Pacific Islands Climate Change Insurance Facility

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Consultancy for enhancing action on comprehensive climate change risk management in the Pacific Region

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Executive Summary for Decision-Makers

The key findings of this consultancy for enhancing action on comprehensive climate change risk management in the Pacific region are as follows:

Gaps / SIS Needs and Priorities

- The Smaller Island States (SIS) of the Pacific Islands Forum (PIF), and other remote, outer island communities, are often overlooked and underserved by existing climate change risk management initiatives.
- Gaps in climate change risk management mechanisms available to the SIS include:
  - Disaster risk financing instruments, which are tailored to the SIS and remote communities; and
  - *Ex-ante financing* mechanisms that address the impacts of slow onset climate change hazards to assets, ecosystems, livelihoods, and public services, particularly related to sea level rise (e.g. chronic inundation and saltwater intrusion) and ocean warming and acidification (e.g. coral bleaching and ecosystem degradation).
- Other than the SIS desk officers at the Pacific Islands Forum Secretariat (PIFS), there is currently no brokerage function on climate change risk management at which the SIS can engage, provide input, view the landscape of initiatives and projects, leverage technical outputs and seek solutions. There is no unified SIS voice, and solutions are siloed.
- The SIS and regional institutions have few resources available for data maintenance and knowledge management, leading to dispersed data, less integrated and systematic planning, missed opportunities to integrate existing technical and scientific work into decision-making, and duplication of effort.

Existing Regional Initiatives

- There are regional institutions - for example, the PIFS, the Secretariat of the Pacific Regional Environment Programme (SPREP), the Pacific Community (SPC), and the Pacific Catastrophe Risk Insurance Company - with significant, but siloed, capabilities related to climate change risk management that should be used for the SIS.

- There are ongoing initiatives in Disaster Risk Financing in the region - including the Pacific Catastrophe Risk Assessment and Financing Initiative (PCRAFI) and the Pacific Insurance and Climate Adaptation Programme (PICAP) - from which the SIS could benefit from deeper integration and collaboration at the product development stage.

- There are existing sources of climate change data - such as those developed through the Pacific Climate Change Science Program (PCCSP) and the Pacific-Australia Climate Change Science Adaptation Planning programme (PACCSAP) - which could benefit the SIS in the development of climate change risk management and financing strategies.

- There is a definite need for the establishment of a broker function - with technical expertise and regional and national relationships - for ensuring the needs of SIS states are well represented and considered across existing initiatives and for championing the development of solutions for gaps.

Next Steps

- A specialised broker function for the SIS to engage with the existing regional institutions and ongoing initiatives in disaster and climate change risk management should be developed to:

    - Advocate and integrate the SIS needs and priorities at the project and product development phase to leverage research and evaluate outputs to inform decision-making and implement solutions;

    - Support knowledge management and straightforward access to climate change risk data; and

    - Support the SIS to weave together existing capabilities to develop and implement comprehensive climate change risk management and financing strategies under a unified framework.

- Technical resources should be used to develop novel climate change risk financing mechanisms that address slow-onset climate impacts on assets, livelihoods, ecosystems, and public services.


Photo: Carlo Iacovino/SPREP

Contents

1. Introduction

The following is a framework paper to support the process of establishing comprehensive climate change risk management measures in the Smaller Island States (SIS) of the Pacific Islands Forum.[1] This paper, commissioned by SPREP with support from the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), has been prepared by an international consortium of experts - Jacqueline Wharton, Jamie Pollard, Dave Traill, and Gabriel Manoughian - in consultation with national and regional stakeholders in the SIS and the wider Pacific region.

Background and Context

The security, prosperity, and integrity of Pacific Island communities are threatened by negative impacts of anthropogenic climate change caused by increasing atmospheric concentrations of greenhouse gases. Climate change impacts are already apparent across the region, and projections in climate research indicate future increases in climate change related hazards. The peoples of the SIS are particularly vulnerable and building resilience across the SIS is one of the most urgent development priorities for communities and governments.

One key way to build resilience is through comprehensive climate change risk management strategies, which include risk reduction (e.g. investments in up-front, structural adaptation such as infrastructure upgrades) and risk management (which includes understanding the evolving risk landscape and planning for future responses, including the arrangement of financing to support response measures). Therefore, the government of Tuvalu proposed the development of a Pacific Islands Climate Change Insurance Facility (PICCIF) at the Pacific Regional Dialogue on Financial Management of Climate Risks (Apia, Samoa from 26 to 28 June, 2017, sponsored by the Government of Tuvalu). The need for PICCIF was recognised and endorsed by the leaders of the Pacific Small Island States (SIS) and the Forum Economic Ministers Meeting (FEMM) in 2018.

This paper seeks to inform the potential development of PICCIF by providing a framework for comprehensive climate change risk management and financing in the SIS, exploring SIS needs and priorities, presenting novel risk management mechanisms for further development, and identifying implementation pathways.

This paper provides:

- A climate change risk management and financing framework (Section 2);
- Climate change risk management and financing principles (Section 3);
- A landscape review of the SIS context and priorities and an outline of current risk management strategies (Section 4);
- An overview of the climate change risks facing the SIS (Section 5);
- A gap analysis of current capabilities in comprehensive climate change risk management (initiatives and data) in the Pacific region and proposed novel climate change risk financing mechanisms and instruments (Section 6); and
- Next steps and recommendations for the implementation of comprehensive climate change risk management and financing in the SIS (Section 7).

[1] The SIS represent the most vulnerable of Forum Island Countries, and its membership comprises of Cook Islands, Federated States of Micronesia, Kiribati, Nauru, Niue, Palau, Republic of the Marshall Islands, and Tuvalu.

2. Climate Change Risk Management and Financing Framework

The following section provides a Climate Change Risk Management and Financing Framework for the SIS to manage the impacts of climate change hazards. The framework answers three critical questions:

1. **What are climate change hazards?**
2. **When and how to respond?**
3. **Who holds the risk?**

What are climate change hazards?

A key challenge in developing appropriate and effective climate risk management and financing tools in the context of a changing climate is in the interaction between what is more traditionally understood as disaster risk (i.e. the volatility associated with shock events, such as storms and earthquakes) and what is more precisely climate change related risk. Climate change will amplify the hazard profile of the SIS with respect to those hydrometeorological perils they already face, and it will also introduce novel threats. Therefore, this report presents a common framework for thinking about all climate change related hazards.

Climate change is a chronic, ever-present pressure, and as the atmosphere gradually warms, it will have cascading and compounding effects on the earth's system[2], altering the characteristics of **both acute and slow-onset hazards**. The **chronic pressures** resulting from global climate changes are various, representing a change to baseline environmental processes. For example, atmospheric and ocean warming is melting ice masses, resulting in global sea level rise.[3] And rising seas are just one example of a chronic pressure that can lead to a state change, which results in the manifestation of **slow-onset hazards** such as coastal inundation and saltwater intrusion which, if compounded by drought, will have serious impacts on water security. Meanwhile, increases in atmospheric carbon are driving ocean acidification, with potentially devastating consequences for marine fauna and ecosystems.[4]

Acute hazards are also being modified by climate change.[5] The Pacific region has always experienced the impacts of acute climate hazards, which arise from extreme, short-term climate variability. These events currently occur relatively infrequently, and disaster risk management is a well-established approach to deal with such acute, intermittent events. However, chronic climate pressures are modifying the frequency, intensity, and character of extreme hydrometeorological events. For instance, since a warmer atmosphere and ocean contains greater energy, the severity of acute events such as tropical cyclones and extreme rainfall can be expected to increase.[6] In fact, climate-driven increases in tropical cyclone severity have been confirmed in some parts of the world.[7]

Therefore, with chronic pressures resulting in relatively rapid changes to environmental baseline processes (as global environmental change has accelerated dramatically since the 1950s),[8] societies must manage and adapt to the changing risk profile they face. To this end, this paper presents a comprehensive climate change risk management and financing framework to support the SIS as they face mounting climate change pressures and impacts from evolving acute and slow-onset climate hazards.

[2] Rockström, J. et al. 2009. A safe operating space for humanity. Nature 461, 472-475.
[3] Nerem et al. 2018. Climate-change-driven accelerated sea-level rise detected in the altimeter era. PNAS. 115(9), 2022-2025.
[4] Fabry, V.J. et al. 2008. Impacts of ocean acidification on marine fauna and ecosystem processes. ICES Journal of Marine Science. 65(3), 414-432.
[5] Stott, P. 2016. How climate change affects extreme weather events. Science, 352(6293), 1517-1518.
[6] Knutson et al. 2020. Tropical Cyclones and Climate Change Assessment: Part II: Projected Response to Anthropogenic Warming. American Meteorological Society BAMS Report.
[7] Trenberth et al. 2018. Hurricane Harvey Links to Ocean Heat Content and Climate Change Adaptation. 6(5), 730-744.
[8] Steffen, W., Crutzen, P.J. and McNeill, J.R. The Anthropocene: Are Humans Now Overwhelming the Great Forces of Nature. AMBIO: A Journal of the Human Environment 36(8), 614-621

The relationship between acute and slow-onset climate hazards

Any climate change risk management and financing framework for the SIS must recognise and address acute and slow-onset climate hazards in an integrated, coherent way. Figure 1, below, illustrates the interaction between chronic climate change pressures and acute and slow-onset hazard events to represent our approach to conceptualising climate change related hazards.

Rather than thinking solely about the intermittent volatility caused by acute events (as in a traditional disaster risk management approach), climate change risk management must address forced action events, which are the result of chronic climate change pressures, – whether the result of a sudden, shock event or the breaching of a severity threshold associated with a slow-onset event that requires – or forces – a response. Therefore, the definition of 'event' throughout this Framework Paper will include all forced action events, where chronic climate change pressures cause either acute or slow-onset impacts to the lives and livelihoods of SIS communities, prompting action in response.

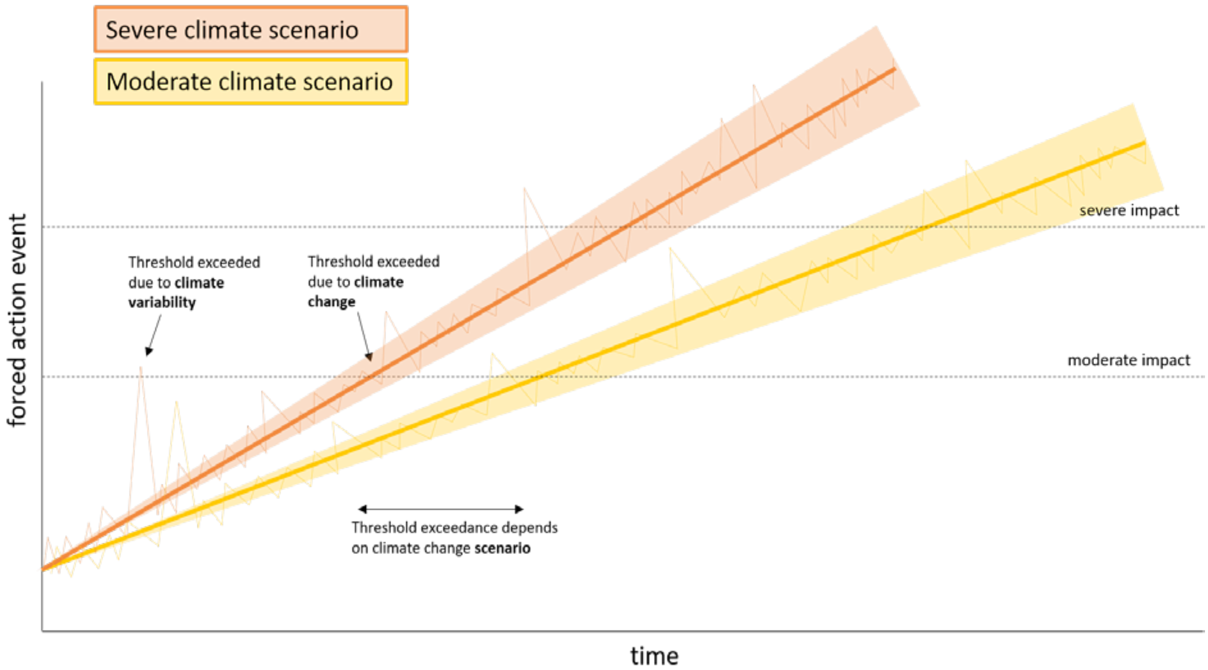


Figure 1. Conceptualising climate hazards

Figure 1 illustrates how acute climate hazard events can deliver sufficient impacts to require action under present day conditions (dotted orange and yellow lines). As baseline environmental processes result in chronic climate change pressure, the frequency with which these events exceed impact thresholds can be expected to increase (as shown by inclined solid lines representing moderate and severe climate scenarios). At some stage, chronic climate pressures will also lead to slow-onset climate change hazards exceeding impact thresholds, therefore resulting in sustained adverse impacts. In the context of global carbon emissions, mitigative action could help to move the future world state away from the severe scenario, towards the moderate scenario. Under such circumstances, it is clear from Figure 1 that adaptation will still be necessary.

When and How to Respond?

As chronic climate change pressures alter the risk profile of the SIS, risk management practices must evolve in response.

Options for responding to climate change risk, also referred to as climate adaptation, encompass two broad categories:

1. **Climate change risk reduction; and**
2. **Climate change risk management and financing.**

Significant capabilities already exist in the region, and progress has been particularly steady in disaster risk management and financing (related to the management of acute extreme events associated with a range of hazards) and climate change risk reduction. These include demonstration projects to invest in climate adaptation measures that reduce the risks associated with climate change impacts to food and water security, critical infrastructure, and health. The framework proposed here joins risk reduction and risk management under a common schema focused on climate change impacts. For example, while there are multiple ongoing initiatives focused on climate change risk reduction (largely funded through international climate funds such as the Green Climate Fund, the Global Environment Facility, and the Adaptation Fund), comprehensive climate change risk management recognises that not all risk can be 'reduced.' Therefore, this framework paper takes a holistic view and proposes an integrated approach to climate change risk reduction, management, and financing.

In framing out the range of options regarding 'when and how to respond' to climate change risk, the traditional disaster risk management approach provides useful groundwork. The disaster risk management cycle is a widely adopted framework for organising responses before, during and after disasters. Actions can be broadly categorised under *mitigation, preparation, response,* and *recovery* activities (see Figure 2, below).

One criticism of this cycle is that it is not inherently progressive, meaning that after completing the various stages, a community may not be better equipped to respond to hazard impacts the next time. Additionally, where insufficient funds, poorly conceived disaster responses, or frequent, large disasters occur, it may be difficult for a country to 'break free' of reactionary disaster responses. This criticism is particularly salient in conceptualising a climate change risk management and financing framework, as communities face chronic climate pressures, which lead to slow-onset hazards in addition to shock events, and they must adapt as they recover. Therefore, we propose a climate change risk management cycle, which anticipates the next phase (Figure 2) and ensures financing supports the upward spiral of building resilience within an economy and community.

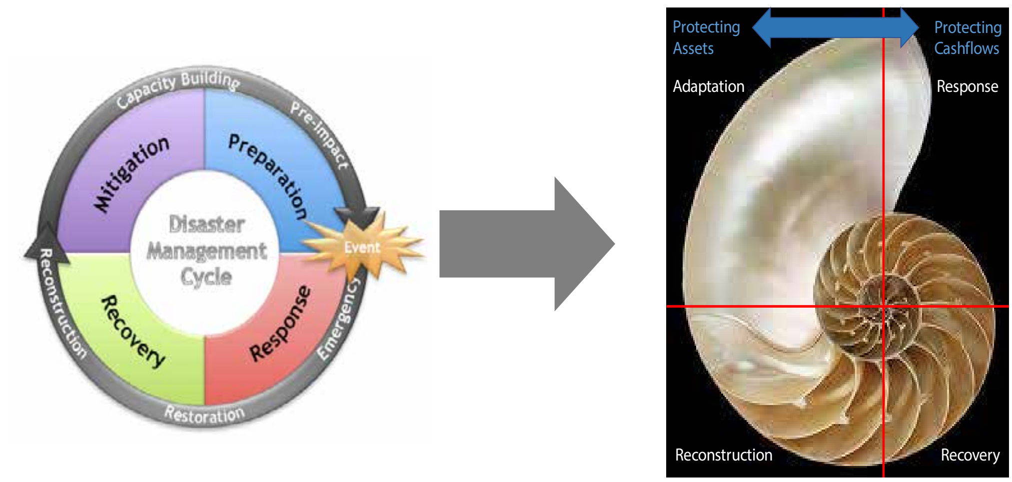


Figure 2. The disaster management cycle and the climate risk management cycle

In order to ensure that the risk management cycle is progressive, we will make a key conceptual shift in the climate change risk management and financing framework: actions will not be hazard event driven, they will be adaptation goal driven. Rather than a framework built around anticipating certain hazards at the first step, we propose a framework that clarifies the priorities for action at each stage of the cycle and ensure financing is targeted to support maximum impacts at each phase.

This climate change risk management cycle is divided into four components:

Adaptive Response:	Activities required just prior to and immediately after an event to ensure impacts are minimised and lives and livelihoods are saved.
Adaptive Recovery:	Activities that ensure the short to medium term impacts of forced action events, like loss of income to a community, are minimised until the community can get back on its feet.
Adaptive Reconstruction:	Activities that facilitate the adaptive reconstruction of assets after an event to restore a community's health while increasing resilience to future climate change impacts (including financial, physical, spiritual and environmental dimensions).
Adaptive Risk Reduction:	Activities that facilitate the redevelopment of assets prior to an event or on a longer timescale to ensure a new level of resilience is achieved.

The financing for the cycle tends to focus on the cashflows for a community or on investment in assets within a community. **Adaptive Response and Recovery** focus on protecting the cashflows, livelihoods and ways of life of a community (either by providing funding for the costs of delivering relief and immediate response, or by providing financing that closes the gaps in incomes due to the impacts of an event). **Adaptive Reconstruction and Risk Reduction,** on the other hand, focus on the short term or long term investment in returning assets to a stronger level of resilience (either by ensuring 'build-back-better' principles are incorporated into the reconstruction phase, or by ensuring strategic investment is made in the redevelopment of community assets over a longer period of time, where climate impacts have not driven the need for the rapid rebuild of a community).

Therefore, we have identified the following 'Guiding Questions' to orient the development of novel climate risk management tools and financing:

1. **What do we want to protect?**
   - What do we have? (asset focus)
   - What drives our prosperity and livelihood? (cashflow focus)
2. **What are the potential impacts?**
   - How do climate change hazards cause damage and disruption to our resources and prosperity?
3. **Where do those impacts fit in the cycle?**
   - How could we best respond?
   - How does action contribute to better actions at other stages in the cycle?

The nautilus shell (shown in Figure 2, above) represents a life cycle, with the strength and size of the shell ever increasing as the nautilus matures, so that it can survive in the ocean environment. The spiral of the shell represents the development journey that we see for Pacific nations as they navigate the impacts of forced action events and continue to build their resilience at every stage.

Who Holds Climate Change Risk?

Finally, it is critical for a comprehensive climate change risk management and financing framework to consider who actually holds the risk of climate change impacts. Our framework will draw heavily on lessons learned in disaster risk management and financing, and we will consider risk as it affects three levels:

1. Macro-level risk is held at the national or sub-national level by governments.

2. Meso-level risk is held at the enterprise level by cooperatives, businesses, or other collectives and communities.

3. Micro-level risk is held at the household level by individuals.

3. Climate-change risk management and financing principles

The following section details seven key climate change risk management and financing principles, which complement the general framework outlined in Section 2 to orient the analysis and recommendations in this paper and inform the evaluation of proposed mechanisms. Each principle seeks to identify the unique purpose of *climate change risk management and financing,* as well as embed a collaborative approach to initiatives in disaster risk finance and climate adaptation.

1. Integrated & complementary. This first principle recognises the importance for any novel climate risk management and financing advice, tools, and/or mechanisms to be integrated with existing and planned climate financing for climate adaptation. In particular, novel mechanisms and recommendations support long-term adaptation planning and investments by accessing financing for the gaps. These gaps may be temporal (e.g. climate change risk financing mechanisms may provide financial protection in the short term while long-term adaptation projects are in progress) or practical (e.g. where there are no appropriate adaptation strategies).

It is also important to note that mechanisms are geared toward the management of climate change related impacts, regardless of the source of finance. Therefore, the climate risk management and financing tools developed are complementary to, rather than a substitute for, potential compensation under the UNFCCC loss and damage negotiations.

2. Supports collaboration. All mechanisms and recommendations are supportive of regional and international cooperation. In particular, risk financing concept, mechanism, and instrument development is informed by global best practice, and this work is a regional broker for engagement with subject-matter experts and development partners alike.[9] This will support work on climate change risk management and financing to be integrated and complementary with work on disaster risk financing and climate adaptation. The development of the **Clearinghouse** concept for transparency, education, and capacity building of climate change risk financing should allow information to be available to all stakeholders and promote knowledge exchange and collaboration across the wider sector (the regional NDC hub is an example of how the Clearinghouse could operate as more than a database tool and support the exchange of ideas and knowledge across the region, provide technical assistance, as well as with other knowledge and information management centres).

3. Promotes resilience. This work to develop comprehensive climate change risk management and financing for the SIS is focused on enabling the long-term resilience of the peoples of the Pacific. Therefore, all proposed mechanisms support behavioural change – of recipient governments, vulnerable communities, and development specialists – to adapt to the impacts of climate change at every phase of the adaptation cycle. Further, all activities prioritise a need-driven 'outcome' focused orientation over hazard-driven 'input' based approaches. Climate change risk financing mechanisms provide access to funding to *manage* (rather than just compensate for) climate change impacts with a forward-looking perspective, focusing on timely and sufficient short-term response (underpinned by planning); adequate, predictable, and reliable recovery; building-back-better; and aligning all finance and response activities with long-term adaptation needs.

4. Responsive to climate risk. All climate change risk management and financing mechanisms and advice are risk-based and informed by the latest climate science, recognising and integrating uncertainty associated with future climate hazards. This initiative and associated mechanisms, implementation pathways and processes will also evolve with changes in exposure and vulnerability (e.g. due to successful climate adaptation) and shifts in climate finance priorities.

[9] 'This work' is further defined, with an institutional identify - the Pacific Islands Climate Change Insurance Facility - in the Conclusion.

5. SIS Focused. This is an SIS-led initiative, and all mechanisms and recommendations are in support of SIS needs and priorities. Its development and operations are driven by country policies, especially climate risk management and adaptation and development plans and goals. This focus on the SIS facilitates its role as a regional hub of expertise, supporting collaboration with other disaster- and climate-focused initiatives in the region, but addressing a critical gap for the SIS.

Ultimately, the proposed climate change risk management and financing mechanisms and recommendations will have broader applications to larger PSIDS with similar attributes (e.g. outer islands), where smaller communities may experience a similar gap in tailored solutions. They may also have wider global applicability to other SIDS and island regions.

6. Multi-Dimensional. Climate change risk management tools recognise the multi-dimensional impacts of climate change across humanitarian, economic, cultural, and environmental spheres. Therefore, recommendations consider the priorities in each of these spheres at the national, community and enterprise levels. Climate change risk management and financing support the safety, livelihoods, and cultural values of communities, the integrity and health of the natural environment, and the sustainable development goals of nations, recognising that climate change will impact each of these goals. Novel mechanisms and recommendations enable adaptation in each of these spheres, recognising the profoundly disruptive threat of climate change.

7. Efficient. Climate change risk financing mechanisms deliver – and demonstrate – value for money. Novel mechanisms and recommendations have a clear value proposition across innovation, customer understanding, and operational excellence. These mechanisms and implementation pathways are clearly communicated and understood by end-users (including SIS, donors, and development specialists), and instruments are easily accessible and clearly defined. Further, there is disciplined management of product life cycles.

These principles make up the climate change risk management and financing mechanism evaluation matrix, which will be used in novel mechanism development and assessment.

Principle	Mechanism Features	
Integrated & complementary	*What role does this mechanism play in the regional climate change risk management and financing landscape and what other programmes and initiatives does it complement or conflict with?*	*Confirm and describe how this mechanism addresses a current gap*
Supports collaboration	*What engagement and collaboration has taken place?*	*How accessible is knowledge on the mechanism to wider stakeholders?*
Promotes resilience	*How does this mechanism support behavioural change toward climate adaptation?*	*What proactive risk management and adaptation outcome does this mechanism support?*
Responsive to climate risk	*Is the mechanism risk-based and does it have an intended life cycle?*	*Does the mechanism support current exposure and vulnerability or future needs?*
SIS Focused	*Is the mechanism tailored to the SIS, or similar communities, and their priorities and goals?*	

Multi-Dimensional	*How does this mechanism support the safety, livelihoods, and cultural values of communities, the integrity and health of the natural environment, and/or the sustainable development goals of nations in a changing climate?*	
Efficient	*Does the mechanism deliver – and demonstrate – value for money?*	*Does the mechanism and supporting infrastructure have a clear value proposition that enables innovation, customer engagement, and operational excellence?*

Additional feasibility criteria focused on the instruments that will support climate change risk management and financing mechanisms, which will be assessed on a product by product basis, are as follows:

Feasibility criteria	**Instrument Features (to be completed in product feasibility assessment)**
Legal and regulatory barriers	*Are there any legal or regulatory barriers to product implementation?*
Funding	*Who will fund the instrument?*
Suitable risk data availability	*Is there sufficient and suitable data available to price the risk?*
Suitable real-time monitoring data availability	*Is there sufficient and suitable data available to monitor the risk in real-time (e.g. to make trigger-based pay-outs and settle claims)?*
If insurance instrument: risk transfer possible at acceptable technical price	*Is insurance an appropriate and affordable instrument for this risk?* *Are reinsurance and other global capital markets supportive of the product?*
Effective use of funds	*Is the planning in place to make effective use of funds?*
Unintended outcomes	*Are there potential unintended outcomes associated with this product?*

4. Smaller Island States landscape review

The following section provides an overview of the SIS socio-economic landscape, development, and climate adaptation priorities, and regional, national, and community drivers and barriers to short and long-term climate resilience. This overview is the result of a literature review, as well as consultations with a range of key stakeholders across the SIS including government and community representatives and subject-matter experts. It will inform the key risks to be prioritised in a comprehensive climate change risk management framework for the SIS, as well as key design features for novel climate change risk financing mechanisms and instruments and actual implementation processes.

Socio-economic landscape

Tables 1 and 2 present summary socio-economic facts and statistics per SIS, which will inform PICCIF's initial purpose and priorities. While each SIS has unique characteristics, they share some attributes worth highlighting:

1. The SIS are geographically remote with small populations, making it difficult to achieve economies of scale (although population density varies from island to island);
2. Many communities rely on subsistence agriculture and fishing for livelihoods and food security;
3. The SIS rely on tourism to varying degrees ranging from Tuvalu, which receives fewer than 1,000 tourists annually, to Palau where tourism contributes around 50% GDP;[10]
4. The considerable contribution of the services sector to GDP across many SIS (Table 1) arises from a large percentage of jobs being government positions and a reliance on remittances; and

A large proportion of SIS government revenue comes from foreign grants or budgetary assistance based on historical ties (FSM, RMI and Palau with US; Cook Islands and Niue with NZ), and fishing licences also comprise a significant portion for the Parties to the Nauru Agreement (of the SIS, Federated States of Micronesia, Kiribati, Marshall Islands, Nauru, Palau and Tuvalu).

Table 1. High-level sectoral composition of SIS economies (Data from CIA World Factbook, various dates)

Country	GDP by sector of origin (%)			Labour force by occupation (%)		
	Agriculture	Industry	Services	Agriculture	Industry	Services
Cook Islands	5.1	12.7	82.1	29	15	56
FSM	26.3	18.9	54.8	0.9	5.2	93.9
Kiribati	23	7	70	15	10	75
Marshall Islands	4.4	9.9	85.7	11	16.3	72.7
Nauru	6.1	33	60.8	-	-	-
Niue	23.5	26.9	49.5	-	-	-
Palau	3	19	78	1.2	12.4	86.4
Tuvalu	24.5	5.6	70	-	-	-

[10] Center for Excellence in Disaster Management & Humanitarian Assistance. (2016) Palau Disaster Management Reference Handbook. 68pp

Table 2 High-level socio-economic facts for SIS (**Data from CIA World Factbook, various dates**).

Country	Population % of population below national poverty line[11,12]	Key economic sectors, including subsistence activities[13]	Key Government Revenue Sources[14]	Principle Exports[15]
 Cook Islands	15,750 28%[16]	· Tourism · Fishing · Agriculture · Aquaculture (pearl)	· Foreign grants · Taxes · Property income	· Fish · Pearls · Noni fruit · Clothing
 FSM	102,843 41%[17]	· Fishing · Agriculture · Tourism	· Taxes · Fishing licence fees · Foreign grants	· Fish · Processed sea cucumber · Aluminium waste / scrap
 Kiribati	110,136 22%[18]	· Fishing · Agriculture	· Fishing licence fees · Foreign grants · Taxes · Revenue Equalisation Reserve Fund	· Copra · Fish · Seaweed
 Marshall Islands	53,158 20%[19]	· Fishing · Tourism · Agriculture	· Fishing licence fees · Taxes · Ship registration fees · Foreign grants	· Transport equipment · Fish · Minerals (other petroleum oils)
 Nauru	10,084 24%[20]	· Mining · Fishing · Tourism · Offshore financial services	· Fishing licence fees · Taxes · Foreign grants · Ronphos (phosphates) · Port fees · Visa revenues	· Phosphates · Transport equipment · Manufacturing · Fish · Clothing · Machinery · IT & electronics
 Niue	1,611 -	· Fishing · Agriculture · Tourism · Retail - stamps and coins	· Foreign grants · Taxes	· Re-exporting of jet fuel · Noni juice · Honey · Arts and crafts
 Palau	17,661 25%[21]	· Tourism · Fishing · Agriculture	· Foreign grants · Fishing licence fees · Taxes · Compact Trust Fund	· Fish · Manufacturing · Machinery · Transport equipment · Waste and scrap aluminium · Fermented beverages · Wood · IT & electronic
 Tuvalu	10,782 26%[22]	· Fishing · Agriculture · Retail - stamps and coins	· Fishing licence fees · Foreign grants · Taxes · Tuvalu Trust Fund	· Transport equipment · Fish · Electronics · Chemicals (Antisera and other blood fractions)

[11] Source: most recent country censuses.
[12] Various sources - see individual datapoints
[13] Source: national statistics offices and Commonwealth Secretariat factsheets
[14] Source: national statistics offices and IMF country reports
[15] Source: national statistics offices and International Trade Centre
[16] https://www.oecd.org/countries/cookislands/47651740.pdf
[17] https://data.worldbank.org/indicator/SI.POV.NAHC
[18] https://data.worldbank.org/indicator/SI.POV.NAHC
[19] Source: Government of the Republic of the Marshall Islands (2007)
[20] National Action Plan for Disaster Risk Management 2008-2018. 76pp.
[21] https://www.adb.org/offices/pacific/poverty/nauru
[22] https://data.worldbank.org/indicator/SI.POV.NAHC

Development and Adaptation Priorities – Grounding Risk Management

Any risk management initiative, tool, and/or financing mechanism for the SIS must be driven by the core purpose of risk management: to support the SIS to pursue their goals predictably and without disruption. In order to prioritise the risks that novel mechanisms should cover, this section synthesises the priorities of the SIS, at both the community, household and national levels. Section 5 will examine how these priorities highlight a number of key climate risk exposures for management.

Humanitarian Priorities - ensuring safety and security

The fulfilment of fundamental humanitarian objectives provides the basis for effective development and adaptation efforts. This process begins at the individual and community level. An ongoing challenge for many island communities includes ensuring **food and water security** for present and future generations. Concerns surrounding food security derive from a growing preference for imported food,[23,24] an associated decline in traditional food systems and knowledge, and limited agriculturally productive land areas[25] owing to the prevalence of poor quality and infertile soils[26]. For water, many SIS face challenges related to limited or non-existent ground-water supplies, resulting in a reliance on variable rainfall harvesting, imported water, or freshwater extraction by energy intensive means. In some places, changing lifestyles are increasing per capita water consumption, while poor waste-water and sanitation management systems threaten to contaminate the resources that do exist.[27,28,29] **Access to energy / electricity** is another key priority to be fulfilled at the community level. For instance, imported oil represents a drain on sovereign funds which could be better spent promoting development objectives.[30,31] Additionally, many SIS have identified transitioning to low-carbon energy systems as an important goal to achieve emissions reduction targets and ensure future energy sustainability and security. [32] Priorities include 'increasing the efficiency of end-use energy consumption, increasing the conservation of terrestrial and marine ecosystems, and enhancing the resilience of energy infrastructure'. [33]

Regionally, humanitarian priorities include effective real-time responses to extreme climate related events such as tropical cyclones, droughts, and extreme water level and rainfall events. Immediately prior to extreme event impact, and during the event itself, **early warning systems**, are critical to enable **appropriate and timely, well-resourced immediate response**. Presently, responses to extreme climate related events often rely on overseas aid which can increase sovereign debt. Where event responses are nationally-driven governments typically rely on sovereign reserves, which divert these resources away from competing development objectives. Finally, and of relevance to chronic climate related pressures such as sea level rise, it will be necessary to strategise about the need for, and approach to, more permanent **displacements alongside shorter term evacuations.**

Economic Development Priorities - building prosperity

The economies of the SIS are limited by their relatively small size, remoteness, and reliance on particular sectors and revenue streams. Where economies are heavily dependent on foreign assistance, and imported goods, they are also vulnerable to external economic shocks (e.g. the Marshall Islands and the U.S. or Niue and New Zealand). [34,35,36] For instance, across Tuvalu, a substantial portion of government and private revenues derive from overseas income in the form of fishing licences and remittances.[37] Consequently, a key priority is ensuring **reliable livelihoods** which ensure employment security and are less exposed to external economic forces. Although all the SIS are reliant on external support in some form, primary sectors such as agriculture and fishing remain an important contributor to local economic activity in most cases.

[23] Government of Kiribati. 2014. Kiribati Joint Implementation Plan for Climate Change and Disaster Risk Management. 112pp. 2
[24] Government of the Republic of Nauru. 2015. Republic of Nauru Framework for Climate Change Adaptation and Disaster Risk Reduction. 29pp.
[25] Government of Niue. 2012. Niue's Joint National Action Plan for Disaster Risk Management and Climate Change. 60pp.
[26] Government of Tuvalu. 2012. Tuvalu National Strategic Action Plan for Climate Change and Disaster Risk Management, 2012-2016. 55pp.
[27] Government of Kiribati. 2014. Kiribati Joint Implementation Plan for Climate Change and Disaster Risk Management. 112pp.
[28] Government of Niue. 2012. Niue's Joint National Action Plan for Disaster Risk Management and Climate Change. 60pp.
[29] Government of the Republic of Nauru. 2015. Republic of Nauru Framework for Climate Change Adaptation and Disaster Risk Reduction. 29pp.
[30] Ibid
[31] Government of the Republic of the Marshall Islands. 2014. Joint National Action Plan for Climate Change Adaptation & Disaster Risk Management 2014 – 2018, 56pp.
[32] Government of the Republic of Palau. 2015. Palau Climate Change Policy: For Climate and Disaster Resilient Low Emissions Development. 56pp.
[33] Framework for Resilient Development in the Pacific: An Integrated Approach to Address Climate Change and Disaster Risk Management (FRDP) 2017 – 2030. 40pp.
[34] Government of the Republic of the Marshall Islands. 2014. Joint National Action Plan for Climate Change Adaptation & Disaster Risk Management 2014 – 2018, 56pp.
[35] Government of Niue. 2012. Niue's Joint National Action Plan for Disaster Risk Management and Climate Change. 60pp.
[36] Government of the Republic of Nauru. 2015. Republic of Nauru Framework for Climate Change Adaptation and Disaster Risk Reduction. 29pp.
[37] Government of Tuvalu. 2012. Tuvalu National Strategic Action Plan for Climate Change and Disaster Risk Management, 2012-2016. 55pp.

For instance, migratory fish stocks such as tuna, which represent a substantial economic resource for RMI,[38] while on Niue, subsistence level agriculture accounts for most agricultural productivity and contributes to 23% of Gross Domestic Product (GDP).[39]

Climate related events have the potential to seriously disrupt agricultural and fisheries productivity, both in the short-term through the destruction of equipment and over longer timescales through soil erosion, and increasingly marginal marine conditions (i.e. warming temperature, increasing acidity). Accordingly, to ensure future economic development, it will be necessary to identify, support and pursue **climate-smart livelihoods**. Practical considerations include **protecting assets** from extreme and chronic climate related threats and also encouraging 'building back better' where assets sustain damage. In the immediate aftermath of an event, local-scale **access to credit** will be important to facilitate timely recovery.

National priorities for sustained economic development mirror those at the community level. SIS governments **require reliable revenue streams** in the form of taxes, fishing licences, and specialty exports (e.g. black pearls, noni fruit, and sea products). Governments also require **access to capital** to support critical infrastructure and public service provision. Enhancing the resilience of energy infrastructure has been identified as a key priority[40], and has been the subject of a successful Green Climate Fund project grant.[41] A further important element of nation-scale infrastructure projects is encouraging community buy-in and sense of ownership.[42] **Protection of public and private assets** has been identified as a priority for several SIS and there are examples of dedicated infrastructure development plans.[43,44] It is noted that often critical infrastructure such as power stations, roads and hospitals are frequently located in low lying coastal areas which makes them susceptible to flooding and inundation. Risk arises both during extreme tropical cyclones and slow-onset sea level rise impacts.[47]


Photo: Carlo Iacovino/SPREP

Environmental Priorities - conserving biodiversity and reliable provision of ecosystem services

The terrestrial, and especially the marine environments underpin the societal and economic functioning of the SIS. Consequently, environmental priorities are inseparable from broader development objectives. Central among these priorities is maintaining **healthy ecosystems** which support both subsistence activities and island revenues. Ecosystems face threats from damaging local activities where non-biodegradable waste usage in urban areas, as well as poor waste and sanitation management result in limited access to unpolluted land and sea, reductions in ecosystem extent and quality, and in some cases, increased occurrences of diarrheal and vector borne diseases.[48] Prioritising these ecosystems will necessitate wider **improvements to island infrastructure and waste management practices.**

[38] Government of the Republic of the Marshall Islands. 2014. Joint National Action Plan for Climate Change Adaptation & Disaster Risk Management 2014 – 2018, 56pp.
[39] Government of Niue. 2012. Niue's Joint National Action Plan for Disaster Risk Management and Climate Change. 60pp.
40 Framework for Resilient Development in the Pacific: An Integrated Approach to Address Climate Change and Disaster Risk Management (FRDP) 2017 – 2030. 40pp.
[41] Green Climate Fund. 2016. Pacific Islands Renewable Energy Investment Program. Approved Concept Note.
[42] Cook Islands Government, JNAP II - Are We Resilient? 2016. The Cook Islands 2nd Joint National Action Plan. 84pp.
[43] Pacific Community (SPC) and Pacific Islands Forum Secretariat (PIFS). 2019. Climate Change and Disaster Risk Finance Assessment Final Report, 122pp.
[44] Government of Kiribati. 2014. Kiribati Joint Implementation Plan for Climate Change and Disaster Risk Management. 112pp.
[45] Government of the Republic of Nauru. 2015. Republic of Nauru Framework for Climate Change Adaptation and Disaster Risk Reduction. 29pp. [46] Government of Tuvalu. 2012. Tuvalu National Strategic Action Plan for Climate Change and Disaster Risk Management, 2012-2016. 55pp.
[47] Government of the Republic of the Marshall Islands. 2014. Joint National Action Plan for Climate Change Adaptation & Disaster Risk Management 2014 – 2018, 56pp.
[48] Government of Kiribati. 2014. Kiribati Joint Implementation Plan for Climate Change and Disaster Risk Management. 112pp.

Alongside local-scale threats, marine and terrestrial ecosystems are vulnerable to global climate changes. Coral reefs provide critical protection from ocean waves and help to supply landward beach systems on many SIS. Increased sea surface temperatures have been linked to increased cases of algae blooms and coral bleaching. Additionally, ocean acidification threatens the calcification processes which comprise reef structures, with potentially adverse impacts for the growth and life cycle of corals, crustaceans and shellfish.[49] As sea levels rise, freshwater aquifers come under threat from **saltwater intrusion,** increasing pressure on water resources, particularly for water-intensive sectors such as agriculture.[50,51] Rising sea levels are likely to result in locally **increased coastal erosion and inundation**, [52,53,54,55] particularly given that many islands are already experiencing such impacts. Protecting certain localities can be extremely costly, especially where defence construction materials must be imported. More existential concerns over future island viability are more uncertain. Observational studies claim that Pacific Islands have displayed considerable resilience over the past few decades, showing little evidence of destabilisation in response to sea level rise acceleration.[56] Furthermore, numerical modelling suggests that islands may be able to adjust to future increases in sea level rise.[57]

Cultural Priorities - protecting cultural integrity

Efforts should be made to **empower individuals throughout communities**, so that they can drive climate resilient changes, rather than reinforcing the power held by those traditionally, or culturally charged with leadership roles. Throughout this empowerment process, there must be an active effort to include vulnerable and marginal groups to ensure that their priorities, knowledge, and experiences are not overlooked. This will ensure continued **connection to local and national land and shared history.**

In the context of climate change mitigation and adaptation, it will be important to continue cultivating **national recognition of the irreparability of climate change**. This is something that the SIS have been highly successful at both nationally, and on the international stage, through promoting a powerful and unifying narrative across Small Islands Developing States globally (see Appendix A). It is important that this narrative is translated into practical actions. Tangible adaptation interventions should be respectful (to local culture and norms), empowering (developed locally rather than imposed from an external source) and inclusive.

Drivers and Barriers

In the context of climate change, there are a number of key institutional, cultural, and economic drivers and barriers to fulfilling SIS adaptation and development priorities - at the international, national, and community levels. To determine the products that will be beneficial (and feasible) in assisting the SIS to reach their goals, this section outlines the key forces driving, or blocking, movement toward pro-actively managing climate change impacts on livelihoods, security, and wellbeing. The most critical force for successful climate risk management will be political will. Drivers and barriers are identified at the international (Figure 3) and national (Figure 4) level.

49 Government of Tuvalu. 2012. Tuvalu National Strategic Action Plan for Climate Change and Disaster Risk Management, 2012-2016. 55pp.
50 Government of the Republic of Nauru. 2015. Republic of Nauru Framework for Climate Change Adaptation and Disaster Risk Reduction. 29pp.
51 Government of the Republic of the Marshall Islands. 2014. Joint National Action Plan for Climate Change Adaptation & Disaster Risk Management 2014 – 2018, 56pp.
52 Ibid.
53 Government of Kiribati. 2014. Kiribati Joint Implementation Plan for Climate Change and Disaster Risk Management. 112pp.
54 Government of Niue. 2012. Niue's Joint National Action Plan for Disaster Risk Management and Climate Change. 60pp.
55 Government of Tuvalu. 2012. Tuvalu National Strategic Action Plan for Climate Change and Disaster Risk Management, 2012-2016. 55pp.
56 Duvat, V. 2018. A global assessment of atoll island planform changes over the past decades. WIRES Climate Change. DOI: 10.1002/wcc.557.
57 Tuck, M.E., Kench, P.S., Ford, M.R., and Masselink, G. 2019. Physical modelling of the response of reef islands to sea-level rise. Geology, 47(9), 803-806. DOI: 10.1130/G46362.1

Figure 3. International drivers and barriers.

International Drivers

· Broad acceptance of the unique and urgent vulnerability of island nations facilitates (and demands) international cooperation and support.

· Strong collaboration between SIDS to increase influence in climate negotiations (AOSIS), which can help access adaptation funds.

· Strong international policies in support of SIDS resilience (e.g. SAMOA Pathway, Sendai Framework, Warsaw International Mechanism, Paris Agreement, Sustainable Development Goals).

· International mechanisms to support SIDS's climate resilience (e.g. Green Climate Fund, Global Environment Facility, Adaptation Fund).

· Regional institutions and expertise in PIFS, SPREP, SPC, etc.

International Barriers

· Competing Geopolitical priorities

· Limited international political progress of Loss & Damage and associated caution.

· Increasing isolationism and internal focus.

· Shifting focus with COVID-19 driving priorities towards economic recovery and public health implications from the global pandemic.

· High expert turnover.

· Incentives to 'save the day' after impacts, rather than proactively manage potential future impacts.

· Politically difficult to invest in mechanisms that may only demonstrate benefits in the future.

· SIS are extremely small, and project / programme results are often calculated by 'number of people reached,' making the SIS less attractive as focal / target countries for initiatives.

Figure 4. National drivers and barriers.

National Drivers

· Strong national policies in support of resilience (e.g. National Adaptation Plans).

· Resilience is extremely high on the agenda, with dedicated government ministries for climate.

· As climate change progresses and impacts are felt, incentives to proactively manage the risk increase.

National Barriers

· Limited institutional capacity, high friction for knowledge sharing, coordination, and collaboration, high turnover.

· Limited data availability.

· Politically difficult to invest in mechanisms that may only demonstrate benefits in the future.

· The outlook is extremely distressing + connection to the current state.

· Scarce resources.

· Difficult to engage remote communities, highly centralised governance processes.

· Low level of risk awareness in marginal communities, where translating scientific and technical risk management information into understandable and relatable formats is a considerable challenge.

· Connection to the land which makes some adaption activities very complex.

· Time delays in renewing and publishing national adaption plans and climate change policy, making some information outdated.

Outline of current risk management strategies at the regional, national, and community levels - landscape in climate risk (players and programmes)

Key priorities of the SIS are also outlined in current risk management strategies. The following section presents an overview of those current strategies at the regional, national, and community levels.[58]

Several of the SIS have developed national action plans in accordance with the National Adaptation Plan (NAP) process, established under the UNFCCC conference in Cancun in 2010. The process is intended to encourage countries to identify and address their medium- and long-term priorities for adapting to climate change. The NAPs are developed by national governments with input from sub-national entities, and the process involves analysing climate related impacts, prioritising adaptation options, and implementing, monitoring and appraising selected interventions.[59] Since 2016, the GCF has approved funding to support the development of NAPs. Table 3 lists the latest strategic policy documents which outline the climate risk management strategies, at a regional scale, and for each of the SIS. These documents are used to undertake a gap analysis to identify where countries are already committing resources, and where additional resources and novel initiatives might add most value.

Table 3 **Summary of regional projects & programmes, national strategic documents, and community projects, that collectively comprise the climate risk policy landscape across the SIS. Note that only the latest strategy documents are included in this table.**

REGIONAL PROJECTS & PROGRAMMES			
Name	Objective	Geographic coverage	Duration
Framework for Resilient Development in the Pacific (FRDP)	To facilitate an Integrated Approach to Address Climate Change and Disaster Risk Management (FRDP)	Pacific region	2017-2030
Pacific Islands Renewable Energy Investment Program	Support a shift from diesel power generation to renewable energy in seven Pacific Small Island Developing States (SIDS) and place the SIDS on a sustainable, climate resilient development pathway.	Cook Islands, Tonga, RMI, FSM, Papua New Guinea, Nauru, Samoa	2016-
Managing Coastal Aquifers in Selected Pacific SIDS	To improve the understanding, use, management and protection of coastal aquifers, towards enhanced water security within a changing climate	Palau, Tuvalu, RMI	2018-

[58] The risk management strategies deployed across the SIS are influenced to greater or less extent by the international climate, development, and disaster risk management landscape. A selection of international conferences and outcomes which have contributed to the disaster risk management landscape across the SIS are summarized and further elaborated in Appendix A.
[59] National Adaptation Plan Global Network. (2019) The National Adaptation Plan (NAP) Process. Accessible at: http://napglobalnetwork.org/2019/12/the-national-adaptation-plan-nap-process-frequently-asked-questions/

NATIONAL STRATEGIC DOCUMENTS			
Name	**Objective**	**Geographic coverage**	**Duration**
JNAP II - Are We Resilient? The Cook Islands 2nd Joint National Action Plan	Strengthen climate and disaster resilience to protect lives, livelihoods, economic, infrastructural, cultural and environmental assets in the Cook Islands in a collaborative, sectoral approach.	Cook Islands	2016-2020
Te Kaveinga Nui National Sustainable Development Plan	To enjoy the highest quality of life consistent with the aspirations of our people, and in harmony with our culture and environment.	Cook Islands	2016-2020
Kiribati Joint Implementation Plan for Climate Change and Disaster Risk Management	To increase resilience through sustainable climate change adaptation and disaster risk reduction using a whole of country approach.	KiribatI	2014-2023
Kiribati Development Plan	The guide for formulating policies and programmes to advance inclusive economic development in Kiribati.	Kiribati	2016-2019
Tile Til Eo 2050 Climate Strategy - Lighting the way	To set a clear framework for progressing towards net zero greenhouse gas emissions by 2050, as well as transitioning to an economy and society that is resilient and can adapt to the inevitable impacts of climate change.	RMI	2020-2050
Republic of the Marshall Islands Joint National Action Plan for Climate Change Adaptation & Disaster Risk Management 2014- 2018	To provide a detailed strategy for holistically and co-operatively addressing risk in the Republic of the Marshall Islands.	RMI	2014-2018
Republic of the Marshall Islands Strategic Development Plan Framework - Vision 2018	To become a country within an inter-dependent world, with an enhanced socio-economic self-reliance, and educate healthy, productive, law-abiding and God-loving people in which individual freedom and fundamental human rights are protected and culture and traditions are respected and development and environmental sustainability are in harmony.	RMI	2003-2018
Federated States of Micronesia Nationwide Climate Change Policy	To mitigate climate change, especially at the international level, and adaptation at the national, state, and community levels to reduce the FSM's vulnerability to climate change adverse impacts.	FSM	2009
Federated States of Micronesia: Strategic Development Plan	To establish an overall strategy for achieving economic growth and self-reliance, and subsequently implementing and monitoring the agreed strategy.	FSM	2004-2023

NATIONAL STRATEGIC DOCUMENTS Name	Objective	Geographic coverage	Duration
Federated States of Micronesia: Strategic Development Plan	To establish an overall strategy for achieving economic growth and self-reliance, and subsequently implementing and monitoring the agreed strategy.	FSM	2004-2023
Republic of Nauru Framework for Climate Change Adaptation and Disaster Risk Reduction	To guide the building of a productive, healthy and sustainable Nauru by tackling vulnerabilities and increasing resilience to the impacts of climate change and natural disasters.	Nauru	2015-
Republic of Nauru National Sustainable Development Strategy	A future where individual, community, business and government partnerships contribute to a sustainable quality of life for all Nauruans.	Nauru	2005-2025
Niue Joint National Action Plan for Disaster Risk Management and Climate Change	A plan of action to address existing gaps relating to vulnerability to climate change impacts and disasters.	Niue	2012-2015
Niue National Strategic Plan	To create opportunities for the Niue people to lead healthy, prosperous lives while protecting the environment and its marine life, flora and fauna.	Niue	2016-2026
Palau Climate Change Policy For Climate and Disaster Resilient Low Emissions Development	Outlines objectives to enhance adaptation and resilience, manage disasters and minimize disaster risk, and mitigate global climate change by working towards low emission development.	Palau	2015-2020
Actions for Palau's Future: The Medium Term Development Strategy	Outlines the key strategies and actions to help achieve economic, social, environmental and cultural goals from 2009 to 2014.	Palau	2009-2014
Te Kaniva: Tuvalu Climate Change Policy 2012	To protect Tuvalu's status as a nation and its cultural identity and to build its capacity to ensure a safe, resilient and prosperous future.	Tuvalu	2012-2021
Tuvalu National Strategic Action Plan for Climate Change and Disaster Risk Management	A joint strategic action plan for climate change adaptation and mitigation and disaster risk management.	Tuvalu	2012-2016
Te Kakeega II – National Strategy for Sustainable Development	To achieve a healthier, more educated, peaceful and prosperous Tuvalu.	Tuvalu	2005-2015

Many of the SIS have developed comprehensive joint action plans for climate change adaptation and disaster risk reduction. In these plans, a series of strategic policy objectives are identified (often drawn from previous, separate climate change action and disaster risk reduction strategies), along with detailed implementation plans (including financing requirements, communication strategies, and monitoring and evaluation procedures). For instance, the Cook Islands have identified Energy and Transport as carrying the greatest resource requirement (76%), while Kiribati estimates that an estimated 50% of resources dedicated to their joint strategy will need to be directed towards promoting reliable infrastructure development and land management.

Where joint implementation plans have not yet been framed, climate adaptation strategies appear distributed over different strategic documents and scales (national, district, sectoral). In these cases, developing a National Adaptation Plan to consolidate the strategies should be a priority, particularly since resources to do so are available through the GCF.

A few SIS have longer-term climate change policies that sit alongside other strategies. For example, the Republic of the Marshall Islands, whose climate policy includes actions extending to 2050.

Table 4 includes the results of a desk-based gap analysis which can be used to identify climate risk management priorities across the region. The analysis classified the climate change adaptation, disaster risk reduction, and broader development objectives of each SIS into policy areas. The next step determined whether each policy area appeared as a priority for each SIS. A policy area was considered a priority if it appeared as part of the core objectives, as outlined in the relevant climate change adaptation and/or disaster risk management strategic documents.

This analysis reveals that certain policy objectives are ubiquitous throughout the existing SIS climate adaptation and disaster risk reduction strategies, others appear in the majority of existing strategies, and some appear in relatively few existing strategies (Figure 5).

Figure 5. Prevalence of each policy area within existing climate change adaptation and disaster risk management strategy documents, across the SIS. Climate change adaptation and disaster risk reduction are abbreviated to CCA and DRR respectively.

Prioritised by 7 or more countries	Prioritised by 5-6 countries	Prioritised by 4 or fewer countries
•Integrating CCA & DRR	•Governance & regulation	•Data & monitoring
•Health & Welfare	•Ecosystems & biodiversity	•Technology use & transfer
•Water & food	•Land management	•Private sector
•Education & training		•Financial sustainability
•Culture & identity		
•Energy & transport		
•Infrastructure		

Several, if not all of the policy areas that are prioritised by relatively few SIS, arose during stakeholder interviews as areas which require attention in order to facilitate insurance sector penetration to the SIS. For instance, improved data monitoring is crucial to inform catastrophe models, which are needed to underpin insurance sector activities. However, the lack of data and monitoring and technology use and transfer in existing national climate change adaptation and disaster risk management strategy documents may highlight the need for, and efficiency of, regional cooperation on these topics. Governance and regulation, as well as ecosystems and biodiversity, are also areas ripe for regional cooperation, which are less prevalent in national priorities.

Table 4 **Gap analysis of climate risk management policy landscape. Red, amber, green is used to indicate the prevalence of each policy area within existing national climate change adaptation and disaster risk management strategy documents.**

Policy area	Objectives	Cook Islands	FSM	Kiribati	RMI	Nauru	Niue	Palau	Tuvalu
Governance & regulation	Strengthen good governance, policy, strategy and legislation for climate change and DRR.	☑		☑	☑		☑		☑
Water & food	Improve water and food security, and capacity building in agricultural and fisheries sectors.	☑		☑	☑	☑	☑	☑	☑
Ecosystems & biodiversity	Sustainable management of critical ecosystems, including responsible use and conservation	☑			☑	☑	☑	☑	☑
Land management	Promote sustainable land use practices and efficient waste management.	☑	☑	☑	☑	☑		☑	
Data & monitoring	Improve climate and disaster monitoring, data storage and analysis capabilities, data management and sharing, and promote high-quality research.	☑		☑					☑
Technology use & transfer	Optimise the use of local technologies for climate mitigation and adaptation efforts, and enhance access to locally appropriate technologies from elsewhere.		☑				☑		☑
Education & training	Delivering awareness, training, and education programmes		☑	☑	☑	☑	☑	☑	☑
Culture & identity	Protect and preserve sovereignty, identity and traditions.	☑	☑	☑	☑	☑		☑	☑
Energy & transport	Promote the development/expansion of low carbon energy generation, whilst maintaining/improving energy security, efficiency, storage, and transportation.	☑	☑	☑	☑	☑	☑	☑	☑
Infrastructure	Promote reliable infrastructure and low carbon development	☑	☑	☑	☑	☑		☑	☑
Integrating CCA & DRR	Integrate climate and disaster risk management strategies at the national and community level, and enhance early warning systems	☑	☑	☑	☑	☑	☑	☑	☑
Health & welfare	Strengthen human health and welfare during response and recovery of climate and disaster impacts.	☑		☑	☑	☑	☑	☑	☑
Private sector	Strengthening and greening the private sector, including small-scale businesses and tourism			☑				☑	
Financial sustainability	Strengthening capacity to access finance, monitor expenditures, and maintain strong partnerships		☑	☑				☑	☑

Common themes arising from key stakeholder interviews

As part of the research for this paper, we conducted interviews with national stakeholders (representing the SIS) and regional stakeholders (representing various bodies actively working in the Pacific region). Based on the feedback obtained from the interviews, we identified the following common themes to support our landscape review and to help shape the conclusions to this report.

Planning & information

· A key focus of adaption planning is on data and information management.

· A core priority for climate change focus is that of better knowledge management, governance and processes.

· A key barrier for climate change financing is that there is a lack of quality data, data leadership and data standards. This impacts the ability to secure investments in projects and to access insurance markets(due to the lack of confidence in data).

· For catalogues of climate change events, there are lots of case studies but nothing definitive - some data is available, but data searches are difficult and data is old - data is available at the national level, but is often not public.

· Risk management processes are mostly ad hoc - interaction with the private sector might be an opportunity.

· Regarding information, avoid making more silos but harness existing investments and create an ongoing resource.

Investment

· National needs assessments provide a good indication of what is needed, but overlooks the sub-national level.

· There needs to be continuous professional development and investing in people as much as technology.

· The role of the private sector is evident for mitigation activities, but not so much for adaptation of communities - companies are not clear on how returns get delivered. There is also uncertainty regarding the role of NGOs in the community space.

· There is nothing systematic regarding structured plans for financing and cost benefit analysis, it is very ad hoc (depends on project and donor, it is not embedded).

· The costs of adaptation are getting higher, but it is more difficult to obtain funds (in terms of timeframe and the capabilities required to produce funding proposals).

· The focus remains on adaptation financing over risk financing. The role of risk financing in climate change has been challenged by an inability to produce measurable results (which is why new hospitals, schools, houses, etc., remain the easy option).

Society

· In terms of gender and social inclusion impacts, this needs to focus on different vulnerabilities, such as those amongst women and children - there is the assumption that everyone is included, but there is a general lack of targeted initiatives (funds are also getting stuck at national level and NGOs).

· People are definitely being displaced, but there is no real focus on the costs or social impacts of displacement (human resource loss by people not returning to areas affected).

· Non-economic losses are generally being overlooked - e.g. language, culture, human resources.

· The distribution of influence remains a challenge. Are projects actually measuring impacts across all of society or do key stakeholder groups wield influence and skew the focus?

Positioning PICCIF

· PICCIF has an opportunity for being a regional broker - the go to point for advice, data and regional expertise, an incubator for future products - a single point for products, solutions, information and ideas – a clearing house for regional SIS needs.

· There is value in working with PCRAFI, especially in terms of sharing data and governance and capital structures.

· Projects like PCRAFI may struggle to cater to the larger economies and at the same time create scalable opportunities for the SIS. There is an opportunity to create an independent pathway for creating smaller deliverables without compromising the ability of programmes to also cater to the larger economies.

· Anecdotal evidence of climate change impacts includes changing island shapes; changing coastlines; increased heavy rainfall; severe cyclones; disturbance to livelihoods and communities (from shoreline corrosion); sea-level rise contaminating soil and affecting crops; algae blooms from increased sea-surface temperature; more frequent king-tides; below average rainfall (drought and water security).

· Key priorities are not all the same across the region. This may impact the ability to leverage region-wide opportunities where scale is possible.

Photo: Carlo Iacovino/SPREP

5. Climate change and the Smaller Island States

Climate change related impacts are likely to be felt on multiple dimensions in the SIS, as they affect safety and security, prosperity, biodiversity and ecosystem services, and cultural integrity. Therefore, when considering the key 'exposures' of the SIS, which would benefit from structured and comprehensive climate change risk management and financing, we consider multiple categories beyond traditional property and hard infrastructure.

Outline of key exposures (assets and cash-flows)

We have identified two broad types of exposure, which could be covered:

- Assets (i.e. those things we have); and
- Cash-flows (i.e. the drivers of prosperity and livelihood).

Table 5 outlines key exposures by type, the potential climate impacts expected by exposure category, and potential response mechanisms, which could be implemented to manage the climate change risk.

Table 5. Summary of key exposures per SIS.

	Exposure	Potential climate impacts?	How could we best respond?
Assets	Infrastructure (energy, water, transportation, etc.)	Direct physical damage and usage disruption, including acute destruction and chronic degradation	· Anticipatory adaptation / retrofitting · Post-event response and replacement, which includes building back better
Assets	Natural capital (reefs, mangroves, beaches, etc.)	Direct physical damage and usage disruption, including acute destruction and chronic degradation	· Climate-smart conservation and/or restoration measures · Post-event response, conservation, and/or restoration
Assets	Agriculture	Direct physical damage, including destruction and/or lowered yield	· Climate-smart water management and agricultural practices · Changes in seeds and crop types · Post-event response and replacement
Assets	Property	Direct physical damage and usage disruption, including acute destruction and chronic degradation	· Anticipatory adaptation / retrofitting · Post-event response and replacement, which includes building back better
Assets	Land	Loss of land	· Adaptation / defense-building (e.g. hard engineering and ecosystem-based adaptation) · Relocation

Cash-flows	Exposure	Potential climate impacts?	How could we best respond?
	Potable water	Reduced availability	· Climate-smart water management · Investments in rain capture and/or desalinisation and additional water storage · Water imports
	Health	Impacts to sanitation and infectious diseases	· Pre-emptive adaptation of sanitation infrastructure · Post-event activation and funding of clean-up teams · Increased health spending
	Emergency response	Increased frequency / cost	· Contingency planning · Arrangement of *ex-ante* finance
	Tax revenue	Decreased income	· Arrangement of *ex-ante* finance to smooth shocks
	Enterprise income	Business interruption caused by acute shocks and chronic pressures - directly (through impacts on property, productive assets, and business activities) and indirectly (through impacts on supply-chains, infrastructure, and natural capital)	· Adaptation of business locations / relocation · Arrangement of *ex-ante* finance to smooth shocks through income replacement
	Household income	Affected by acute shocks and chronic pressures - directly (through impacts on property, productive assets, and livelihood activities) and indirectly (through impacts on infrastructure and natural capital)	· Shock responsive social protection, including arrangement of *ex-ante* livelihood protection (private and/or public) · Relocation
	Fishing licence revenue	Threatened due to changes in fish abundance	· Diversification of government revenue sources · Arrangement of ex-ante finance to smooth shocks

Outline of key hazards and impacts, now and with future climate change – acute and slow-onset

The SIS are recognised as vulnerable to an array of acute and slow-onset climate related hazards. Observational records and modelling efforts reveal the climatic trends and associated hazards that have impacted the SIS in recent decades. Over the past 50 years, the SIS have experienced an increase in annual surface air temperatures in the order of 0.08-0.2ºC per decade and an associated increase in the number of hot days and nights (where temperatures exceed the 90th percentile).[60] There is no clear regional trend in average rainfall since 1950. Over the past 30 years, central Pacific islands have received less rainfall, while islands in the southwest and northwest experienced more rainfall. Regionally averaged rates of sea level rise are currently 2-4 times the global average, and mean sea level has risen by 10-20 cm since 1990. In addition to rising sea levels, the seas are warming, by as much as 1ºC since the 1970s.[61]

The trends which have characterised the SIS in the recent past are expected to continue, and in some cases intensify in the future. The average annual temperature across the SIS is projected to increase up to 1.4ºC of further rise projected by 2050. This will in turn increase the number of hot days and nights, in addition to the number of heavy rain days which is projected to increase. Additionally, extreme rainfall events that occurred once every 20 years over the period 1986-2005, are expected to occur once every 4-10 years by 2090, depending on the emissions scenario.[62] Future sea level rise is expected to match, or slightly exceed global average projections of 26-98 cm by 2100. Sea surface temperatures are also projected to increase by up to 1.4ºC by 2050 and, along with ocean acidification, represent an important driver of coral bleaching events.[63]

The Pacific Region's weather and climate is influenced by various atmospheric patterns including the South Pacific Convergence Zone (SPCZ), the Madden-Julian Oscillation (MJO), the Interdecadal Pacific Oscillation, and the El Niño Southern Oscillation (ESNO), which exerts the most significant influence on annual variability. The positive phase of ENSO, El Niño, is associated with higher sea levels in the central and eastern Pacific in addition to warmer sea temperatures which drive more and more intense tropical cyclones. Future changes in the frequency and severity of El Niño events represent a key uncertainty in contemporary climate models.[64]

Further uncertainty surrounds the frequency and severity of tropical cyclone events, which exemplify the intersection between acute and slow-onset climate hazards. Atmospheric and ocean warming has the potential to increase tropical cyclone severity through an increase in available energy. Globally, under a 1.5ºC warming scenario, there is a projected decrease in the frequency of weaker tropical storms and an increase in the number of intense cyclones (as represented by an increase in category 4 and 5 cyclones).[65,66] Globally and regionally across the Pacific, trends in tropical cyclone frequency and intensity are characterised by considerable uncertainty[67] that derives from: challenges in understanding and modelling (at sufficiently high resolution) the processes of tropical cyclone initiation and development, the short duration of observational records, particularly in the context of natural variability.[68] Alongside changes in the frequency and intensity of tropical cyclones themselves, a rise in baseline sea levels can contribute to increased severity of coastal flooding events associated with tropical cyclones. Accounting for the complexity of tropical cyclone formation, modelling studies suggest a decrease in the overall frequency of these events, and an increase in severity.

[60] USAID. 2018. Climate Risk Profile: Pacific Islands. Accessible at: https://www.climatelinks.org/sites/default/files/asset/document/2018-26-Feb_CadmusCISF_Climate-Risk-Profile-Pacific-Islands.pdf
[61] Ibid.
[62] Australian Bureau of Meteorology and CSIRO, 2014. Climate Change in the Pacific: Scientific Assessment and New Research. Volume 1: Regional Overview. Volume 2: Country Reports.
[63] Ibid.
[64] Hoegh-Guldberg, O., D. Jacob, M. Taylor, M. Bindi, S. Brown, I. Camilloni, A. Diedhiou, R. Djalante, K.L. Ebi, F. Engelbrecht, J.Guiot, Y. Hijioka, S. Mehrotra, A. Payne, S.I. Seneviratne, A. Thomas, R. Warren, and G. Zhou, 2018: Impacts of 1.5ºC Global Warming on Natural and Human Systems. In: Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty [Masson-Delmotte, V., P. Zhai, H.-O. Pörtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J.B.R. Matthews, Y. Chen, X. Zhou, M.I.Gomis, E. Lonnoy, T.Maycock, M.Tignor, and T. Waterfield (eds.)].
[65] Wehner, M.F., K.A. Reed, B. Loring, D. Stone, and H. Krishnan, 2018a: Changes in tropical cyclones under stabilized 1.5 and 2.0°C global warming scenarios as simulated by the Community Atmospheric Model under the HAPPI protocols. Earth System Dynamics, 9(1), 187–195, doi:10.5194/esd-9-187-2018
[66] Pacific Community (SPC), Secretariat of the Pacific Regional Environment Programme (SPREP), Pacific Islands Forum Secretariat (PIFS), United Nations Development Programme (UNDP), United Nations Office for Disaster Risk Reduction (UNISDR) and University of the South Pacific (USP), 2016. Framework for Resilient Development in the Pacific: An Integrated Approach to Address Climate Change and Disaster Risk Management (FRDP) 2017 – 2030.
[67] Klotzbach, P.J. and Landsea, C.W. 2015. Extremely Intense Hurricanes: Revisiting Webster et al. (2005) after 10 Years. American Meteorological Society, 1-9, DOI: 10.1175/JCLI-D-15-0188.1
[68] Masuda, S., Philip Matthews, J., Ishikawa, Y. et al. 2015. A new Approach to El Niño Prediction beyond the Spring Season. Nature Scientific Reports 5, 16782. DOI: 10.1038/srep16782.

Observational evidence covering all SIS show that ocean acidification has increased since the eighteenth century, a trend that will likely continue into the future. Under moderate to high emission scenarios, changes to ocean chemistry will result in future conditions that are only marginal for healthy coral reef growth by 2030. Under a high emissions scenario, ocean acidification will continue, to a point where coral reefs have not been found historically. Additionally, as a result of ocean warming, the corals surrounding the SIS will likely experience an increase in the duration of bleaching events and an increase in the occurrence of such events.

Risks and vulnerability per SIS – main risks and perils; priorities for focus

Notwithstanding the regional trends outlined above, it is crucial to recognise that climate risk profiles vary on an island by island basis. This variation results from diverse island geography, geology, and topographic characteristics. The main risks to which all islands are exposed are temperature rise, changes to rainfall regimes, sea level rise, and ocean acidification and warming (with associated ecological impacts such as coral bleaching). Additional perils which impact some SIS include tropical cyclones and drought.

[Note below that while Kiribati and Nauru do not usually get any cyclones, they do suffer from storm surges]


Photo: Carlo Iacovino/SPREP

Table 6. Summary of selected present and future risks and risk-drivers.[69]

	Historic trends and present conditions			Future projections		
	Surface air temperature (over twentieth century)	Tropical cyclone frequency (average number per decade)	Mean sea level rise (mm per year since 1993)	Surface air temperature (degrees)	Tropical cyclone frequency (trend to 2090)	Mean sea level rise (cm)
Cook Islands	Increased/stable	18	4	2030: 0.3-1.0 2090: 0.2-4.2	Decrease (low confidence)	2030: 7-17 2090: 22-86
Federated States of Micronesia	Increased	71	10	2030: 0.4-1.1 2090: 0.8-3.5	Decrease (low confidence)	2030: 3-15 2090:16-62
Kiribati	Increased	n/a	1-4	2030: 0.4-1.2 2090: 0.6-4.5	n/a	2030:7-17 2090: 23-87
Marshall Islands	Increased	22	7	2030: 0.4-1.1 2090: 0.8-4.2	Decrease (low confidence)	2030: 7-19 2090: 23-92
Nauru	Increased	n/a	5	2030: 0.4-1.2 2090: 0.6-4.5	n/a	2030: 8-18 2090: 24-89
Niue	Increased	10	5	2030: 0.3-1.1 2090: 0.6-2.6	Decrease (high confidence)	2030: 7-18 2090: 23-87
Palau	Increased	28	9	2030: 0.5-1.0 2090: 0.4-4.0	Decrease (low confidence)	2030: 8-18 2090: 25-88
Tuvalu	Increased	8	5	2030: 0.4-1.0 2090: 0.4-4.0	Decrease (high confidence)	2030: 7-18 2090: 23-87

[69] Australian Bureau of Meteorology and CSIRO, 2014. Climate Change in the Pacific: Scientific Assessment and New Research. Volume 1: Regional Overview. Volume 2: Country Reports.

Cook Islands

Comprising fifteen separate landmasses, the Cook Islands are located in the South Pacific Ocean and vulnerable to a range of climate related perils. Since the mid-twentieth century, temperatures have increased in the southern Cook Islands but remained stable in the North Cook Islands. Across both island groups, climate projections suggest that by 2030, air temperatures will increase by between 0.3-1ºC with little difference between alternative emissions scenarios. By 2090, the projected range of temperature increase is 0.2-4.2ºC, depending on the emissions scenario. [70]

Records extending to the beginning of the twentieth century suggest no significant trend in annual rainfall or extreme daily rainfall occurrences. Average annual rainfall is not projected to change significantly in the future, though extreme rainfall events are expected to occur more frequently. For the Northern Cook Islands, the frequency of extreme droughts is expected to increase, while less severe drought events show no significant trend. By contrast, the Southern Cook Islands will likely experience a slight decrease in the number of mild droughts, with other types of drought events remaining the same.

Observational evidence suggests average sea level rise of 4 mm per year since 1993. This trend is projected to accelerate in the future, with sea level rise in the range of 7-17 cm by 2030, and 22-86 cm by 2090, depending on the emissions scenario.[71] Sea level rise is a particular threat to the Cook Islands given that 88% of the land area lies within 5m above sea level.[72]

Tropical cyclones impact the Cook Islands between November and April, with 74 such events crossing the Exclusive Economic Zone over the 42-year period between 1969-2011.[73] In the Cook Islands, global climate models suggest a decrease in cyclone frequency. Projected changes in wave climate are relatively limited and highly uncertain.

As for the other SIS, ocean acidification presents a further threat to the Cook Islands' marine ecosystems. Additionally, ocean warming increases the risk of coral bleaching through increasing the frequency and duration of such events.[74]

Forced action event: Tropical Cyclone Pat

On the 10th February 2010, Tropical Cyclone Pat made landfall on the Southern Cook Islands delivering 200 km per hour winds and prompting the declaration of a State of Disaster. The north west of Aitutaki Island was the most severely damaged area, where an estimated 78% of houses were destroyed.[75] In response, the Emergency Management Cook Islands, Major and Island Council, and New Zealand High Commission representatives coordinated with disaster relief agencies to provide temporary shelter, food, water, and psycho-social support.

[70] Cook Island Meteorological Service, Australian Bureau of Meteorology and CSIRO. 2013. Current and future climate of the Cook Islands. Accessible at: https://www.pacificclimat-echangescience.org/wp-content/uploads/2013/06/9_PCCSP_Cook_Islands_8pp.pdf
[71] Pacific Climate Change Portal: Cook Islands. https://www.pacificclimatechange.net/country/cook-islands
[72] Australian Bureau of Meteorology and CSIRO, 2014. Climate Change in the Pacific: Scientific Assessment and New Research. Volume 1: Regional Overview. Volume 2: Country Reports.
[73] Ibid.
[74] Ibid.
[75] Reliefweb. 2010. Cook Islands: Tropical Cyclone Pat – Feb 2010. Accessible at: https://reliefweb.int/disaster/tc-2010-000024-cok

Federated States of Micronesia

The Federated States of Micronesia (FSM) consists of four states located in the Western Pacific, north of the equator. FSM is impacted by numerous perils which may be influenced by future climatic changes, including droughts, cyclones, storm waves and surges, flooding, and landslides.

Consistent with global trends, annual and seasonal maximum and minimum temperatures have increased in FSM since the 1950s. Depending on the emissions scenario, air temperature increase is projected to range between 0.4-1.1°C by 2030, and between 0.8-3.5°C by 2090.[76] Alongside this general trend, the number of very hot days will increase and the number of cool nights will decrease.

Annual rainfall patterns are determined by the movement of the ITCZ, with inter-annual rainfall strongly moderated by ENSO. Since 1950, annual rainfall during the wet season has decreased, while no clear trend is evident for the dry season. Future rainfall projections suggest a reversal of this historic trend, with an increase in average and seasonal rainfall and reduced occurrence of droughts in the coming century.[77]

The FSM is impacted by tropical cyclones between June and November, with 248 such events entering the Exclusive economic zone over the 44-year period between 1977-2011.[78] The frequency of tropical cyclones is projected to decrease, though uncertainty is high with some models predicting increased cyclone frequency in the future.

Sea level has risen by an average of 10 mm per year in FSM since 1993, approximately three to four times the global average rate (though this may partly result from interdecadal phenomena such as ENSO). It is highly likely that sea level will continue to rise in the future, with a projected range of between 3-15 cm by 2030, and between 16-62 cm by 2090, depending on the emissions scenario.[79] Marine ecosystems such as coral reefs are expected to suffer from worsening ocean acidification, compounded by other stressors including coral bleaching, storm damage, and fishing pressure.

Forced action event: Coastal erosion and flooding across the FSM

Sea level rise has resulted in the disappearance of several islands within living memory, and is driving chronic erosion issues along many of the reef-edge islands that remain. Additionally, rapid sea level rise exacerbates high tide events, known as 'king tides'. In 2007 and 2008, high tides resulted in saltwater contamination of groundwater systems and caused considerable damage to crops. In response, food and water relief was provided to impacted populations.[81]

[76] Australian Bureau of Meteorology and CSIRO, 2014. Climate Change in the Pacific: Scientific Assessment and New Research. Volume 1: Regional Overview. Volume 2: Country Reports.
[77] Ibid.
[78] Ibid.
[79] Federated States of Micronesia National Weather Service Office, Australian Bureau of Meteorology, and Commonwealth Scientific and Industrial Research Organisation (CSIRO). 2011. Pacific Climate Change Science Program. Current and future climate of the Federated States of Micronesia.
[80] Nunn, P.D., Kohler, A., and Kumar, R. 2017. Identifying and assessing evidence for recent shoreline change attributable to uncommonly rapid sea-level rise in Pohnpei, Federated States of Micronesia, Northwest Pacific Ocean. Journal of Coastal Conservation, 21, 719-730.
[81] Fletcher, C.H. and Richmond, B.M. 2010. Climate Change in the Federated States of Micronesia. Food and Water Security, Climate Risk Management, and Adaptive Strategies. 72pp.

Kiribati

Located in the central Pacific Ocean, Kiribati comprises over 30 coral atoll islands. Kiribati has experienced steady atmospheric warming since 1950. This trend is expected to continue across all island groups, with projected warming in the range 0.4-1.2°C by 2030, and 0.6-4.5°C by 2090, depending on the emissions scenario. The increase in average temperatures is expected to generate a proportionate increase in extreme temperatures, resulting in an increased number of hot days and decreased number of cool nights.

Annual and seasonal rainfall across Kiribati show little change, with the exception of eastern Kiribati which has experienced a seasonal (November-April) increase in rainfall since the 1940s.[83] There is no trend in extreme rainfall events over this observational period. Over the coming century, long-term average rainfall is projected to increase, for both the wet and dry season, covering all island groups. In the short and medium term, inter-annual variability will likely continue to dominate rainfall patterns, though the increasing trend will become increasingly evident towards the end of the century. For all island groups, the overall proportion of time spent in drought conditions is expected to decrease. Instances of extreme drought conditions are expected to remain stable across the Gilbert and Phoenix Islands, whilst increasing slightly for the Line Islands.

Sea level has risen across Kiribati by 1–4 mm per year since 1993. Future sea level rise is projected to be 7-17 cm by 2030, and 23-87 cm by 2090, depending on the emissions scenario. This represents a considerable threat given that 96% of Kiribati's land area and 95% of the population reside within 5m above sea level.[9] Wave climate is strongly influenced by the location of the SPCZ and to some extent ENSO resulting in considerable inter-annual variability and no clear historical trends.[84]

Continued ocean acidification will threaten the future viability of coral reefs, which are also vulnerable to bleaching, driven by increased sea surface temperatures. Ocean modelling suggests that Kiribati will likely experience an increase in the duration of bleaching events and an increase in the occurrence of such events.

Forced action event: Extended drought in Kiribati, 2015-2017

Starting in 2015, Kiribati experienced a period of extended drought which disrupted the usual October-March rainy season and continued into 2017. Thought to be El-Nino-induced, the lack of seasonal rainfall has resulted in depletion of groundwater resources with particularly severe impacts across the southern island. Drought duration is an important factor, within 3 months adverse impacts on crops and rainwater tanks were evident, with severe depletion of household wells prevalent after 6 months. [85]

[82] Kiribati Meteorological Service, Australian Bureau of Meteorology and CSIRO. 2013. Current and future climate of Kiribati, Accessible at: http://world.350.org/pacific/files/2014/01/11_PCCSP_Kiribati_8pp.pdf
[83] Ibid.
[84] Ibid.
[85] Reliefweb. 2017. Pacific: Drought – 2015-2017. Accessible at: https://reliefweb.int/disaster/dr-2015-000127-fji

Marshall Islands

The Marshall Islands encompass over one thousand islands and islets, twenty-nine of which are inhabited. Consequently, there is some level of variability in historic and future climate trends across the Islands. Since the 1950s, air temperatures have increased across both the southern and northern Marshall Islands. This has led to an increase in the number of warm days and a reduction in the number of cool nights. Surface air temperatures will likely continue increasing, with a rise of 0.4-1.1°C by 2030, and a rise of 0.8-4.2°C by 2090, depending on the emissions scenario.[86]

Rainfall is highly variable over inter-annual timescales due to the influence of ENSO and to some extent the ITCZ. The long-term average rainfall across the northern and southern Marshall Islands is expected to increase, but inter-annual variability will continue to dominate rainfall patterns until the end of the century. The frequency and intensity of extreme rainfall events is expected to increase. Across both island groups, the proportion of time spent in drought conditions is expected to decrease.

The Marshall Islands are impacted by tropical cyclones between June and November, with 78 such events crossing the Marshall Islands Exclusive Economic Zone over a 34-year period between 1977-2011. ENSO exerts a clear control on tropical cyclone incidence, with 50 cyclones per El Nino year, compared to 3 cyclones per La Nina year.[87] Climate models suggest a decrease in tropical cyclone occurrence, though the uncertainty surrounding this projection remains high, with considerable inconsistency between models.

Since 1993, mean sea level has risen by approximately 7mm per year. Mean sea level is expected to rise by 7-19 cm by 2030, and by 23-92 cm by 2090, depending on the emissions scenario. In 2019, Marshall Islands declared a national climate crisis because of the mounting risk of sea-level rise, and the recognition that 99% of the Marshall Islands' land area and resident population lies within 5m above sea level.[88] Future projections of wind-driven waves across the Marshall Islands are uncertain and interannual variability is likely to continue to dominate in the near term.[89] Changes to ocean chemistry will drive increased future acidity, alongside rising sea surface temperatures, both of which threaten coral reef systems.

Forced action event: Coastal flooding due to extreme waves

Many of the Marshall Islands are impacted by a combination of sea level rise and low-lying coastal topography. Majuro Atoll, which hosts the capital of the Marshall Islands, has been inundated numerous times over the past decade due to a combination of high tides, swell, and waves. In March 2014, flooding resulting from extreme swell waves forced 1000 residents into temporary shelter and the relocation of 250 people to the neighboring atoll of Arno.[90,91] As recently as November 2019, 185 Majuro residents were evacuated after wave-induced flooding once gain impacted the capital.[92]

[86] Marshall Islands National Weather Service Office Meteorological Service, Australian Bureau of Meteorology and CSIRO. 2013. Current and future climate of the Marshall Islands. Accessible at: http://world.350.org/pacific/files/2014/01/8_PCCSP_Marshall_Islands_8pp.pdf
[87] Ibid.
[88] Ibid.
[89] Ibid.
[90] US Climate Resilience Toolkit. 2014. In the Dark of Monday Morning: Waves Inundate a Pacific Community. Accessible at: https://toolkit.climate.gov/case-studies/dark-monday-morning-waves-inundate-pacific-island-community.
[91] USGS. 2014. Low-lying areas of tropical Pacific islands. Accessible at: https://www.usgs.gov/centers/pcmsc/science/low-lying-areas-tropical-pacific-islands?qt-science_center_objects=0#qt-science_center_objects.
[92] Johnson, G. 2019. Over 200 evacuate as ocean swells flood Majuro Atoll. Accessible at: https://www.rnz.co.nz/international/pacific-news/404386/over-200-evacuate-as-ocean-swells-flood-majuro-atoll

Nauru

Nauru is a coral atoll island, located just south of the equator, with a total land area of 22 km^2. Over the past 50 years, air and sea surface temperatures have increased. Climate models suggest that regardless of future emissions scenario, air temperatures are expected to warm by 0.4-1.2°C by 2030 relative to 1995. Further warming of 0.6-4.5°C by 2090 is projected, depending on the emissions scenario.[93] Increases in average temperatures will also result in a rise in the number of hot days and warm nights, and a decline in cooler weather.

The island is characterised by an exceptionally variable rainfall regime, partly due to the influence of ENSO. Over the period 1916-1993, average rainfall was 2126 mm per year, but with a range of 280-4590 mm for any given year.[94] This variability has resulted in prolonged droughts in the past, which add further stress to the already limited freshwater resources.[95] It is expected that long-term average rainfall will increase, though annual variability is still expected to dominate short to medium term rainfall patterns on Nauru[96]. The frequency and intensity of extreme rainfall events are also projected to increase.

Since 1993, mean sea level has risen by 5 mm per year. It is highly likely that sea level will continue to rise in the future, with a projected rise of between 8-18 cm by 2030, and between 24-89 cm by 2090, depending on the emissions scenario.[97] Wind-driven waves are projected to decrease slightly, but this trend is only significantly different from annual variability towards the end of the century. Additionally, proximity to the equators means that tropical cyclone formation is extremely unlikely, with no events on record.

Ocean acidification, resulting from increased atmospheric CO_2 concentrations, poses a threat to Nauru's fringing coral reefs and marine ecosystems. Under high emission scenarios, changes to ocean chemistry will result in future conditions that are only marginal for healthy coral reef growth. This could happen as soon as 2030 under a high emission scenario. Ocean acidification poses a threat not just to coral reefs but the entire marine ecosystem which the reef helps to support.

Forced action event: Repeated, extended drought

Nauru experiences repeated periods of drought, which last an average of 19 months, with an average interval of just 5 years between major droughts. Over the period 2005-2015, an estimated 60% of households were adversely affected by drought conditions.[98] The drought of 1998-2000 is an especially severe example, which resulted in heavy reliance on desalinised water as the limited rainfall and groundwater reserves were depleted.[99]

[93] GEF, UNDP, and SPREP. 2007. Pacific Adaptation to Climate Change: Nauru. Accessible at: https://www.sprep.org/attachments/Climate_Change/PACC_Report_of_in-country_consultations_Nauru.pdf
[94] Ibid.
[95] Government of Nauru. 2015. Republic of Nauru Framework for Climate Change Adaptation and Disaster Risk Reduction.
[96] Australian Bureau of Meteorology and CSIRO (2014). Climate Variability, Extremes and Change in the Western Tropical Pacific: New Science and Updated Country Reports. Pacific-Australia Climate Change Science and Adaptation Planning Program Technical Report, Australian Bureau of Meteorology and Commonwealth Scientific and Industrial Research Organisation, Melbourne, Australia.
[97] Ibid.
[98] Campbell, J., Oakes, R., and Milan, A. 2016. Nauru: Climate change and migration – Relationships between household vulnerability, human mobility and climate change. Report No.19. Bonn: United Nations University Institute for Environment and Human Security (UNU-EHS).
[99] Republic of Nauru. 2012. National Water, Sanitation and Hygiene Implementation Plan. 60pp.

Niue

Niue is a coral island located in the west Pacific Ocean, south of the equator. Atmospheric temperatures have been warming since records began in the 1940s, while the occurrence of warm days and warm nights have increased significantly.[100] In the future, the average surface air temperature is projected to increase between 0.3-1.1°C by 2030, and by 0.6-2.6°C by 2090, depending on the emissions scenario.[101] This trend will drive a proportional increase in the occurrence of extremely hot days in the future.

Inter-annual rainfall variability is strongly influenced by ENSO, with no clear trend in annual rainfall since the early twentieth century. Future projections of rainfall variability are relatively uncertain with slight increases or decreases in rainfall suggested, depending on emissions scenario and timescale. Despite the lack of a clear average trend, the frequency and intensity of extreme rainfall events is projected to increase. Meanwhile, the overall proportion of time spent in drought conditions is expected to decrease or stay the same, depending on the emissions scenario.[102]

Tropical cyclones impact Niue between November and April, with 41 tropical cyclones travelling through Niue's Exclusive Economic Zone between 1969-2011.[103] The number of tropical cyclones impacting Niue varies considerably year on year (from zero to four over the 42 year period), but the reason for this is complex. Over the observational period, ENSO does not have a statistically significant influence on the number of tropical cyclones occurring in a given year. Global climate models suggest a decrease in tropical cyclone occurrence, with relatively high confidence given agreement between different models.

Sea level has risen near Niue by about 5 mm per year since 1993, approximately double the global average rate. Projections suggest an increase in mean sea level in the range 7-18 cm by 2030, and 23-87 cm by 2090, depending on the emissions scenario. Projections of wind-driven waves are relatively uncertain but suggest a possible decrease in wave height in accordance with a decrease in wind strength. These changes only deviate from interannual variability towards the end of the century.

The corals surrounding Niue will likely experience an increase in the frequency and duration of bleaching events, driven by rising sea surface temperatures. Increased ocean acidity is also expected, resulting in conditions that are only marginal for reef growth under moderate and high emissions scenarios.

Forced action event: Tropical cyclone Heta

In January 2004, Niue was among several islands impacted as tropical cyclone Heta tracked through the west Pacific Ocean, developing into a category 5 cyclone with peak wind speeds of 280 km per hour.[104,105] In addition to the severe winds, extreme rainfall and coastal flooding resulted in considerable losses across the island. For example, Niue hospital was entirely destroyed by wave action.[106] Heta prompted a widespread international response and the publication of a national recovery plan, 'A New Niue', which prioritises actions for recovery and longer-term resilience to the impacts of tropical cyclones.[107]

[100] GCCA, EU, and SPREP. 2013. Climate Change Profile: Niue. Accessible at: https://www.pacificclimatechange.net/sites/default/files/documents/Niue%20CC%20Profile%20v2.pdf 101 Niue Department of Meteorology and Climate Change, Australian Bureau of Meteorology and CSIRO. 2013. Current and future climate of Niue. Accessible at: http://world.350.org/pacific/files/2014/01/12_PCCSP_Niue_8pp.pdf

[102] Ibid.

[103] Ibid.

[104] Reliefweb. 2004. Cyclone Heta hits tiny Pacific island of Niue. Accessible at: https://reliefweb.int/report/niue-new-zealand/cyclone-heta-hits-tiny-pacific-island-niue

[105] Reliefweb. 2004. Cyclone Heta; Initial lessons learnt. Accessible at: https://reliefweb.int/report/niue-new-zealand/cyclone-heta-initial-lessons-learnt

[106] Howorth, R., Bonte, M., Prasad, R., Goosby, S., Oliver, S., Elliot M. and Smith, R. 2004 Impacts of Tropical Cyclone Heta to Niue. Australian Meteorological and Oceanographic Society, 1-3.

[107] Government of Niue. 2004. Niue Foou – A new Niue. Cyclone Heta Recovery Plan. Accessible at: https://reliefweb.int/sites/reliefweb.int/files/resources/NIUE_HETA2004_Recovery%20Plan.pdf

Palau

Palau comprises around 340 islands, located across the western Pacific Ocean, just north of the equator. Consistent with global trends, annual mean air temperatures have increased in Palau since records began in the 1950s. Future projections suggest an increase in surface air temperatures in the range 0.5-1.0°C by 2030, and 0.4-4°C by 2090, depending on the emissions scenario.[108] Increases in average temperatures will also result in a rise in the number of hot days and warm nights, and a decline in cooler weather.

Historical records of annual and extreme daily rainfall suggest no directional change since the 1940s. ENSO strongly moderates interannual rainfall patterns resulting in high variability year on year.[109] The frequency and intensity of extreme rainfall events are projected to increase. Meanwhile, the overall proportion of time that Palau is expected to spend experiencing drought conditions will likely decrease. All categories of drought are expected to remain stable or decrease, depending on the emissions scenario.

Tropical cyclones impact Palau between June and November, with 97 such events crossing Palau's Exclusive Economic Zone between 1977-2011.[110] The number of tropical cyclones impacting Palau varies considerably year on year (from zero to eight over the 44-year period), but the reason for this is complex. Over the observational period, ENSO does not have a statistically significant influence on the number of tropical cyclones occurring in a given year. Projections suggest a decrease in tropical cyclone frequency, though the uncertainty associated with these projections is high.

Mean sea level rise has been 9 mm per year since 1993. Sea level rise is projected to accelerate in the future. Projections suggest a mean sea level rise of 8-18 cm by 2030, and 25-88 cm by 2090, depending on the emissions scenario.[111] Seasonal changes in wind-driven wave climates are predicted, though uncertainty is high and trends only deviate significantly from interannual variation towards the end of the century, for high emissions scenarios.

Under moderate and high emissions scenarios, ocean acidification will continue, to a point where coral reefs have not been found historically.[112] Additionally, as a result of ocean warming, the corals surrounding Palau will likely experience an increase in the duration of bleaching events and an increase in the occurrence of such events. The impact of increased acidification on the health of reef ecosystems is likely to be compounded by other stressors including coral bleaching, storm damage and fishing pressure.

Forced action event: Marine thermal shock

Palau's marine ecosystems are vulnerable to extended periods of above average sea temperatures which typically coincide with the La Nina phase of ENSO. Impacts include major coral bleaching events and broader ecosystem damages. For example, Ongeim'l Tketau (also known as Jellyfish Lake), is a major tourist attraction owing to its unique ecosystem. Here, several mass jellyfish die off events are known to have occurred following thermal heat stress, most recently between 2016-2018. This results in a considerable loss of income for the Koror State government.

[108] Palau National Weather Service Office, Australian Bureau of Meteorology and CSIRO. 2013. Current and future climate of Palau Accessible at: https://www.pacificclimatechange-science.org/wp-content/uploads/2013/06/2_PCCSP_Palau_8pp.pdf
[109] Ibid.
[110] Ibid.
[111] Palau National Weather Service Office, Australian Bureau of Meteorology and CSIRO. 2013. Current and future climate of Palau Accessible at: https://www.pacificclimatechange-science.org/wp-content/uploads/2013/06/2_PCCSP_Palau_8pp.pdf
[112] Ibid.

Tuvalu

Tuvalu consists of nine coral reef and atoll islands, located in the Pacific Ocean, just south of the equator. Annual and extreme air temperatures have increased since the 1930s, a trend which is expected to continue in the future. Projections suggest the average surface air temperature will increase by 0.4-1°C by 2030, and by 0.4-4°C by 2090, depending on the emissions scenario.[113] The increased mean air temperatures will drive a proportional increase in extreme high temperatures. The overall proportion of time spent in drought conditions is expected to decrease under all emissions scenarios.

Observational records suggest no trend in the annual rainfall trend since the 1920s, or in the occurrence of extreme rainfall events since the 1960s. While it is highly uncertain whether mean annual rainfall will increase or decrease in the future, the frequency and intensity of extreme rainfall events are projected to increase, with relatively high confidence.[114]

Sea level has risen near Tuvalu by about 5 mm per year since 1993, approximately double the global average rate. Projected sea level rise is estimated to be between 7-18 cm by 2030, and between 23-87 cm by 2090, depending on the emissions scenario. This represents a considerable threat given that 100% of Tuvaluan land and population resides within 5m above sea level, placing it among the most exposed countries to future sea level rise.[115]

Spring tides and tropical cyclones are among the main extreme events that affect Tuvalu. Tropical cyclones impact the country between November and April, with 35 such events passing through Tuvalu's Exclusive Economic Zone between 1969-2011. As well as high winds and rainfall, tropical cyclones also cause storm surges and swells. The resulting flooding causes agricultural losses, particularly of taro crops, and damage to buildings and roads along the coast. Projections suggest with high confidence that the frequency of tropical cyclone occurrence will decrease in the future.

The compounding pressures of ocean acidification and increased sea surface temperatures will result in ocean conditions that are increasingly marginal for healthy reef growth. Additionally, the corals surrounding Tuvalu will likely experience an increase in the frequency and duration of bleaching events.

Forced action event: Tropical Cyclone Pam

Tropical Cyclone Pam impacted numerous Pacific Island states as it reached category 5 severity in March 2015, with peak wind speeds of 350 km per hour and 'king tides' of 3.4m. [116] Almost half of Tuvalu's population was impacted as an estimated USD 10 million in damages were sustained across the islands. The islands of Nui and Nukufetau were most severely impacted. On Nui, in addition to over 70 displaced families, vegetable, banana and pulaka crops were damaged along with poultry and pig enclosures. On Nukufetau, 76 people were displaced while coastal defence structures suffered damage.[117]

[113] Tuvalu Meteorological Service, Australian Bureau of Meteorology and CSIRO. 2013. Current and future climate of Tuvalu, Accessible at: http://world.350.org/pacific/files/2014/01/4_PCCSP_Tuvalu_8pp.pdf
[114] Ibid.
[115] Palau National Weather Service Office, Australian Bureau of Meteorology and CSIRO. 2013. Current and future climate of Palau Accessible at: https://www.pacificclimatechange-science.org/wp-content/uploads/2013/06/2_PCCSP_Palau_8pp.pdf
[116] World Bank. 2015. Tuvalu Gets Continued Support for Cyclone Pam Recovery. Accessible at: https://www.worldbank.org/en/news/press-release/2015/09/15/tuvalu-gets-contin-ued-support-for-cyclone-pam-recovery
[117] ReliefWeb. 2015. Tuvalu: Tropical Cyclone Pam Situation Report No. 1 (as of 22 March 2015). Accessible at: https://reliefweb.int/report/tuvalu/tuvalu-tropical-cyclone-pam-situa-tion-report-no-1-22-march-201

6. Implementing climate risk management and finance in the Smaller Island States

This section draws on the priorities and specific SIS risks (exposures and hazards) identified in Section 5, combined with a gap analysis of current capabilities in comprehensive climate change risk management in the Pacific, to inform the development and implementation of climate change risk financing strategies, mechanisms, and instruments. First, this section summarises lessons and best practices from existing initiatives and mechanisms focused on disaster risk management, disaster risk financing and insurance, and climate adaptation. It identifies gaps in current capabilities and needs for future development. This section also details potential climate change risk management and financing concepts for future development.

Lessons and best practices from existing mechanisms

There are currently significant capabilities in the Pacific region, and globally, related to disaster risk management and finance, as well as climate change risk management and adaptation, which are applicable to SIS-focused comprehensive climate change risk management and finance. Table 7 identifies and lists existing and ongoing initiatives, projects, and mechanisms that focus on climate risk management - from the perspectives of both disaster risk management (which tends to address the 'normal' volatility of climate-driven extreme events, the profile of which will be modified in a changing climate) and climate adaptation (which tends to address the slow-onset hazards associated with chronic climate-change pressures through investments in risk reduction) - in the Pacific region and globally (to highlight lessons learned from other regions facing similar challenges, e.g. the Caribbean).

While Table 5 is fairly comprehensive regarding the specific ongoing projects related to disaster risk finance and insurance in the region, the same level of detail is not provided on ongoing projects related to climate adaptation. This is for three reasons, the first of which are relatively tactical and related to scope, but the third of which is more meaningful:

1. Disaster risk finance is a relatively 'smaller world,' with fewer initiatives and active institutions, compared to the much broader world of climate adaptation. Therefore, the list is simply shorter.

2. There are already initiatives to list climate adaptation projects, e.g. on the Pacific Climate Change Portal.[118]

3. While climate adaptation encompasses the entire spectrum of risk management approaches - from risk reduction to risk financing - there has been much more development and implementation of projects that focus on up-front investments in climate change risk reduction in specific sectors and communities than developing holistic frameworks or mechanisms to deploy climate change risk financing. This is not to say that the vast array of projects, across the SIS, the Pacific region, and the globe, going back more than a decade, and the strong regional and national institutions that have undertaken these types of projects, do not represent significant capabilities related to climate adaptation, or that these projects are not strategic and necessary. Rather, Table 7 does not list out the individual risk reduction projects because it focuses on the residual climate change risk and current capabilities to manage that remaining risk.

[118] https://www.pacificclimatechange.net/projects

Table 7: Current Capabilities

REGIONAL INITIATIVES, PROJECTS, AND MECHANISMS			
	Name	**Current Capability**	**Applicability to SIS-focused Comprehensive Climate Risk Management / Lessons**
Disaster Risk Management and Finance (DRMF)	Pacific Catastrophe Risk Assessment and Financing Initiative (PCRAFI)[119]	PCRAFI developed comprehensive risk assessments for 14 Pacific Island Countries, building an open source exposure database (available via the PacRis Geonode) and commissioning an AIR catastrophe model (with proprietary hazard modelling and vulnerability module) for tropical cyclone, earthquake, and tsunami (more information in the data and modelling section). It also led to the establishment of the Pacific Catastrophe Risk Insurance Company (PCRIC; see below). There is currently an active project under PCRAFI Phase II to develop a novel insurance product, which would be offered by PCRIC, to cover sovereign excess rainfall and drought risk.	There is an ongoing (open source) initiative to update the exposure database, which could underpin novel product development. AIR hazard and vulnerability data and modelling is not open source and not easily or freely accessible to the SIS or partners. This kind of proprietary modelling should be avoided for public risk management and financing mechanisms in the future. To be confirmed, but the current project to develop rainfall and drought insurance (awarded to CelsiusPro in partnership with Risk Frontiers) may be applicable to cover extreme rainfall and/or drought events in the SIS.
	Pacific Catastrophe Risk Insurance Company (PCRIC)	As the Pacific regional catastrophe risk pool, PCRIC offers parametric emergency response insurance for governments against tropical cyclones, earthquakes, and tsunami.	PCRIC could provide a platform to mutualise SIS risk, but it can only expand its product offering with additional resources and potential conversion to a segregated cell structure. PCRIC currently has limited internal resources to determine the needs of the SIS and develop appropriate solutions to address them without regional technical support.
	Pacific Financial Inclusion Programme (PFIP)[120]	PFIP has supported a number of insurance product innovations in the Pacific region (mainly life and health insurance), including bundled microinsurance. PFIP, in partnership with the Munich Climate Insurance Initiative (MCII), is also assessing opportunities to set up the Pacific Insurance and Climate Adaptation Programme (PICAP), which 'will aim at increasing Pacific Island's disaster risk management activities and overall resilience through improved disaster risk financing and the development of innovative market-based insurance products for the middle and lower income groups.'[121]	PICAP could execute product development to provide livelihood protection for (climate-driven) extreme weather events. While this is initially focused on Fiji, Solomon Islands, Samoa, Tonga, Papua New Guinea, and Vanuatu, it may be applicable to the SIS. However, the data underpinning the products may not be high-resolution enough for deployment in the smaller islands, with basis risk too high.

[119] http://pcrafi.spc.int/. A joint initiative of Geoscience Division, SPC, World Bank, and the Asian Development Bank with the financial support of the Government of Japan, the Global Facility for Disaster Reduction and Recovery (GFDRR) and the ACP-EU Natural Disaster Risk Reduction Programme, and technical support from AIR Worldwide, New Zealand GNS Science, Geoscience Australia, Pacific Disaster Center (PDC), OpenGeo and GFDRR Labs.
[120] http://www.pfip.org/. Funded by Australian Aid, New Zealand, European Union, UNCDP, and UNDP.
[121] http://www.pfip.org/our-work/work-streams/financial-innovation/pacific-insurance-adaptation-programme-picap/

Name	Current Capability	Applicability to SIS-focused Comprehensive Climate Risk Management / Lessons
Pacific Ocean Finance Programme (POFP)[122]	The insurance workstream of the POFP, led by Willis Towers Watson, focused on the feasibility and design of insurance instruments to support Pacific Ocean health and thereby increase the resilience of Pacific communities. Three novel insurance concepts to: · Protect coral reefs and mangroves from climate shock events, including acute threats (such as storms) and chronic threats (such as increasing ocean temperatures; and · Provide livelihood protection (covering cyclones and extreme rainfall) to support fisherfolk resilience and incentivise improved fisheries management with initial product design in Fiji, Palau, and Vanuatu were proposed.	The approach to covering climate risk to coastal ecosystems could be explored for the SIS; however, additional technical work is required. Next steps toward implementation are detailed in the final report of the Pacific Ocean Finance Programme - Insurance (POFPI) project. Next steps will also be discussed below.
PCRIC and World Bank project to develop insurance for excess rainfall and drought[123]	This project was publicly tendered and awarded, but it is ongoing, and any outcomes are to be confirmed. It was awarded to CelsiusPro, in partnership with Risk Frontiers,[124] who are tasked with providing analytics to underpin an excess rainfall and drought insurance product in the Pacific (possibly starting with Fiji, Vanuatu, and the Republic of the Marshall Islands). The project will include a feasibility study for rainfall and drought insurance, as well as the design of corresponding insurance product options for up to 14 countries in the Pacific region.	To be confirmed, although outcomes may be applicable to informing the potential for insurance for extreme rainfall events in the SIS.
Pacific Adaptation to Climate Change (PACC) Programme[125]	The PACC Programme was the first major climate change adaptation initiative in the Pacific region in 2009. It focuses on building an integrated and coordinated approach to the climate change challenge through three main components: practical demonstrations of adaptation measures, driving the mainstreaming of climate risks into national development planning and activities, and sharing knowledge in order to build adaptive capacity.[126]	Demonstration measures to reduce vulnerability in coastal areas (Cook Islands, Federated States of Micronesia, Samoa and Vanuatu), food production (Fiji, Papua New Guinea, Palau and Solomon Islands) and water management (in Marshall Islands, Nauru, Niue, Tonga, Tokelau and Tuvalu) were implemented in selected communities as 'demonstrations.' This community-based adaptation has practical lessons, in addition to the policy-mainstreaming of climate change risk management and capacity building and knowledge sharing related to planning and responding to climate related risks, which provide a strong foundation for the SIS to develop comprehensive climate change risk management strategies, complete with financing mechanisms.

[122] Implemented by the Pacific Islands Forum Fisheries Agency (FFA) and the Office of the Pacific Ocean Commissioner (OPOC) with funding from the Global Environment Facility (GEF) and the World Bank
[123] Ongoing / to be confirmed
[124] https://www.celsiuspro.com/pacific-island/
[125] The PACC Programme is a partnership between several key regional agencies and national agencies and communities in 14 Pacific island countries. It is funded by the Global Environment Facility (GEF) and the Australian Government, with the United Nations Development Programme (UNDP) as its implementing agency and the Secretariat of the Pacific Regional Environment Programme (SPREP) as implementing partner. The Project is supported by the United Nations Institute for Training and Research (UNITAR) C3D+programme.
[126] https://www.sprep.org/pacc https://www.sprep.org/attachments/Publications/CC/PACC_Programme.pdf

Name	Current Capability	Applicability to SIS-focused Comprehensive Climate Risk Management / Lessons
Global Climate Change Alliance: Pacific Small Island States (GCCA: PSIS) Project[127]	The overall objective of the GCCA: PSIS project was to support the governments of the Cook Islands, Federated States of Micronesia, Kiribati, Marshall Islands, Nauru, Niue, Palau, Tonga, and Tuvalu to develop and implement long-term strategies and approaches to adaptation planning. This project supported the focus countries to mainstream climate change into national and/or sector response strategies and articulate adaption strategies, and nine national adaptation projects were implemented (focused on environmental monitoring, water security, capacity building, coastal protection, and food security and agroforestry).	Each of the 'demonstration' adaptation projects have valuable practical lessons for the implementation of further monitoring and pre-emptive adaptation projects for remote communities and outer islands - implementation takes time. This project also highlighted the need to coordinate aid delivery and engage in practical partnerships between regional institutions, national governments and communities, as there are a large number of ongoing climate change projects and activities. The project also emphasised the importance of capacity building to ensure sustainability of good practice.
Global Climate Change Alliance Plus Scaling up Pacific Adaptation (GCCA+ SUPA) Project[128]	The GCCA+ SUPA is an ongoing project to scale up climate change adaptation measures in specific sectors in the Cook Islands, Federated States of Micronesia, Fiji, Kiribati, Marshall Islands, Nauru, Niue, Palau, Tonga, and Tuvalu, supported by knowledge management and capacity building. This project will strengthen strategic planning at the national levels by developing an impact methodology to assess past adaptation interventions, it will enhance the capacity of sub-national government stakeholders through resilience training, and it will scale up investments in adaptation measures such as coastal protection, rainwater harvesting and desalinisation, health programmes focused on nutrition (through atoll agriculture) and vector-borne diseases, and aquaculture development.	While this project has a large component that is focused on up-front investments in climate change risk reduction, the capacity building component will be a strong foundation for participating SIS.
The Pacific Climate Change Portal (PCCP)[129]	The PCCP is the one stop location for accessing climate resources, news, events and more in the Pacific Islands region. It has many e-resources, including country profiles, a virtual library, educational resources, climate tools, information on projects, etc.	While the PCCP is a fantastic online resource, human resources are also necessary to create a 'knowledge-management culture' that is extremely beneficial in the Pacific region due to the multiple ongoing projects with multiple actors

[127] A European Union funded project implemented by the Secretariat of the Pacific Community (SPC) in collaboration with the Secretariat of the Pacific Regional Environment Programme (SPREP). Additional key partners included the ADB, APAN, GIZ, NIWA (NZ), PFTAC, PIFS, UNDP, USAID (ADAPT Asia-Pacific), USP, and WHO. http://ccprojects.gsd.spc.int/wp-content/uploads/2016/05/1.-GCCA-PSIS-Factsheet.pdf

[128] A European Union funded project implemented by the Secretariat of the Pacific Community (SPC) in partnership with the Secretariat of the Pacific Regional Environment Programme (SPREP) and the University of the South Pacific (USP), in collaboration with the governments and peoples of Cook Islands, Federated States of Micronesia (FSM), Fiji, Kiribati, Marshall Islands, Nauru, Niue, Palau, Tonga and Tuvalu. http://ccprojects.gsd.spc.int/wp-content/uploads/2019/12/1.-GCCA-SUPA-factsheet-Nov19.pdf

[129] https://apt.pacificclimatechange.net/home

NATIONAL INITIATIVES, PROJECTS, AND MECHANISMS (IN THE SIS AND WIDER PACIFIC)

Name	Current Capability	Applicability to SIS-focused Comprehensive Climate Risk Management / Lessons
Fiji Livelihood Protection Programme	The International Finance Corporation (IFC), in partnership with Willis Towers Watson and DHI, are developing a parametric livelihood protection programme in Fiji, covering low income households against tropical cyclone and extreme rainfall risk. The insurance will pay out per province, and the amount will depend on the highest severity of windspeeds within that province at any point during a cyclone. The pay-out will be automatically credited to the bank account of listed and registered households or via their farmer association. This programme includes an online hazard information and claims management platform, which will alert when the insurance is triggered.	This product utilises PCRIC's AIR hazard data for tropical cyclone risk analytics and NASA GPM data for rainfall risk analytics. This demonstrates how data used to underpin one product can be used to underpin another.
National Adaptation Planning (and Joint Planning) and Implementation	As detailed in Section 4, National Adaptation Planning is underway in the SIS, which lays out key adaptation priories and pathways to implementation.	Existing National capacities to set priorities for climate adaptation will be invaluable to the implementation of SIS-focused climate change risk management and financing concepts.

TRANSFERRABLE LESSONS FROM OTHER REGIONS		
Name	**Current Capability**	**Applicability to SIS-focused Comprehensive Climate Risk Management / Lessons**
Caribbean Catastrophe Risk Insurance Facility Segregated Portfolio Company (CCRIF SPC)	CCRIF SPC offers parametric earthquake, tropical cyclone, and excess rainfall insurance to the CARICOM member and associate member states in the Caribbean and COSEFIN countries in Central America. The pool utilises both traditional and, for 2014-2017, capital markets for reinsurance capacity. As a Segregated Portfolio Company, CCRIF SPC is able to innovate and expand the coverage it is able to offer. For example, the Caribbean Oceans and Aquaculture Sustainability Facility (COAST) has now been implemented as a cell within CCRIF SPC, which developed and offers parametric insurance coverage focused on increasing the resilience of Caribbean fisheries in the face of natural disaster risk. The scheme offers both technical assistance and insurance products to participant countries to incentivise country-level planning on food security and disaster risk management in the context of adopting a sustainable Fisheries Policy.	CCRIF SPC's segregated cell structure could be similarly implemented in the Pacific to extend PCRIC's ability to engage in product innovation and expand coverage to the SIS. Like PCRIC, CCRIF SPC's remit remains squarely in disaster risk management and financing of the regular volatility of climate-driven extreme weather events (it does not cover slow-onset climate change impacts), as market-based risk transfer through insurance has not proven an efficient or effective way of financing chronic climate change risk.
Climate Risk Adaptation and Insurance in the Caribbean Programme (CRAIC)	CRAIC, led by the Munich Climate Insurance Initiative (MCII) and implemented through CCRIF, MicroEnsure and Munich Re in partnership with MCII, focuses on the design and implementation of insurance products for low-income groups in the Caribbean. The core CRAIC product currently available (in Jamaica, Grenada, and Saint Lucia) is the Livelihood Protection Policy (LPP), a weather index insurance product that offers individuals, organisations, and institutions coverage for heavy rainfall and strong wind events.	CRAIC is a great example of a separate, but coordinated, product development project, led by one organisation (MCII), which then successfully transitioned to implementation by involving existing regional institutions (CCRIF) and private market partners (MicroEnsure and Munich Re), in partnership with the product development partner (MCII), rather than establishing another, competing institution or initiative. It was successful in part because, while it was a separate initiative to CCRIF, it coordinated with the regional risk pool (CCRIF), thus becoming a complementary rather than competing initiative. This allowed CRAIC and the LPP to maintain autonomy and a separate purpose whilst being complementary to CCRIF.

Gaps in current capabilities - identifying the need

The various capabilities listed in Table 7 above are distributed across institutions and individual experts (with support from a range of funding sources), and there is currently no independent, specialised focal pointbroker (or foci) for the SIS to engage, provide input, and use as a vantage point from which to view the entire landscape of initiatives and projects. This makes it extremely difficult (and resource-intensive) for the SIS to evaluate the various options and mechanisms currently available or in development and advance an integrated and holistic strategy regarding their implementation. It also limits SIS input into the strategic direction of the projects and initiatives themselves, creating a barrier to the SIS clarifying and registering their needs and priorities, meaning that they can be overlooked in research and development and further investments. For example, this barrier is highlighted by the progress being made in the Pacific region more broadly in the area of 'livelihood protection,' which provides cover at the household-level for climate-driven extreme events. It is critical that the SIS are able to leverage progress and technical developments across the region, just as it is critical that novel and ongoing initiatives consider the unique needs of the SIS in project development. Therefore, one current gap is the need for an independent specialised focal pointbroker for the SIS to engage with to develop and implement holistic and integrated climate change risk management and financing strategies. This focal pointbroker would play a knowledge management and capacity building role, supporting strategic decision-making regarding:

i. How to engage with the various actors (including funders and implementing organisations) working in disaster and climate risk management and financing - at both the project development and implementation stages to align work with SIS needs and priorities; and

ii. Which of the existing and developing institutions, initiatives, projects, and mechanisms to pursue and ultimately deploy.

In addition to the need for an 'independent focal pointbroker' for comprehensive climate change risk management and financing for the SIS, the landscape scan of current capabilities has revealed a number of projects focused on up-front investments in adaptation and climate change risk reduction (e.g. coastal protection measures and rainwater collection and desalinisation) funded through international climate finance (e.g. the Green Climate Fund (GCF), the Global Environment Facility (GEF) - including the Least Developed Countries Fund (LDCF) and the Special Climate Change Fund (SCCF) - and the Adaptation Fund (AF)) and a number of projects and mechanisms focused on disaster risk management and financing. However, it has also revealed a gap in the existence of ex-ante financing mechanisms (i.e. mechanisms that arrange financing in advance of an event) focused on pre-positioning funding, which can be deployed in the future to address the evolving risks associated with long-term impacts of chronic climate pressures.

Identification of potential novel mechanisms, based on links to SIS priorities

Therefore, the following section identifies potential novel ex-ante 'climate change risk financing mechanisms,' which could address this SIS need for pre-positioned finance to address evolving climate change risks.

We recommend a 'needs-driven' approach, rather than an 'instrument-driven' approach to the development of novel mechanisms. Therefore, it is important to consider the needs of each country, island, and community in concept development, as there will be similarities and differences in adaptation priorities, risk profile, and preferred climate change risk management strategy. For the purposes of initial SIS climate change risk management and financing product concept design, we have identified overlaps in SIS needs to identify shared priorities for initial product development.

The identified 'exposures' offer insight into SIS needs, and are linked to SIS priorities. They can be grouped into four key categories with associated risk financing concepts:

1. **Fixed assets** (including infrastructure and property);

2. **Ecosystems** (i.e. natural assets such as reefs and mangroves);

3. **Livelihoods** (including household-level consumption needs and climate-vulnerable livelihood activities, as well as productive assets, e.g. crops); and

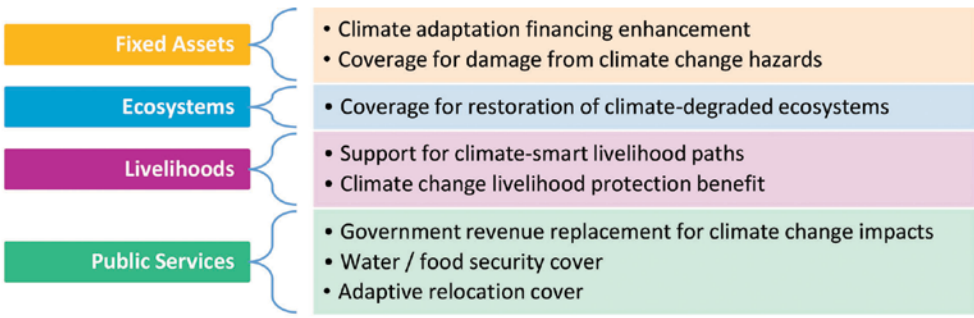
4. **Public services** (including emergency response, education and health service provision, and social programmes).

Climate Change Risk Financing Concepts

Therefore, we have identified the following climate change risk financing concepts associated with each exposure category. There are eight total concepts (as listed in Figure 6) with descriptions of each provided by category below.

It is also important to note that many of these proposed mechanisms are complementary and could be combined into hybrid financing tools that address multiple dimensions and levels of risk (e.g. livelihood protection mechanisms could be combined with public service covers to provide micro, meso, and macro cover). This is especially true for mechanisms that address the same hazards (e.g. inundation) and are therefore driven by the same underlying index. However, for clarity, each concept is presented separately and combinations are explored in the conclusions and recommendations section.

Figure 6: Proposed novel climate change risk financing concepts, by exposure category



A) Fixed Asset Climate Change Risk Management and Financing

As detailed in the 'gap assessment,' there are many existing disaster risk management and financing initiatives and products available to finance the 'normal' volatility and impacts associated with climate-driven extreme events (e.g. cyclones and floods) to fixed assets (e.g. from direct foreign aid to contingent credit facilities and traditional insurance). There are also many existing climate change risk reduction initiatives and projects (and institutions) focused on up-front investments in climate adaptation. The concepts outlined here, therefore, address the identified gap in climate change risk financing that manages specific climate change risks by pre-positioning finance and enabling long-term climate adaptation planning in two key ways:[130]

1. The climate adaptation financing enhancement concept enables the inclusion of 'build back better' provisions on top of traditional disaster risk financing mechanisms, specifically to finance climate adaptation measures; and

2. The coverage for damage from climate change hazards concept finances responses to climate change hazards, which are not covered in disaster risk frameworks.

It is worth noting that we have not developed new concepts to manage disaster risk to fixed assets from extreme climate-driven events, as traditional disaster risk financing tools are applicable and there are ongoing initiatives to enhance SIS access to ex-ante financing for fixed assets. However, the risk profile associated with these events is changing as a result of climate change, which may be a challenge in disaster risk management and financing. Please see the 'amplified extreme event enhancement' concept under 'Risk financing for climate-resilient public services' for an indication of how climate finance could be combined with disaster risk finance in a circumstance where protection for fixed assets becomes more expensive due to climate change.

1. Climate adaptation financing enhancement

Description:

This climate change risk financing mechanism would act as an add-on to an existing disaster risk financing mechanism, including an additional tranche of funding to cover 'build back better' provisions for implementation during rebuilding following an extreme event. The amount of 'add-on' could be associated with the cost of the desired adaptation measures or a climate change metric (e.g. atmospheric carbon, sea level, or ocean temperature). Additionally, (concessional) access to the underlying disaster risk financing mechanism could be provided in exchange for planned and executed adaptation measures (e.g. concessional access to traditional insurance could be granted as a result of improved building strength).

Benefits:

Damage from an extreme event offers a convenient circumstance to undertake adaptation measures, simultaneous to rebuilding, but the additional funding required for 'building back better' are often not available and/or rebuilding efforts only consider immediate requirements. Adaptation measures covered could include retrofitting, including additional resilience measures, and/or relocation. This mechanism also facilitates contingency planning, which includes long-term adaptation considerations and bridges the gap between disaster response and climate adaptation.

Limitations:

It may be difficult to enforce the use of pay-outs or guarantee they go toward climate adaptation measures. However, standards for the use of pay-outs could be baked into financing agreements and policy wording (if insurance), e.g. through the inclusion of predefined adaptation measures or rebuilding protocols and potential third-party audits to verify the adherence.

[130] Existing disaster risk management and financing initiatives often overlook the SIS. While climate change is the focus of this paper, it is worth noting that it would be beneficial to focus on the SIS in existing disaster risk programmes, such as PCRAFI as well.

2. Coverage for damage from climate change hazards

Description:

This climate change risk financing mechanism uses a climate change metric (sea level) as an underlying index to determine pay-outs, which would fund adaptation measures when sea level reaches a certain level at a certain place.

Benefits:

Simple and easy to understand with a single parameter (sea level) influencing pay-outs. This pre-positioning of reliable finance, which would be accessed at a pre-agreed sea level, would also give certainty to communities that when they experience a forced adaptation event due to sea level rise, they will receive timely and predictable funds to respond. This mechanism also facilitates contingency planning for anticipated climate change impacts, enabling the ex ante financing of long-term, strategic adaptation plans, from which financing is often diverted to cover more immediate needs and crises. Pay-outs could fund retrofitting, including additional resilience measures, and/or relocation.

Limitations:

Long-term financing agreements may need to be reaffirmed or renegotiated at regular, pre-agreed intervals based on governance processes (e.g. with changes in government). Additionally, locating funders with the appetite to provide this kind of financing may be difficult. For example, donors are likely to be hesitant to take on this kind of long-term contingent liability, and insurers are unlikely to provide cover for inevitable, slow-onset events at an affordable price. A contingent credit arrangement or 'soft' agreement with donors (i.e. where they do not officially assume liability) may be most plausible.

Ecosystem Risk Management and Financing

Ecosystem services are crucial to communities across the SIS, as healthy oceans and ecosystems provide prosperity and protection to coastal communities. But just like 'grey' and 'brown' assets (i.e. built and/or cultivated assets), 'green' and 'blue' assets - such as coral reefs and mangroves - are at risk to climate pressures and extreme events. Therefore, we have identified a core concept[131] to address the climate change risk facing ecosystems:

3. Coverage for restoration of climate-degraded ecosystems

Description:

This climate change risk financing mechanism would fund the response and restoration of ecosystems following climate change impacts (such as marine heatwaves causing coral bleaching and mortality and cyclones causing increasing damage to reefs and mangroves due to their chronically degraded condition from rising ocean temperatures and ocean acidification). Response measures could include, for example, cleaning debris, reattaching corals, replanting mangroves after a storm, or extending the boundaries of protected areas during bleaching events to relieve anthropogenic pressures.

Benefits:

Like roads and bridges, natural assets can be thought of as public infrastructure, even though they do not often feature explicitly on government asset lists or balance sheets. Revenue streams, and the associated economic well-being of coastal and small-island communities, depend on their presence and continued health. Therefore, this mechanism allows for their inclusion in risk management and response frameworks (including finance), alongside 'grey' (i.e. built) assets. Ecosystems are not typically a priority after an extreme event, yet they are increasingly distressed due to chronic climate pressures, so this mechanism would ensure

[131] This concept is based on concepts developed by Willis Towers Watson under the insurance workstream of the Pacific Ocean Finance Program, which was implemented by the Pacific Islands Forum Fisheries Agency (FFA) and the Office of the Pacific Ocean Commissioner (OPOC) with funding from the Global Environment Facility (GEF) and the World Bank.

funding post-event. This mechanism could also fund community members affected by extreme events (e.g. people employed in the tourism sector) to undertake restoration activities, smoothing shocks to their income while protecting vulnerable ecosystems.

Limitations:

The evidence base on the effectiveness of restoration activities is continuously evolving, and there may be some events for which no post-event response is adequate to restore the provision of ecosystem services.

Livelihood Protection from Climate Change Impacts

In addition to the 'normal' volatility associated with extreme events, which, as we note above, is traditionally addressed by the disaster risk management and financing community and initiatives, household livelihoods will be directly impacted by climate change. For example, sea level rise and coastal erosion encroach on communities; ocean warming and acidification affects fisheries, and changing patterns of precipitation and saltwater intrusion impact agriculture. Additionally, many households may not have traditionally 'insurable assets,' which leaves them even more vulnerable to climate change impacts and related shocks which affect their livelihood activities or basic consumption needs. Therefore, we have identified concepts to provide climate-sensitive livelihood protection.

These should be integrated with existing social protection mechanisms if possible, for example, adding a further 'climate-change responsive' layer of assistance for existing or additional climate-vulnerable beneficiaries.

4. Support for climate-smart livelihood paths

Description:

This climate change risk financing mechanism would fund direct support to households to shift to 'climate-smart' livelihoods. This may include technical assistance, capacity building and training (e.g. to move to a new crop type, or occupation entirely), the direct provision of climate resilient materials and equipment, such as agricultural inputs, and/or direct cash or in-kind assistance during a shift from climate vulnerable livelihood activities to climate-smart livelihood activities. This assistance could be planned in advance and triggered by reaching a pre-determined threshold of a climate change parameter such as sea level rise or changed patterns of precipitation and drought.

Benefits:

Direct support of households will be critical to orderly adaptation that does not further disadvantage the most vulnerable. Social assistance related specifically to the transition to climate-smart livelihoods will facilitate a climate resilient development pathway through the adaptation of the private sector and individuals, while considering future food security, as the agricultural (including fishing) sector must adapt to future climate impacts on productivity and yields.

Limitations:

This is a sensitive concept, as cultural values are deeply connected with traditional livelihood activities and lifestyles. Therefore, it must be culturally sensitive and supported by target communities. A participatory process is recommended, which would also make this concept more effective in the long-term. Additionally, it is critical that this concept benefit the most vulnerable (with a gender-responsive design). Integration with wider development plans and processes will be paramount. Care must also be taken at the design phase not to introduce moral hazard or disincentives for household-level and private sector adaptation.

5. Climate change livelihood protection benefit

Description: This climate change risk financing mechanism would fund social assistance for vulnerable households displaced by climate change hazards. It could use a climate change metric (e.g. sea level) as an underlying index to determine pay-outs, which would fund costs associated with relocation when sea level reaches a certain level at a certain place. It could also be administered through a process by which vulnerable households could apply for assistance and receive the benefit based on vulnerability criteria, rather than being based on a climate parameter. It could be a fixed benefit or needs-based. The benefit could be in the form of conditional or unconditional direct cash transfers, in-kind support such as agricultural inputs or equipment and food and/or vouchers or subsidies, and would be directly transferred to households.

Benefits: This pre-positioning of reliable finance for households, which would be accessed at a pre-agreed sea level or vulnerability criteria, would give certainty to communities that when they experience a forced adaptation event due to climate change, they will receive timely and predictable funds to respond and relocate, as well as smooth associated consumption and income shocks. It will also help them to plan toward that event. Eligibility could include incentives for household adaptation measures, which would empower communities to adapt in the short- and medium-term while providing security for the long-term. Additionally, if there is an application process, it could be designed to incentivise early action on adaptation.

Limitations: This is a highly (and politically) sensitive concept, as it deals with one of the most emotionally charged realities of climate change: climate displacement from permanent loss of land. Therefore, it must be culturally sensitive and supported by target communities.

A participatory process is recommended, and this concept should support ongoing discussions with communities and government on displacement and relocation. Care must also be taken at the design phase not to introduce moral hazard or disincentives for household-level or private sector adaptation. This concept will also be controversial with donors, and it is therefore crucial that the concept design target the management and financing of the risk to communities associated with climate displacement (e.g. costs), rather than compensation for losses.

B) Risk Financing for Climate-Resilient Public Services

As noted above, public services are affected by climate-driven natural disaster events (and, for example, there are emergency response covers available and under development through disaster risk management and financing initiatives to smooth shocks to public services from extreme events). However, they are also at risk to climate change impacts. For example, climate change is expected to impact key sources of government revenue, which currently finance public services, such as fishing licences and visa entry fees. It is also expected to impact on water security, as sea level rise-induced saltwater intrusion and changes in precipitation affect the availability of potable water, which will require increased public resources to manage. Additionally, the climate change amplification of extreme events such as cyclones and extreme rainfall events will require additional public resources as impacts intensify.[132] And as climate impacts force population displacement, governments will require resources to respond, relocate and support their citizens. Therefore, we have identified concepts to support governments to provide public services in the face of climate change, including:

6. Government revenue replacement for climate change impacts

Description This climate change risk financing mechanism would act as a kind of 'business interruption' cover for governments financially impacted by climate change. Pay-outs would be triggered at pre-set threshold(s) of a climate change metric such as sea surface temperature or sea level rise, which would be linked to disruptions to financial flows. For example, marine heatwaves that cause coral bleaching or other sea life mortality also cause disruptions to associated government revenues from visitor fees if sites are closed or degraded. It could also provide funds

[132] Another existing initiative to learn from, while not currently operational: ARC's Extreme Climate Facility (XCF) - https://www.africanriskcapacity.org/product/extreme-climate-facility-xcf/

for additional public sector costs associated with climate change impacts, such as increased health costs due to increases in vector-borne diseases.

Benefits SIS are often heavily reliant on particular sectors (e.g. fishing or tourism) for government revenue, which leaves them particularly vulnerable to shocks to those sectors. This concept allows for the smoothing of government revenues during those shocks, so that climate impacts do not disrupt investments in development and public services. Linking pay-outs to independent, objective triggers reduces moral hazard. Additionally, access to this risk financing mechanism could be made concessional in exchange for a longer-term commitment to adaptation and behavioural change, which would incentivise long-term adaptation while providing cover for medium-term risk.

Limitations This concept contains basis risk - i.e. the risk that movements in its underlying independent index (e.g. sea level or sea surface temperature) do not proxy government revenue impacts as expected. Additionally, this concept may disincentivise adaptive development if it de-risks revenue sources that are not viable without encouraging adaptation. This risk could be reduced through concept design, (e.g. by providing short- to medium-term concessional access to this risk financing concept in exchange for long-term commitments to adaptation).

7. Water and food security cover

Description:

This climate change risk financing mechanism would provide funds to access and provide emergency potable water and emergency food, when supplies are threatened by saltwater intrusion. While a mechanism that addresses the risk of drought-driven water insecurity is already under development (through PCRIC and the World Bank), this mechanism would address the impacts of chronic climate change on groundwater. Funds for emergency water, emergency food, or investments in water infrastructure or agricultural adaptation could be triggered by a certain level of sea level rise or an inundation event.

Benefits:

Food and drinking water is essential for life, and it is critical that there is a contingency plan and funding in place to access and provide food and water if its supply is impacted by climate change. This mechanism could also fund adaptive upgrades to water infrastructure or the agricultural sector at a set climate hazard threshold, if upgrades are not immediately required.

Limitations:

It may be unsustainable, in the long-term, to rely on emergency shipments to provide food and drinking water. Additionally, this concept is highly prone to basis risk, as saltwater intrusion is linked to multiple environmental drivers, including sea level rise, drought, and surge (wave inundation combined with high tide). This basis risk could be managed through the design of multi-dimensional indexes, which would add technical complexity to the concept.


Photo: Carlo Iacovino/SPREP

8. Adaptive relocation cover

Description:

This climate change risk financing mechanism would provide funding for public displacement response and relocation support for citizens and government. Pay-outs could be triggered by changes in a climate change metric (e.g. sea level) and could fund the government costs of relocation and population displacement. This could be integrated with the 'Climate change livelihood protection benefit' mechanism, with some funds financing government costs and some funds flowing straight through to households. This could fund anything from necessary communications and preparations for relocation, to relocation of government services themselves.

Benefits:

The establishment of an objective, risk-based, trigger-based mechanism that would provide funds at a certain level of sea level rise (or some other climate change parameter) to prepare for or implement pre-planned relocation could provide a much more orderly response to existential climate change threats than a reactive response.

This could give the government and communities some certainly around available resources for relocation, and it would also allow time for governments to prepare in a structured way, as well as communicate and raise awareness. This could also provide a structured, back-bone concept for loss and damage negotiations.

Limitations:

This is a highly politically charged issue from every perspective. For example, it is not clear how 'costs' of relocation would be established. It is also unclear whether political timescales would allow for a commitment to this type of financing mechanism, which may trigger under a future administration; so it would likely need to be renegotiated or reaffirmed at every governmental change.

Photo: Carlo Iacovino/SPREP

Potential Financing Instruments for Concept Implementation

The climate change risk financing concepts sketch out mechanisms for climate risk management and financing for the SIS, yet they are agnostic as to the instrument used to raise the financing to manage the risk, with a variety of ex-ante financing options to be combined, evaluated, and compared.

Risk financing instruments (retention and transfer)

1. Contingency fund (which could be capitalised by a capital instrument or built up over time);
2. Contingent credit;
3. Re/insurance; an
4. Insurance-linked securities (ILS) and derivatives.

Note that these instruments must be funded (i.e. reserves must be put aside, premiums or coupons paid), possibly through capital instruments such as grants or loans. Those capital instruments would raise additional or new capital, but budget allocation could also be used to finance any of the concepts.

It is also important to note that these risk financing instruments, which could underpin the novel climate change risk financing concepts, would be complementary to (and could also be capitalised or funded by) existing capital instruments and climate finance funds that address climate change risk through risk reduction and upfront investments in adaptation.

The suitability of each option, and the ultimate instrument design, for each novel climate change risk financing concept must be developed and evaluated in a further stage of work on comprehensive climate change risk management for the SIS (guided by the instrument-focused feasibility criteria outlined in Section 3 and in collaboration with technical partners, representatives from the SIS, and representatives from donors and development partners - as further outlined in Section 7). An indication of options for each are highlighted in Table 14.

Table 14: Climate change risk financing concepts and potential instruments

Category	Concept	Risk financing instruments		
		Contingency fund	Contingent credit	Insurance and ILS
Fixed Assets	Climate adaptation financing enhancement	☑	☑	☑
	Coverage for damage from sea level rise (or other slow-onset climate change hazard)	☑	☑	
Ecosystems	Ecosystem climate impact response financing	☑	☑	☑
Livelihood Protection	Support for climate-smart livelihood paths	☑	☑	
	Climate change livelihood protection benefit	☑	☑	☑
Public Services	Government revenue replacement for climate change impacts	☑	☑	
	Water security cover	☑	☑	☑
	Amplified extreme event enhancement	☑	☑	
	Financing for displacement response and relocation	☑	☑	☑

Overview of data availability and existing modelling

Each of the proposed climate change risk financing concepts require climate data to underpin their design and implementation.

The data sets and model coverage can be classified in various ways. In terms of data:

· Historical environmental data - long-term data sets covering key environmental variables (e.g. rainfall, sea level) are important for establishing baselines, which can be used to contextualise present and future risk;

· Socio-economic and asset / 'exposure' data - this includes information about the characteristics of the population and built environment. Such data is typically collected less frequently than environmental datasets (often owing to resource and access issues), but up-to-date information is still required;

· Real-time monitoring - high resolution, real-time monitoring is important for measuring event characteristics and validating near-real time modelling; and

· Extreme event records - often extreme event records pre-date continuous monitoring efforts, owing to associated severe impacts and anecdotal evidence.

In terms of modelling:

· Models for comprehensive risk assessment - sophisticated catastrophe models that incorporate hazard, exposure, and vulnerability to develop a multi-dimensional view of risk. Such models often include capabilities for running future socioeconomic and environmental scenarios (e.g. including climate change under different emission scenarios); and

· Near-real time hazard models - such models can be run rapidly and may inform emergency response and the dispersal of risk financing (e.g. contingency fund or insurance pay-outs).

In addition to various global datasets which necessarily cover the Pacific region (e.g. the National Oceanic and Atmospheric Administration's (NOAA) tropical cyclone track archive), there are several data hubs dedicated to collating regionally specific physical science and socio-economic information (Table 8).

Table 8 Summary of environmental and socio-economic datasets covering the Pacific Islands region

Name	Description	Source
PCRAFI Data Portal	A selection of spatial administrative, hazard, exposure, and risk datasets	http://pcrafi.spc.int/layers/?limit=100&offset=0
Pacific Data Hub	A collection of nearly 12,000 regional and global socio-economic and environmental datasets.	https://pacificdata.org/
Pacific environmental portal	Regional and national datasets for monitoring, evaluating, and analysing environmental conditions and trends to support environmental planning, forecasting, and reporting requirements at all levels.	https://pacific-data.sprep.org/
Pacific climate change portal	Provides access to climate resources, news, and events in the Pacific Islands region.	https://www.pacificclimatechange.net/
Pacific Ocean portal	Range of datasets including tourism, ocean monitoring, coral reefs, sea level, fisheries, and shipping.	http://oceanportal.spc.int/portal/ocean.html
Pacific regional data repository for Sustainable Energy for All	Provides access to up-to-date, reliable energy data and project information.	http://prdrse4all.spc.int/
Statistics for Development	Pacific island statistics covering topics including: the economy, the environment, health, industry & services, and population.	https://sdd.spc.int/

Two major research programmes have been dedicated to furthering the state of knowledge surrounding climate change in the Pacific region. These programmes were led by a collaboration between the Australian Bureau of Meteorology (BoM), the Commonwealth Scientific and Industrial Research Organisation (CSIRO), and SPREP, together with Pacific Island State meteorological and climate change government departments.

Pacific Climate Change Science Program (PCCSP), 2009-2011

This initial programme built on the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report to assess past, present, and future climate changes across the western Pacific. A two-volume report documents the programme findings at the regional- and country-scale. The programme also established a data portal (http://www.bom.gov.au/climate/pccsp/), which provides baseline physical science datasets including rainfall patterns, temperature trends, atmospheric circulation (ENSO), wind, and tropical cyclones.

Pacific-Australia Climate Change Science Adaptation Planning programme (PACCSAP), 2011-2014

In addition to updating the physical science aspects of PCCSP, PACCSAP developed science communication and capacity building activities to improve the understanding of current and future climate across the Pacific. This project was followed by the Pacific Climate Change Science and Services Outreach Project, 2016-2018 which aimed to facilitate uptake of the PACCSAP climate science knowledge products across the Pacific island states.

In addition to reviewing the above outputs, this section considers insurance industry climate and catastrophe models that have been developed for the Pacific region.

Data requirements for climate change risk management and financing

The approach towards implementing comprehensive climate risk management and financing across the SIS will depend to a large extent on the availability and coverage of environmental and socio-economic datasets. Robust information on hazards, exposure, and vulnerability across the SIS is necessary to facilitate the risk assessments upon which financial products will be based. The following tables provide an indication of the data requirements across these three categories.

Table 9 Hazard data requirements

Hazard data requirements	
Coverage	Regional and national scale datasets are required to inform risk financing products and drive catastrophe models. Where dedicated regional and national datasets are not available, it may be possible to downscale global climate models (GCMs).
Resolution	Minimum resolution will vary by hazard and SIS but can range from tens of metres (extreme rainfall) to thousands of metres (drought).
Hazard type	Tropical cyclone, sea level change, extreme rainfall, drought.

Table 10 Exposure data requirements

Exposure data requirements	
Coverage	National scale exposure datasets are required to quantify the impact of hazards. Where sub-national data is available, hotspots of exposure can be identified.
Resolution	Minimum resolution depends on the asset type but could vary from household-level, to community level, up to aggregated values across an island.
Asset type	Building type, crop type, population, critical infrastructure, livelihoods and subsistence activities, natural capital and ecosystems, business activities.

Table 11 Vulnerability data requirements

Vulnerability data requirements	
Coverage	As far as possible, the resolution of vulnerability data should match the resolution of corresponding exposure datasets. It may be possible to use proxies for vulnerability.
Resolution	Minimum resolution depends on the asset type but could vary from household-level, to commune level, up to aggregated values across an island.
Asset characteristics	Building composition and structural characteristics, crop type and susceptibility (to drought, for example), population socio-economic characteristics, infrastructure composition and structural characteristics, economic diversification, natural capital extent, quality, and adaptive capacity (to increased air and sea temperatures, for example).

The data requirements and risk finance options must be considered iteratively, and in concert to ensure that the proposed risk financing options and structures are realistic. Additionally, the selection of a particular preferred risk financing option may determine the extent and priorities for environmental hazard monitoring and socio-economic data collection across the SIS in the future.

Existing data and model review

The PCCSP data portal collates numerous climate related datasets and monitoring networks across the Pacific region. Routine monitoring focuses on rainfall and air temperature and varies considerably across the SIS. Data availability, duration, frequency, and completeness for selected Pacific island states are recorded in the PACCSAP report and summarised for the SIS (Table 12).

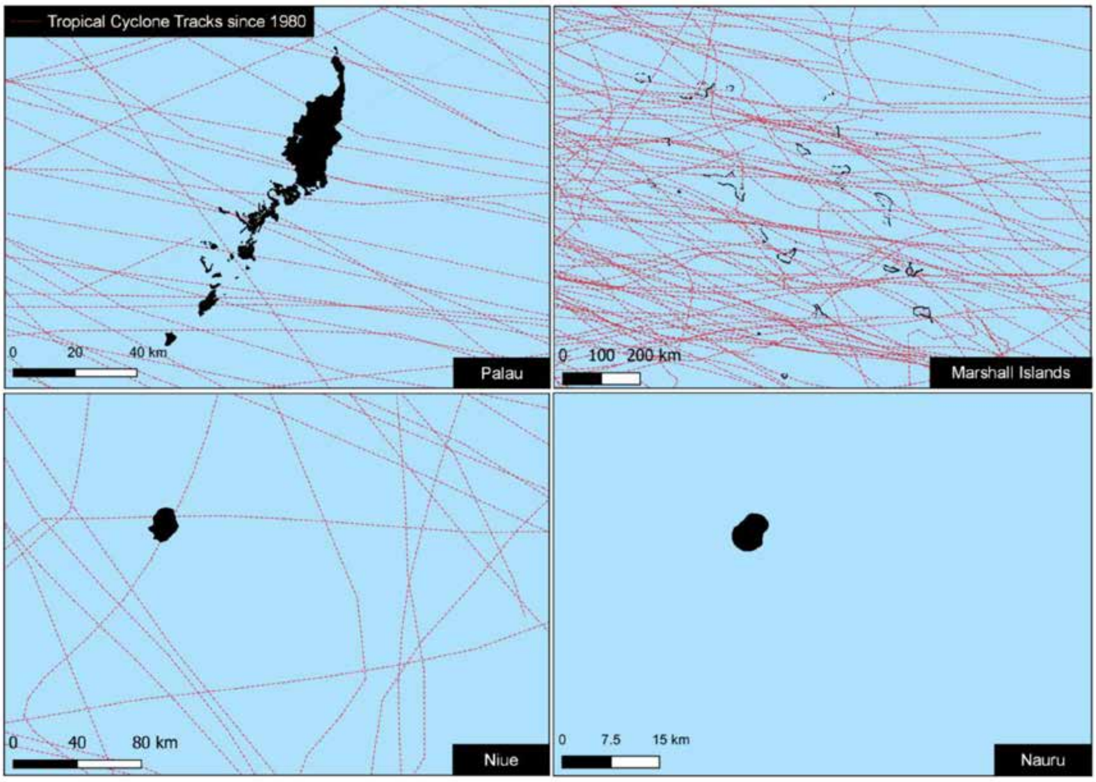
Table 12 Summary of observational rainfall and air temperature records[133]

	No. of stations	Distribution	Record length	Record frequency	Completeness
Cook Islands	7	Mangaia, Mauke, Aitutaki, Pukapuka, Penrhyn, Manihiki, and Rarotonga.	The Rarotonga station covers 1899-present (rainfall); and 1907-present (air temperature)	Daily	Reliable records are available from 1899 (rainfall) and 1934 (air temperature)
Federated States of Micronesia	23	Chuuk State, Pohnpei State, Kosrae State, and Yap State.	Collectively, stations cover 1900-present.	Multiple times per day	Reliable records are available at Pohnpei since 1949 (rainfall) and 1950 (air temperature) and at Yap since 1951 (rainfall and air temperature)
Kiribati	5	Tarawa Atoll, Kiritimati Atoll, Banaba, Tabuaeran, and Canton	Collectively, stations cover 1909-present (rainfall and air temperature)	Daily	Reliable records are available since 1947 (rainfall) and 1950 (air temperature)
Marshall Islands	9	Majuro, Utirik, Ailinglaplap, Jaluit, Wotje, Mili, Amata Kabua International Airport, Kwajalein, Laura, and Arno	Observations available at Majuro from 1951-present and Kwajalein from 1945-present.	Multiple times per day	Reliable records are available at Majuro from 1954 (rainfall) and 1955 (air temperature), and at Kwajalein from 1945 (rainfall) and 1949 (air temperature)
Nauru	2 plus 2 rainfall-only	Yaren (north-west)	Observations available from 1893-present (rainfall) and 1951-present (air temperature)	Daily	Reliable records are available from 1927 (rainfall) and unavailable for air temperature
Niue	2	Hanan Airport (west) and Liku (east)	Composite information is available from 1905-present	Multiple times per day	Reliable records are available from 1905-present (rainfall) and 1940-present (air temperature)
Palau	5	Koror, the Palau International Airport, Kayangel, Nekken, and Peleliu.	Observations are available for Koror from 1924 (rainfall) and 1953 (air temperature).	Multiple times per day	Reliable records are available at Koror from 1948.
Tuvalu	4 plus 5 rainfall-only	Nanumea, Nui, Funafuti, Niulakita, Nanumaga, Niutao, Nukufetau, Vaitupu, and Nukulaelae.	Observations are available at Funafuti from 1927 (rainfall) and 1933 (air temperature).	Multiple times per day	Reliable records are available at Funafuti from 1927 (rainfall) and 1961 (air temperature)

133 Australian Bureau of Meteorology and CSIRO, 2014. Climate Change in the Pacific: Scientific Assessment and New Research. Volume 1: Regional Overview. Volume 2: Country Reports.

Tropical cyclone tracks are available globally from the National Oceanic and Atmospheric Administration (NOAA). The International Best Track Archive for Climate Stewardship (IBTrACS) dataset documents tropical cyclone tracks from 1841 to the present along with key characteristics including maximum sustained wind speed and minimum central pressure. A dataset comprising events since 1980 is also provided since these events have been documented to a greater degree of certainty.

Figure 7 Tropical cyclone tracks since 1980 for selected SIS. Tropical cyclone tracks from the IBTrACS dataset



The BoM collates various marine and atmospheric observations from across the Pacific region through the Pacific Sea Level and Geodetic Monitoring Project. Recorded variables include sea level, barometric pressure, water temperature, and air temperature. Except for Palau, monitoring stations are located at each of the SIS: Cook Islands (Rarotonga, Avatiu), FSM (Pohnpei, Dekehtik), Kiribati (Tarawa, Betio), Marshall Islands (Majuro, Uliga), Nauru (Aiwo), Niue (Alofi, Alofi Wharf), Tuvalu (Funafuti, Fongafale). In all cases, data is available from 1993-present and collected monthly.[134]

For physical variables where observational data records are not available, modelling can be used to generate historical datasets. This is a routine approach to generate wind-wave datasets across the Pacific Islands since existing wave buoys are sparse and cover relatively short time periods. For each of the SIS, modelled surface wind datasets have been used to drive a wave model, creating a wind-wave dataset covering the period 1979-2009.[135]

The Pacific Catastrophe Risk Assessment and Financing Initiative (PCRAFI) has collated various hazard, exposure and risk assessment datasets across the Pacific region.[136] For the SIS considered here, this includes tropical cyclones (wind speeds at 1:100, 1:250, and 1:500) and earthquakes (peak ground acceleration, 1:100, 1:500, 1:2500) compiled by AIR Worldwide. In terms of exposure, map layers detailing buildings, building replacement costs and landuse landcover (water, vegetation, bare soil, artificial structures) are available for all SIS.

[134] Australian Government Bureau of Meteorology (2020) Accessible at: http://www.bom.gov.au/oceanography/projects/spslcmp/data/monthly.shtml
[135] Australian Bureau of Meteorology and CSIRO, 2014. Climate Change in the Pacific: Scientific Assessment and New Research. Volume 1: Regional Overview. Volume 2: Country Reports.
[136] Pacific Catastrophe Risk Assessment and Financing Initiative. 2020. Accessible at: http://pcrafi.spc.int/

On the Cook Islands, additional exposure datasets include bridges, roads, and population. Global population datasets are available for other islands, for example through the EU Joint Research Centre (JRC) Global Human Settlement Layer (GHSL) which collates various population proxies (e.g. night time lights) and observational records (census data). Average annual loss layers are available across the SIS, as compiled by AIR Worldwide model.

Modelling can also be used to forecast future meteorological and climatological conditions. The PACCSAP approach to climate change modelling across the Pacific region incorporates up to 26 global climate models (taken from the Coupled Model Intercomparison Project 5, which also forms the basis for the latest IPCC Assessment Report) that have been assessed to perform well in the region. In addition to capturing regional trends, this modelling provides national projections for a selection of environmental variables (annual surface air temperature, 1:20 year maximum temperature, 1:20 year minimum air temperature, total annual rainfall, total seasonal rainfall, aragonite saturation state, and mean sea level), future emissions scenarios (very low, low, medium, high), and timescales (2030, 2050, 2070, and 2090) for each SIS.[137]

In addition to modelling conducted by the IPCC, and downscaled during the PCCSP and PACCSAP, a number of industry models have been developed to cover the Pacific region. Largely owing to non-existent or poorly developed insurance markets, these models are relatively limited in terms of level of sophistication and underlying data. Convincing vendor companies to invest in models to be used specifically in the Pacific region is likely to remain a challenge owing to these underlying constraints.

Table 13 Catastrophe model coverage for the Pacific Islands region

Country/Region	Hazard	Model Name	Source/Vendor
Global	Tropical cyclone	KAC multi-model	Kinetic Analysis Corporation (KAC)
Fiji, PNG, Solomon Islands, Vanuatu, FSM, RMI, Nauru, Palau, Cook Islands, Tonga, Tuvalu	Tropical cyclone	Tropical Cyclone Model for the South Pacific	AIR Worldwide
Cook Islands, FSM, Kiribati, Marshall Islands, Nauru, Niue, Tuvalu, Palau	Earthquake	Earthquake Model for the South Pacific	AIR Worldwide

Identifying and Integrating Data Sources

Key considerations regarding the feasibility of the novel climate change risk financing mechanisms, and the evaluation of potential instruments for implementation, focus on data availability, suitability, and reliability.

It is worth noting that we do not propose any novel mechanisms for the management and financing of acute climate change hazards, as the ongoing initiatives and existing institutions related to disaster risk management and financing (especially PCRAFI and PCRIC) already address them. There are, however, significant opportunities for the SIS to engage with these initiatives and institutions, which are discussed further in Section 7.

[137] Australian Bureau of Meteorology and CSIRO, 2014. Climate Change in the Pacific: Scientific Assessment and New Research. Volume 1: Regional Overview. Volume 2: Country Reports

Each novel mechanism that is proposed responds to **a hazard index of slow-onset climate parameters, with movements in an index of a climate change metric (e.g. atmospheric carbon, sea level, ocean temperature) triggering fund**s (with some concepts including other indices as well). Therefore, core hazard data requirements, and opportunities for partnering with existing initiatives on their development and implementation, are aligned along the eight mechanisms.

Data priorities and collection requirements can be broadly understood in three categories:

- **'Design' data,** which is required to structure the mechanism and establish that the proposed hazard index will capture actual impacts and perform as a good 'proxy for costs.' This includes exposure and vulnerability data.
- **'Probabilistic' data,** which is forward-looking, is required to understand the likely frequency and severity of hazard events and assess and quantify the likelihood and timing of movements in the hazard index.
    - Note that for slow-onset climate change hazards, the risk of reaching a 'trigger' threshold may be 100% over time, with the amount of time depending on the emissions pathway the world follows. This is why contingent credit and contingency financing may be a more efficient way to pre-arrange climate change risk financing than traditional, market-based insurance or other forms of private risk transfer.
- **'Settlement' data**, which is required to trigger pay-outs. A real-time data stream of the underlying hazard index is required to 'trigger' the disbursal of funds at a pre-agreed index value for each mechanism (e.g. a sea surface temperature >31°C). This could be modelled data (e.g. modelled sea level rise) or direct observational data (e.g. sea surface temperature measured through earth observation technology) and must be agreed and 'locked in' in advance of mechanism implementation.

When it comes to slow-onset climate change hazards, the global emissions pathway that is realized is an important determinant of regional and national risk profiles. When it comes to future emissions pathways and associated projected hazard parameters, an appreciation of uncertainty, and uncertainty change over time, will also influence the feasibility of climate risk financing concepts. Every climate change risk financing concept requires the following 'probabilistic' data:

· Relationship (or 'sensitivity') of hazard parameters (e.g. sea level or sea surface temperature) to global atmospheric greenhouse gas concentration;

· Regional influences on the relationship between emissions and hazard parameters (known as climate 'downscaling') which can be used to modify globally-derived relationships; and

· Assessment of future hazard levels over time, under different emission pathways and associated climate conditions (e.g. inundation scenarios).

There are opportunities to engage with the institutions and experts involved in the two major research projects in the region, which have focused on understanding climate change in the Pacific. These are the Pacific Climate Change Science Program (PCCSP) and the Pacific-Australia Climate Change Science Adaptation Planning programme (PACCSAP), which were led by SPREP, BoM and CSIRO, together with Pacific Island state meteorological and climate change government departments.

The following 'settlement' data is required:

· Real-time monitoring of climate change hazard parameters.

And there are opportunities to partner with Pacific Island state meteorological and climate change government departments and regional monitoring initiatives, as well as international earth observation initiatives to integrate existing settlement data sources.

Finally, the following 'design' data is required by concept (this is an indication for further development based on concept development and refinement):

1. Climate adaptation financing enhancement - cost information regarding planned 'build back better' provisions; geolocation data regarding covered assets.

2. Coverage for damage from climate change hazards - cost information regarding planned adaptation measures; geolocation data regarding covered assets.

3. Coverage for restoration of climate-degraded ecosystems - cost information regarding response and restoration activities; geolocation data regarding covered ecosystems.

4. Support for climate-smart livelihood paths - cost information regarding proposed livelihood support activities; socio-economic and geolocation data regarding beneficiaries.

5. Climate change livelihood protection benefit - cost information regarding social assistance measures; socio-economic and geolocation data regarding beneficiaries.

6. Government revenue replacement for climate change impacts - financial information regarding government revenue (including sources and amounts).

7. Water security cover - information on current water sources and cost information related to emergency water supplies.

8. Adaptive relocation cover - cost information regarding relocation.

There are opportunities to partner with existing projects (e.g. through PCRAFI) to develop an exposure database, which would constitute a part of the design data required. National Adaptation Planning processes also offer opportunities for collaboration.

7. Conclusions, Next Steps, and Recommendations

a) Identifying the 'quick wins' where donors and SIS are aligned and there is a shared desired state across the region

We have identified two 'quick wins,' where donors and the SIS are aligned and there is a shared desired state across the region:

· The establishment of a specialised broker function to ensure the needs of the SIS are well represented and considered across existing initiatives and for championing the development of solutions for gaps; and

· The technical development of mechanisms to manage slow-onset climate change risk and impacts.

It is critical that the specialised broker is not intended to become a siloed and autonomous unit but to be a 'weaver' of existing workstreams, knowledge and activity identifying the strands, raw materials, and tools in existing institutions and initiatives, promoting discussion and transparency on their opportunities for SIS, and integrating them into finished products suited to the SIS needs and priorities. This weaver needs to have enough technical expertise to evaluate, leverage, and synthesise research and technical outputs to inform practical solutions and underpin robust decision-making. The weaver also needs a deep connection to the SIS to represent and advocate their needs and priorities and inform integrated, demand-driven strategies. Further, while building strong relationships with existing institutions (e.g. though MoUs, etc.) at the strategic and technical levels, the weaver should be independent of ongoing initiatives, projects and technical work so as to engage across existing institutions and act as an independent advisor to the SIS.

The broker must therefore be an accomplished weaver, with knowledge of the materials, techniques, and end-use of climate change risk management mechanisms, instruments, and strategies. It will perform three critical functions at the **development, implementation, and operational (including governance) levels** of comprehensive climate change risk management and financing:

1. Development: Streamline SIS engagement with existing institutions and ongoing initiatives in climate change risk management - from disaster risk financing to climate adaptation - providing both the SIS and the existing institutions with:

a. A strategic, coordinated overview of the landscape of existing work (including technical assistance to the SIS to develop comprehensive and integrated climate change risk management and financing strategies under a unified framework);

b. A platform for collaboration to advocate and integrate SIS needs and priorities at the project development stage;

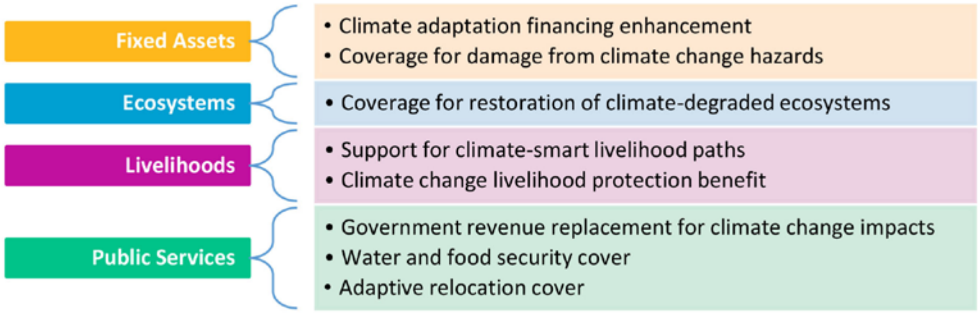
c. A regional clearinghouse to evaluate the suitability and applicability of available solutions to the SIS; and

d. Technical assistance in the review and enhancement of adaptation plans with concrete roadmaps, investment plans, and financing strategies;

2. Implementation: Leverage outputs from past and ongoing initiatives to implement comprehensive climate change risk management and financing strategies under a unified framework. This will include the review and integration, or weaving together, of solutions from existing institutions and the collaboration with the SIS to inform decision-making, and may include technical assistance to bridge the gap between scientific and technical research to practical solutions, mechanisms, instruments; and

3. Operational (including governance): Build a culture of knowledge management and data maintenance and invest in SIS capabilities and systems (technical, procedural and cultural) to leverage, manage, integrate, and update existing climate, environmental, socio-economic, and financial data and information from across projects, initiatives, and institutions. This should be fully integrated into the 'day jobs' of SIS officials and agencies, supporting existing priorities and ongoing work rather than acting as a distraction from core responsibilities or separate planning exercise.

Separate from the 'weaver' broker, the technical workstream related to the management of slow-onset climate change risk and impacts would concentrate on the technical and policy requirements to develop and implement novel climate change risk management and financing mechanisms, for example, those identified and outlined to manage key SIS exposures:



These novel mechanisms could then be woven into the comprehensive climate change risk management strategies of the SIS.

b) Recommended framework

i. What will be covered and links to complementary initiatives

In terms of a framework to guide the development of comprehensive climate change risk management strategies, we recommend that strategies weave together the existing capabilities within the region to address:

· Acute climate change risks at the sovereign and community levels -

· Complementary initiatives: PCRAFI, PICAP.

· Active regional institutions: PCRIC, PFIP, PIFS, USP.

· Slow-onset climate change risks at the sovereign and community levels –

· Complementary initiatives: PCCSP, PACCSAP for data, nothing for ex ante financing mechanisms. Maybe some work out of LSE Grantham Institute.

·Active regional institutions: SPREP, SPC, PIFS, USP.

·National adaptation planning and GCF readiness.

Through the following strategies:

- Adaptive risk reduction - investments in up-front adaptation;

- Adaptive response - immediate response activities, with financing pre-arranged at the sovereign level for emergency response to infrastructure and ecosystems and at the community level for immediate food and water security;

- Adaptive recovery - the deployment of social protection mechanisms such as livelihood protection, the pre-arrangement of financing for costs of temporary relocation and/or ecosystem restoration; and

- Adaptive reconstruction - pre-financing building back better and/or costs of relocation and longer-term displacement;

At the macro, meso, and macro levels.

ii. Broad financing options

We have identified the following broad financing options for comprehensive climate change risk management and financing:

Risk reduction (adaptive risk reduction):

- Capital instruments and investments - likely grant or concessional loan.

Risk management (adaptive response, recovery and reconstruction):

Acute events:

- Indemnity insurance
- Parametric insurance
- Contingent credit
- Contingent funds and reserves

Slow-onset events:

- Parametric contingency fund and trigger-based reserves
- Parametric contingent credit
- 'Life' insurance

c) Steps required to implement the initiative

i. Resources to support development

The specialised broker for comprehensive climate change risk management for the SIS will require resources at the establishment and operational phases. During establishment, close collaboration between the existing CROP Agencies with a mandate related to climate change risk management (e.g. SPREP, SPC, PIFS, and USP) will be essential, in addition to input from and collaboration with and between the SIS themselves. Before launch, resources from existing institutions should be dedicated to the evaluation and agreement of next steps toward the establishment of a specialised and independent broker. The launch of the broker will then include the delineation and set-up of dedicated resources (with role clarity between existing institutions) to the broker. During operation, while there are some existing resources (e.g. the SIS desk officers at PIFS), which could be leveraged to support the integration of the broker into existing processes and policies such as the Framework for Resilient Development in the Pacific, additional long- and short-term experts, with a clear mandate and technical expertise in climate change risk management (e.g. with backgrounds related to disaster risk management and financing, insurance, climate adaptation, etc.) and knowledge management (especially related to capacity building, systems deployment and data maintenance training), will be required.

Note that the Regional Pacific Nationally Determined Contributions Hub in the Pacific Island region (the NDC Hub)[138] offers a potential template for a similar 'Hub' (i.e. 'specialised broker') for comprehensive climate change risk management. The establishment process for a specialised SIS broker should investigate and evaluate the benefits and limitations of launching as a sister 'Adaptation Hub' to the 'NDC Hub,' established under similar processes and integrating lessons learned.

The development of novel climate change risk management and financing mechanisms for slow-onset climate change risks will require technical resources on a dedicated workstream, likely housed at one of the existing CROP Agencies (e.g. SPREP, SPC, USP), or possibly a working group between them. This workstream should also coordinate closely with the proposed broker.

ii. Updated roadmap

Therefore, the following next steps are required toward the establishment of a specialised broker for comprehensive climate change risk management for the SIS:

- A facilitated session with existing CROP Agencies with a mandate in climate change risk management and the SIS, with a major outcome being a roadmap for the launch and operationalisation of the broker. This will establish role clarity and alignment between existing institutions and with the SIS during the establishment phase to produce and agree:
    - An endorsed concept note (with governance arrangements);
    - A business plan (including a budget and operationalisation, and resourcing strategy);
    - An engagement strategy (including input from the SIS); and
    - A financing strategy and plan.
- A facilitated 'project coordination technical' session with representation and input from:
    - Existing institutions and ongoing initiatives in disaster risk financing, e.g. the Pacific Catastrophe Risk Insurance Company (PCRIC), the Pacific Catastrophe Risk Assessment and Financing Initiative (PCRAFI), and the Pacific Insurance and Climate Adaptation Programme (PICAP);

[138] https://www.pacificclimatechange.net/project/regional-pacific-ndc-hub

- Experts in climate modelling, such as those involved in the Pacific Climate Change Science Program (PCCSP) and the Pacific-Australia Climate Change Science Adaptation Planning programme (PACCSAP); and

- The SIS and broker representatives.

The following next steps are required toward the project development for novel climate change risk management and financing mechanisms for slow-onset climate change risks:

· The establishment of a technical workstream with resources from experts in climate finance, climate modelling and risk assessment, and risk financing.

Another key consideration related to the development of financing mechanisms for slow-onset climate change risk management will be when and how to engage climate finance institutions such as the Green Climate Fund, the Adaption Fund, and the Global Environment Facility. This should be evaluated through the specialised broker but will require input from the technical workstream.


Photo: Carlo Iacovino/SPREP

Appendix A. Policy context: pathway to PICCIF

This appendix provides an overview of the international climate, development, and disaster risk policy landscape to contextualise discussions surrounding a Pacific Island Climate Change Facility for the Smaller Island States (SIS). The policy context is summarised in Figure 5.

International climate negotiations - an 'outsized policy influence'[139]

Globally, the climate risk management challenge faced by the SIS is well-recognised. Consequently, the SIS, and small island developing states (SIDS) more generally, occupy an iconic position in discussions surrounding climate change and associated mitigation and adaptation strategies.[140] It has been argued that the SIDS have developed a coherent island vulnerability narrative through participation at various international summits since the 1980s. This narrative comprises three tenets: climate change is a global phenomenon requiring international action; the SIDS are among the smallest contributors but likely to suffer considerable damages and, given their limited resources, the SIDS cannot combat the impacts of climate change alone, requiring international collaboration.

The SIDS narrative was consolidated through the formation of the Alliance of Small Island States (AOSIS) in 1991. Adopting an overall mission to increase member state influence on climate negotiations,6 AOSIS has since provided SIDS with a united voice on the international stage. A crucial driver of progress towards the desired resilient state across the SIS is the combination of hazard, exposure, and vulnerability which generates high risks to climate related impacts.[141] One of the earliest achievements of AOSIS, and highly relevant to this paper, was the collaboration with the Munich Climate Insurance Initiative, to develop proposals for using insurance as a mechanism to address climate impacts.[142]

This powerful 'moral leadership' has tangible outcomes.[143] For example, at the Copenhagen Summit in 2009, AOSIS built momentum around a proposed 1.5oC warming target (supported by over half of UN member states at Copenhagen and endorsed ten years later at the Paris Summit), funds for adaptation (for which the SIDS states have preferential access), and a legally binding commitment on climate action (yet to be achieved, though parts of the Paris Agreement are legally binding, such as the preparation of Nationally Determined Contribution documents).[144]

In addition to providing a united platform for SIS at international climate negotiations, AOSIS acts as a regional centre for climate change, sustainable development, and ocean conservation expertise. For example, the AOSIS Climate Change Fellowship Program provides individuals with training and experience through participation in UN and UNFCCC sessions in New York, the Warsaw International Mechanism, established at the 2013 UNFCCC conference is viewed as an important milestone in the policy discussions initiated by AOSIS and its member states.[145] The Mechanism recognises that regardless of mitigative actions, damages and losses will occur (and indeed are already happening) as a result of climate related impacts.

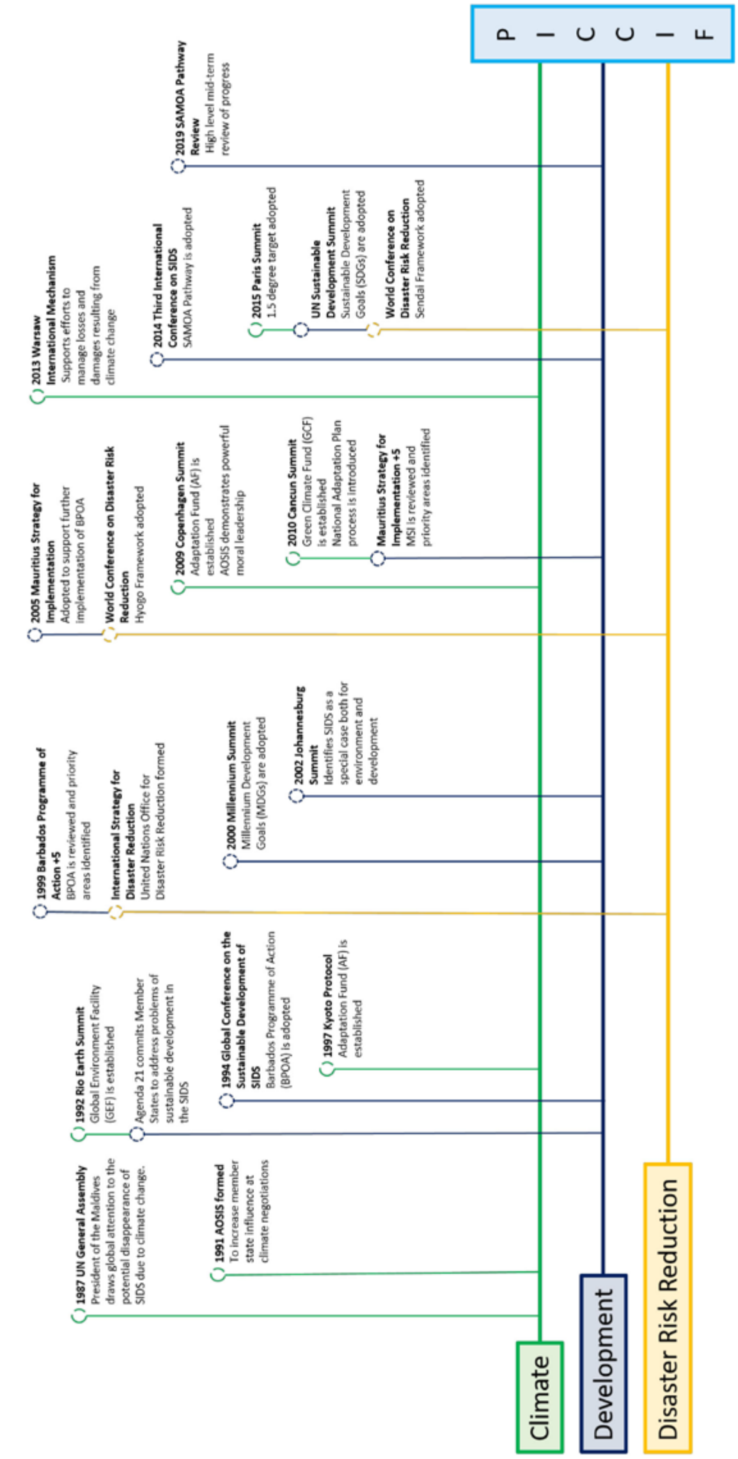
The Mechanism supports efforts to manage losses and damages by:[146]

- Enhancing knowledge and understanding of comprehensive risk management approaches to address loss and damage associated with the adverse effects of climate change, including slow onset impacts;
- Strengthening dialogue, coordination, coherence and synergies among relevant stakeholders; and
- Enhancing action and support, including finance, technology and capacity-building, to address loss and damage associated with the adverse effects of climate change.

[139] The Economist. 2019. Nothing so concentrates the mind: Island states have had an outsized influence on climate policy. Accessible at: https://www.economist.com/international/2019/09/19/island-states-have-had-an-outsized-influence-on-climate-policy
[140] Klöck, C. and Nunn, P.D. (2019) Adaptation to Climate Change in Small Island Developing States: A Systematic Literature Review of Academic Research. Journal of Environment & Development, 28(2), 196-218.
[141] Rasheed, A.A. (2019) Role of Small Islands in UN Climate Negotiations: A Constructivist Viewpoint. International Studies, 56(4), 215-235.
[142] Linnerooth-Bayer J., Surminski, S, Bouwer L.M., Noy, I., and Mechler, R. (2019) Insurance as a Response to Loss and Damage? In Mechler, R., Bouwer, L. M., Schinko, T., Surminskil, S., and Linnerooth-Bayer, J. (Eds.) (2019) Loss and Damage from Climate Change: Concepts, Methods and Policy Options, Climate Risk Management, Policy and Governance. 563 pp.
[143] Águeda Corneloup, I. and Mol A.P.J. (2014) Small island developing states and international climate change negotiations: the power of moral "leadership". Int Environ Agreements, 14:281–297.
[144] Wong, P.P. (2010) Small island developing states. WIREs Climate Change. 2(1), 1-6. 145 United Nations University. (2013). Significance of the Warsaw International Mechanism. Accessible at: https://ehs.unu.edu/news/news/significance-of-the-warsaw-international-mechanism.html.
[145] United Nations University. (2013). Significance of the Warsaw International Mechanism. Accessible at: https://ehs.unu.edu/news/news/significance-of-the-warsaw-international-mechanism.html.
[146] UNFCCC. 2020. Warsaw International Mechanism for Loss and Damage associated with Climate Change Impacts. Accessible at: https://unfccc.int/topics/adaptation-and-resilience/workstreams/loss-and-damage-ld/warsaw-international-mechanism-for-loss-and-damage-associated-with-climate-change-impacts-wim#eq-1

The SIS and broader group of SIDS have used the global platform provided by these negotiations to amplify their concerns and proposed solutions, thereby exerting a considerable influence over international climate policy. One manifestation of this influence is a shift in the UNFCCC agenda from environmental issues to fundamental concerns surrounding security and prosperity.[147] A further valuable contribution is the strong focus of organisations such as AOSIS on climate change mitigation and the responsibility of major emitters to take effective actions.[148] This prior success at raising the profile of SIS indicates how international summits may drive these states towards a desired climate-resilient state.

Figure 8 Pathway to PICCIF. The timeline displays key international conferences and summits in the climate, development, and disaster risk reduction space



[147] Jaschik, K. (2014) Small states and international politics: climate change, the Maldives and Tuvalu. International Politics, 51(2), 272–293.
[148] Eckerslet, R. (2012) Moving Forward in the Climate Negotiations: Multilateralism or Minilateralism. Global Environmental Politics, 12(2), 24-48

Sustainable development and disaster risk reduction

The SIDS have played a less prominent role in international discussions surrounding disaster risk reduction and management. Such discussions are nonetheless an important driver towards more effective climate risk management. The Sendai Framework for Action provides four overarching priorities to focus disaster risk reduction efforts until 2030. These are: developing an understanding of disaster risk (to facilitate risk assessment, prevention, mitigation, preparedness, and response), strengthening disaster risk governance (at national, regional, and global levels), investing in disaster risk reduction (from private and public sector), and facilitating building back better.[149]

Additionally, AOSIS was key in the implementation of the SIDS Accelerated Modalities of Action (SAMOA) Pathway, adopted by UN Member States following the Third International Conference on Small Island Developing States in Samoa in 2014. The SAMOA Pathway is an explicit recognition that SIDS require international support to achieve sustainable development. The SAMOA Pathway has a broad remit and includes several issues directly relevant to climate risk management including sustainable energy; disaster risk reduction (DRR); means of implementation, including partnerships, financing, trade, capacity-building, technology, data and statistics, and institutional support for SIDS.

The Sendai Framework for Action and the UNFCCC are united at a regional level through the Framework for Resilient Development in the Pacific (FRDP), which outlines the disaster risk management and climate adaptation agenda for the Pacific from 2017-2030. This has encouraged individual states to prepare 'joint implementation plans' which combine disaster risk management and climate change adaptation strategies.

Alongside global climate and disaster risk reduction agreements, the Sustainable Development Goals (SDGs) provide a further international driver towards the achievement of a more climate resilient state. Recognition of the unique and urgent needs of the SIDS from a development perspective first emerged through the implementation of Agenda 21 following the 1992 Rio Earth Summit. Agenda 21 committed Member States to address the problems of sustainable development of SIDS. This commitment was renewed with the inception of the Sustainable Development Goals in 2015, with Targets 13.b, 14.a, and 14.b mentioning SIDS explicitly. Target 13.b includes a climate impact focus:

'Promote mechanisms for raising capacity for effective climate change-related planning and management in least developed countries and small island developing States, including focusing on women, youth and local and marginalised communities'.

Target 14.a also incorporates climate related elements focussing on improving ocean health and marine biodiversity through increased scientific knowledge, research capacity, and marine technology transfer. Along similar lines, Target 14.b emphases sustainable use of marine resources through sustainable management of fisheries, aquaculture, and tourism. The strong linkages between international climate agreements and sustainable development targets emphasises the intractable nature of these two issues and the need to address them jointly.

Building on international climate change commitments and associated legislation, several international funds are available to support climate risk management across the SIS. Three major funding bodies are the Global Environment Facility (GEF), the Adaptation Fund (AF), and the Green Climate Fund (GCF).

Through providing resources for the implementation of climate adaptation projects, these funds represent an important driver towards achieving desired states across the SIS.

The GEF was established at the Rio Earth Summit in 1992 and has since contributed to over 4,700 projects globally.150 As of 2018, the GEF had contributed USD$ 0.578 billion to projects across the SIDS, in addition to numerous regional and global programmes which SIDS have participated in, totalling an additional USD $0.81 billion. The AF was established under the Kyoto Protocol and has contributed to over 100 adaptation projects.151 The AF has allocated USD $0.11 billion to projects across 14 SIDS with approximately half of this funding contributing to projects across the Asia-

[149] United Nations. 2005. Sendai Framework for Disaster Risk Reduction, 2015-2030. 32pp

Pacific region.152 The GCF was established by the UNFCCC in 2010 and is financed by donations from countries, regions, and one city.153 The GCF identifies the SIDS as a focus recipient region given the high vulnerability to climate related impacts. As of March 2020, the GCF had approved 26 projects across the SIDS, amounting to USD $0.877 billion, equivalent to 17% of total GCF funding.154 Funds are distributed through local accredited entities and place strong emphasis on local ownership of projects.

Appendix B. Primer: Risk Financing Instruments

This appendix presents various risk financing instruments and their core considerations around their development and implementation.

Traditional Insurance	
What is it?	Loss protection operating on an indemnity basis
Purpose	Insure risks located in the SIS with claims being paid according to the actual amount of loss or damage (subject to insurance terms)
Key Benefits	**Core Considerations**
Protection provided by professional insurers	Costs and coverage can vary
Risks can be spread amongst a number of insurers	Not available for all types of losses[2]
Helps to maintain living standards following a loss	Open to movements in the international market
Payment of premiums encourages saving[1]	Number of insurers for the Pacific is limited[3]
Reduced dependency on the state	Need to educate people on need for insurance
Promotes understanding of risk	May not be affordable for all potential insureds

[1] original insureds are investing in protection by paying a premium

[2] may not be available for certain categories of climate-change related risks, such as slow-onset risks (e.g. sea level rise)

[3] relatively few insurers have an appetite for risks from the Pacific region due to issues of scale

Microinsurance	
What is it?	Protection of low-income people with affordable insurance
Purpose	Insuring the livelihoods of low-income people in the SIS with easy to understand insurance policies
Key Benefits	**Core Considerations**
Policies are affordable with low premiums	High sales volumes needed
Insurance coverage is basic and understandable	Must be cheap to sell
Provides wider distribution of insurance	Must be cheap to service
Encourages understanding of risk	Comprehensive data on insureds is unlikely
Flexible premium plans are possible	Need to educate people on need for insurance
Can partner with microinsurance specialists	
Possible to establish a mutual model[1]	

[1] the policyholders own the insurer and profits are distributed to policyholders or used to reduce premiums

Parametric Trigger

What is it?	Insurance where losses are paid according to whether pre-defined conditions – measured by an index – are met
Purpose	Insure risks located in the SIS where traditional (indemnity) insurance is not available or difficult to obtain

Key Benefits	Core Considerations
Loss payments can be made quickly	Basis risk if actual loss doesn't match index[3]
No need to establish actual loss amounts	Data and analysis needed to support the index
Fills gaps not covered by traditional insurance	A 3rd party body is needed to measure the index[4]
Reduced administration costs[1]	Insureds may be expecting indemnity payouts
Lower premiums may be possible[1]	
Index can be based on many factors[2]	
This method is already used for climate risks	

1 there are no administration costs associated with risk inspections and loss adjustment

2 examples may be strength of a storm; sea temperature; soil salination level; sea level; rainfall level

3 insureds may suffer a loss but not receive payments because the index conditions are not met

4 the 3rd party will determine whether the index conditions have been met and, therefore, whether a payout is payable

Catastrophe Bond (Cat Bond)

What is it?	An instrument used by insurers to transfer risk to investors – a Cat Bond gives investors a high rate of return over a period of around 3-5 years
Purpose	The SIS could raise large sums of money following a large natural disaster

Key Benefits	Core Considerations
Access large funds from investors	Price can be higher than traditional (re)insurance[1]
Capacity & pricing is fixed for more than one year	High detail of data required for modelling
Can be indemnity or parametric trigger based	Cat Bond market is relatively small[2]
Attractive to investors as returns can be high	Arrangements can be complex
Security of investors is often very high	Terms often stricter than traditional (re)insurance[3]

1 not only is price generally higher than reinsurance but significant legal and other costs are incurred making catastrophe bonds uneconomic for smaller insurance amounts (e.g. less than $20m)

2 the market has been growing but recent losses have reduced investor demand

3 for example, there is typically no reinstatement available, so if cover is exhausted in year 1 of a 3 year bond, a new bond must be issued to continue cover, with time delays and potential price increases if confidence in modelling is reduced

Reinsurance	
What is it?	A method for providing insurance protection for the risks carried by insurers
Purpose	Provides financial strength and stability to insurers and could provide capital support for an insurance fund protecting the SIS
Key Benefits	**Core Considerations**
Reduces risk for insurers	Cost and availability depends on the global market
Increases capacity for insurers	Limited appetite for traditional insurance[1]
Provides protection for a wide-range of risks	Limited availability for slow-onset climate risks[2]
Provides effective catastrophe protection	Many reinsurers seek high profit margins[3]
Stabilises the loss experience of insurers	
Reinsurers and brokers provide technical support	
There is a large global pool of reinsurance capacity	

1 few reinsurers with an appetite for traditional indemnity insurance risk in the Pacific although there is a large appetite for parametric risks

2 may not be available for certain categories of climate-change related risks, such as slow-onset risks (e.g. sea level rise)

3 reinsurance brokers can be engaged to drive price competition between reinsurers and provide modelling and advisory services to increase negotiating leverage

Pure Captive Insurance	
What is it?	Establish an insurance company which is wholly owned and controlled by the SIS
Purpose	Insure risks located in the SIS, allowing the SIS to take full control over insurance pricing, terms and conditions
Key Benefits	**Core Considerations**
Can provide traditional or parametric insurance	Requires capital injection to set up the captive
Less reliance on the commercial market	Reserves need to be established and maintained
Control of insurance pricing & terms	Administration and operational costs can be high[2]
Coverage tailored for unique needs	An approved captive manager may be required[3]
Greater control of data and processes	Exposed to unexpected or worsening claims
Potential tax advantages[1]	Reinsurance support is likely to be required
Retention of premiums which can be invested	
Reinsurance for the captive can be obtained	

1 depending on the domicile of the captive, it might qualify for tax benefits

2 similar to running an insurance company, including auditing, claims, risk management, accounting and legal

3 depending on the applicable jurisdiction, might be required to obtain licences and registration

Contingent Funding	
What is it?	Funding is made available that may be called upon if a disaster event occurs
Purpose	The SIS would have guaranteed access to funds to use in response to losses arising from climate-change events
Key Benefits	**Core Considerations**
Contingent loan drawn down following a disaster	Loan adds to country debt, may impact credit rating
Loan only triggered if event occurs	Once drawn down the facility has gone[2]
Often flexibility when government can call facility[1]	Not a replacement for insurance[3]
Useful where there is a funding gap	
Loans are normally at concessional terms	

1 no basis risk

2 a new facility needs to be agreed, leaving a window with no guaranteed post event funding (although insurance of the facility may be possible)

2 could be a valuable part of a funding strategy - a contingent facility could fill gaps where other products cannot provide a solution

Concessional Funding	
What is it?	A loan ("soft loan") which has more generous terms than a market loan
Purpose	The SIS could develop a disaster fund using cheap capital that may not be available from the market
Key Benefits	**Core Considerations**
Funds obtained in advance could be invested	Reliance on loans may lead to debt issues
Interest rates are lower	Strict conditions can apply to the loan[1]
Repayment period is longer	There might be restrictions regarding investment
Use of a loan may promote finance discipline	Available loans may require high returns[2]
Could be used with other products	Need to differentiate from other schemes[3]
Useful where there is a funding gap	
The fund could be (re)insured	

1 the issuer of the loan may require the funds to be used for very specific purposes

2 for example, a return measured in terms of impact on growth and development

3 as there will be schemes competing for funding, the SIS will need to show how their proposal is different

NOTE: For each of the potential products and structures outlined, we have only summarised the key benefits and core considerations. More detailed work is needed to fully explore the benefits, feasibility and suitability of these products and structures for the PICCIF.

Furthermore, each of these products and structures will have gaps in terms of what they are able to achieve. Therefore, it is possible that a combination might be used to achieve the required overall solution.