a viable and sustainable climate financing mechanism (Climate Investment Funds 2012).

The Tonga CCTF was setup by the Government of Tonga with the assistance of the Climate Resilience Sector Project funded under the Climate Investment Fund of the Asian Development Bank (ADB). This fund also supports the implementation of adaptation measures such as projects identified in the JNAP 2. GOT continues to contribute to the fund together with funding of US\$700,000 received from the Irish Trust Fund administered by the ADB (Asian Development Bank 2017).

It was envisaged the Tonga CCTF (TCCTF) would serve also as a source of supplementary financial support to small-scale, community-based, climate-related projects proposed by other organisations such as church groups, charities and non-government organisations.

Disbursements from the TCCTF have been made public, including through reports of contracts signed with successful applicants. In 2019, the second call for proposals resulted in funding being awarded to communities for water-related projects (Department of Climate Change 2019).

Assessment of Adaptation Effectiveness

Comprehensiveness and inclusiveness

Much progress has been made in the implementation of a variety of initiatives under sub-objectives of JNAP 2. Tonga's Department of Climate Change has been at the forefront of consultations and partnership working to enable the complex and cross-cutting issues of climate change to be discussed and documented and to facilitate the funding of many shorter- and longer-term initiatives. Work in developing the JNAP 2 has highlighted the fact that there is need for deepening partnership working with local communities as well as seeking to enable policy changes. To this end, the work with the ECCSCP of Tonga's Parliament is to be commended.

The Civil Society Forum of Tonga (CSFT), an umbrella organisation for NGOs and CSOs in Tonga has played a role in supporting climate change adaptation initiatives. Through its broad-based membership and engagement across multiple initiatives, CSFT has contributed to efforts to strengthen climate change awareness and adaptation, including through physical measures and educational activities aimed at empowering communities, particularly in coastal areas.

Implementability and integration

While Tonga's action plans identify a range of appropriate initiatives and policies to support climate change adaptation, challenges remain in translating these measures into implementation. In addition to ensuring the timely availability of adequate finance, it is important that climate change adaptation considerations are incorporated into the design of infrastructure projects and into mitigation measures and environmental impact assessment processes. This would help to ensure that adaptation is considered systematically in the planning and implementation of development activities.

Despite the allocation of funding by GOT for communication, feedback from stakeholders consulted for this study highlighted a lack of awareness about climate adaptation measures, need for consistency in keeping the public informed about climate adaptation as well as climate change, plus the urgent need for investments in capacity building to address this gap in knowledge and understanding and to improve awareness in communities. There are opportunities also for closer and more purposeful engagement with local communities, not simply for 'consultation' as part of planning and/or developing plans that are then shelved and not implemented in the communities/ for the people with whom the consultations were held.

Individually and collectively, businesses represent an important stakeholder group that contributes to the strengthening of a resilience in Tonga as part of climate change adaptation measures and disaster risk management. In considering this stakeholder group, it should be recognised that not only is there a role for large firms, including multinational enterprises, but also for small and medium-sized enterprises (SMEs) as well as micro businesses.

Monitoring and evaluation

In JNAP 2, there was commitment to establishing a specific role for a member of the JNAP Secretariat to monitor, evaluate and share learning from implementation of adaptation measures. In preparing this case study, it was not possible to confirm the extent to which this action had been implemented and delivered success for stakeholders. While it was acknowledged that lessons learnt from the first JNAP had informed JNAP 2, no mention was made about the frequency with which such updates would be provided.

One of the actions recommended from this research is for the JNAP 2 Secretariat to arrange for the uploading of updates on progress in implementing JNAP 2 to the Climate Change Portal as this will enable useful information to be more widely available for access by the public in Tonga. It will also allow for such information to be available for awareness raising and educational initiatives by more decision-makers and communities in Tonga and beyond. The sharing of useful content will be invaluable in increasing knowledge about climate change adaptation.

The Climate Change Portal (<https://climatechange.gov.to/>) of the Department of Climate Change in Tonga's Ministry of Meteorology, Energy, Information, Disaster Management, Environment, Climate Change and Communications (MEIDECC) is an important resource for strengthening the effectiveness of climate change adaptation measures in Tonga. Launched in March 2021, the portal has contributed to raising awareness of climate change and, in particular, to improving access to information on the implementation of climate change adaptation measures.

Lessons Learned and Exemplars of Good Practice

Grants, loans and other sources of climate finance are an essential part of financing climate change adaptation in Tonga, and much more is needed to achieve the ambitious and necessary adaptation measures outlined in JNAP 2. Adequate resourcing will enable greater progress to be made in implementing climate change adaptation (CCA) measures and reduce the adverse effects of sea-level rise on the lives and livelihoods of households in Tonga's island communities. Indeed, financing climate change adaptation in Tonga remains a significant barrier to the pace of implementation, as well as to the appropriate expansion and long-term sustainability of initiatives needed to enable full integration and mainstreaming of adaptation measures.

Feedback received from stakeholders indicates that as an umbrella NGO, the CSFT – despite its inability to fund projects without the financial input from partners – is keen to fight on issues and activities that lead to rising sea levels. There is the perception also that not enough of the limited available funding reaches communities; instead, what finance is available is used to hold consultations and develop planning documents. This view suggests a gap between current approaches and what is required/criteria for meaningful engagement with communities.

However, noticeably absent from the Climate Change Portal is active participation by the private sector. An approach that encourages greater engagement with specific sectors, similar to that used in work with NGOs, could deepen the involvement of the private sector and business community in the country.

For any of the three main targets, actions to implement appropriate adaptation measures would best be done by mainstreaming actions (from design and planning through to implementation) alongside the building of capacity. Mainstreaming adaptation measures increases the likelihood of the benefits being realised over the longer term and creating behaviour change. The latter applies to individuals, households, communities and organisations (public, private, NGOs).

Recommendations

Tonga has made significant progress in mainstreaming climate change adaptation. However, five areas require further attention, as follows.

- There is a need for education and awareness raising at all levels and across all sectors of society.
- Active participation by businesses is required in the adoption and implementation of adaptation measures to reduce risk to sea level rise from climate change.
- It is important to make greater use of technology in the planning, design, implementation and monitoring of adaptation measures.
- There is a need to foster greater engagement among stakeholders at the community level beyond participation in consultations.
- New livelihood opportunities should be promoted in local communities through use of ecosystem-based adaptation measures.
- Climate change adaptation should be integrated into primary and secondary curricula, enabling students to engage directly with sea level rise issues through creative and analytical activities.
- In addition to taking action to implement relevant climate adaptation measures, businesses can sponsor educational initiatives on climate change and serve as a catalyst for innovation through initiatives to strengthen science and technology at the secondary and tertiary levels of education.
- Digital technologies and satellite imagery should be deployed for climate monitoring and adaptation planning, consistent with GOT's e-government programme.
- Achieving meaningful community participation requires both capacity building and ensuring that resources reach local communities directly.
- Capacity building for nature-based enterprises, such as mangrove nurseries and honey production, can expand livelihoods while contributing to climate adaptation.

Conclusions

This case study on Tonga highlights significant progress made in implementing adaptation measures to address risks to lives, livelihoods, natural resources and infrastructure because of rising sea levels along coastal areas. Establishing a dedicated portal for information on climate change and the establishment of the Climate Change Trust Fund are to be lauded. With appropriate resources (financial and human), effectiveness and resilience can be strengthened through the mainstreaming of adaptation to sea level rise in Tonga. Recommended actions include: education and awareness raising; active participation by businesses to integrate adaptation measures in all relevant areas; using technology in the planning, design, implementation and monitoring the effectiveness of adaptation; and ensuring meaningful engagement among stakeholder groups in all communities, beyond that of participation in consultations. Critical to enhancing effectiveness is capacity building to enable the creation of nature-based enterprises such as nurseries for mangrove cuttings and honey production so as to expand livelihoods and entrepreneurial opportunities in Tongan communities.

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Annexes

Annex A. Country dashboard

COMMONWEALTH SEA LEVEL RISE CASE STUDY	MODEL
TONGA	DASHBOARD

Country snapshot

Coastline 718km² land mass	Coastal population ~80% of total	Coastal elevation Low-lying coral and volcanic islands
GDP from primary sectors 17.4% (primary) + 52.7% (services)	176 islands; 360,000 km ² ocean area Archipelago	Second most at-risk country (2017) World Risk Report

Sea level rise indicators

Observed local SLR 7.3mm/yr vs. global ~3.2mm/yr	Projected rise by 2100 Up to +51cm by 2055 above current levels	Projected rise by 2030 Up to 17–27cm high emissions scenario
Population at risk 4–14% of Tongatapu from SLR + extreme events	CCTF established February 2017 first in the Pacific region	Tide gauge record Since 1993 Tonga monitoring station

Adaptation at a glance

Type	Key measures	Status
Coastal protection	Coastal Resilience Project, flood management in low-lying areas	Active; JNAP 2 priority
Ecosystem based	Mangrove replanting, SMAs, ecosystem-based approaches	Active; community-led
Accommodation	Climate-smart agriculture, education curricula, capacity building	In progress
Planned retreat	Not addressed in JNAP 2	No specific measures
Climate finance	CCTF (ADB-supported), Global Climate Fund (GCF), GEF, donor funding	Active; needs expansion

Key milestones

1989	2010	2016	2017	2018	2019	2021
<i>Holdgate Report</i>	JNAP 1 established	Climate Change Policy Published	CCTF established	JNAP 2 published	TREP approved	Climate Change Portal launched

Apia Commonwealth Ocean Declaration relevance

How does sea level rise in this country intersect with the **priorities set out in the Commonwealth Apia Ocean Declaration?**

	Ocean–Climate Nexus Primary Action Group for this series. Local SLR rate of 7.3mm/yr is more than twice the global average. Eighty (80)% of population and critical infrastructure within 1km of shoreline. Projected inundation of northern Tongatapu and capital by 2090. Local SLR: 7.3mm/yr (global: ~3.2mm/yr)		Marine Pollution Sea level rise threatens coastal ecosystems and marine resources. Salinisation of agricultural lands and water tables affects coastal communities. Soil erosion and loss of arable land compound environmental degradation. Land use: 43.1% agriculture, 12.5% forest cover
	Sustainable Fisheries Fisheries is a key economic pillar. SMAs and MPAs being expanded toward 30% EEZ target. Mangrove replanting supports coastal fisheries. Community-based fisheries management strengthened. Primary sector (incl. fisheries): 17.4% GDP		Blue Economy Tonga's economy relies on agriculture, fisheries and tourism. TREP advancing renewable energy transition (70% target by 2030). COVID-19 severely impacted tourism and trade. CCTF funding community climate projects. Asset exposure: US\$7.8 billion Oil: 2019 onwards
	Marine Protection and Restoration Tonga is committed to expanding marine protected areas (MPAs) and special management areas (SMAs) to cover 30% of its EEZ. CSFT leads community mangrove replanting and ecosystem restoration. The 2022 Hunga eruption caused significant marine ecosystem damage, underscoring the urgency of marine conservation. EEZ target: 30% MPA/SMA coverage 176 islands across 360,000 km²		

Annex B. Legislative and policy framework summary

Category	Instrument / Framework	Year	Description	Relevance to SLR
International agreements	UNFCCC	Ratified	Party to the UN Framework Convention on Climate Change.	Provides framework for climate adaptation obligations.
International agreements	Paris Agreement	2016	Ratified 21 September 2016; INDC became first NDC upon entry into force.	Commits Tonga to adaptation and resilience building.
National strategy	Tonga Strategic Development Framework II (TSDF II)	2015–2025	Overarching national development strategy; informs climate policy.	National Outcome F: inclusive, sustainable environment management and climate resilience.
National strategy	Tonga Strategic Development Framework III (TSDF III)	2026–2036	Successor to TSDF II; endorsed by Cabinet March 2026.	Continues integration of climate resilience into national development.
National policy	Tonga Climate Change Policy	2016	Five-year policy: 'Resilient Tonga by 2035'; aligned with TSDF II.	Sets adaptation direction across sectors; addresses SLR impacts.
National policy	Joint National Action Plan 1 (JNAP 1)	2010–2015	First integrated plan on climate change adaptation and DRM.	Established foundation for joint CCA/DRM planning.
National policy	Joint National Action Plan 2 (JNAP 2)	2018–2028	Informed by JNAP 1 lessons; integrates CCA and DRM with specific implementation actions.	Primary operational framework for climate adaptation including SLR response.
National policy	Nationally Determined Contribution (NDC)	First: 2016; Second: 2020	Commits to reducing vulnerability, strengthening capacity and enhancing resilience.	Reconfirms that development shall not compromise environment or livelihoods.
National policy	Third National Communication on Climate Change	2019	Reports to UNFCCC on climate change status and adaptation measures.	Documents SLR observations and adaptation progress.
Regional framework	Framework for Resilient Development in the Pacific (FRDP)	2017–2030	Regional guidelines for Pacific island resilience building.	Informs JNAP 2 and national adaptation approaches to SLR.
Institutional	Department of Climate Change	–	Leads consultations and partnership working on climate change.	Central agency for climate adaptation co-ordination.
Institutional	National Climate Change Coordinating Committee (NCCCC)	–	Decision-making structure for climate co-ordination.	Key governance mechanism for mainstreaming adaptation.
Institutional	JNAP Task Force	–	Supports implementation and co-ordination of JNAP 2 actions.	Operational co-ordination body for CCA/DRM.
Institutional	Environment and Climate Change Standing Committee (ECCSCP)	–	Parliamentary standing committee on environment and climate.	Provides legislative oversight of climate adaptation.
Gap	Climate change management legislation	Not yet enacted	Identified as priority action under JNAP 2 but not yet passed.	Absence limits legal enforceability of adaptation measures.
Gap	Community development plans	Inconsistent	Plans often lack focus on vulnerabilities and resilience building.	Revised CDPs planned for at least 23 champion villages under JNAP 2.

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