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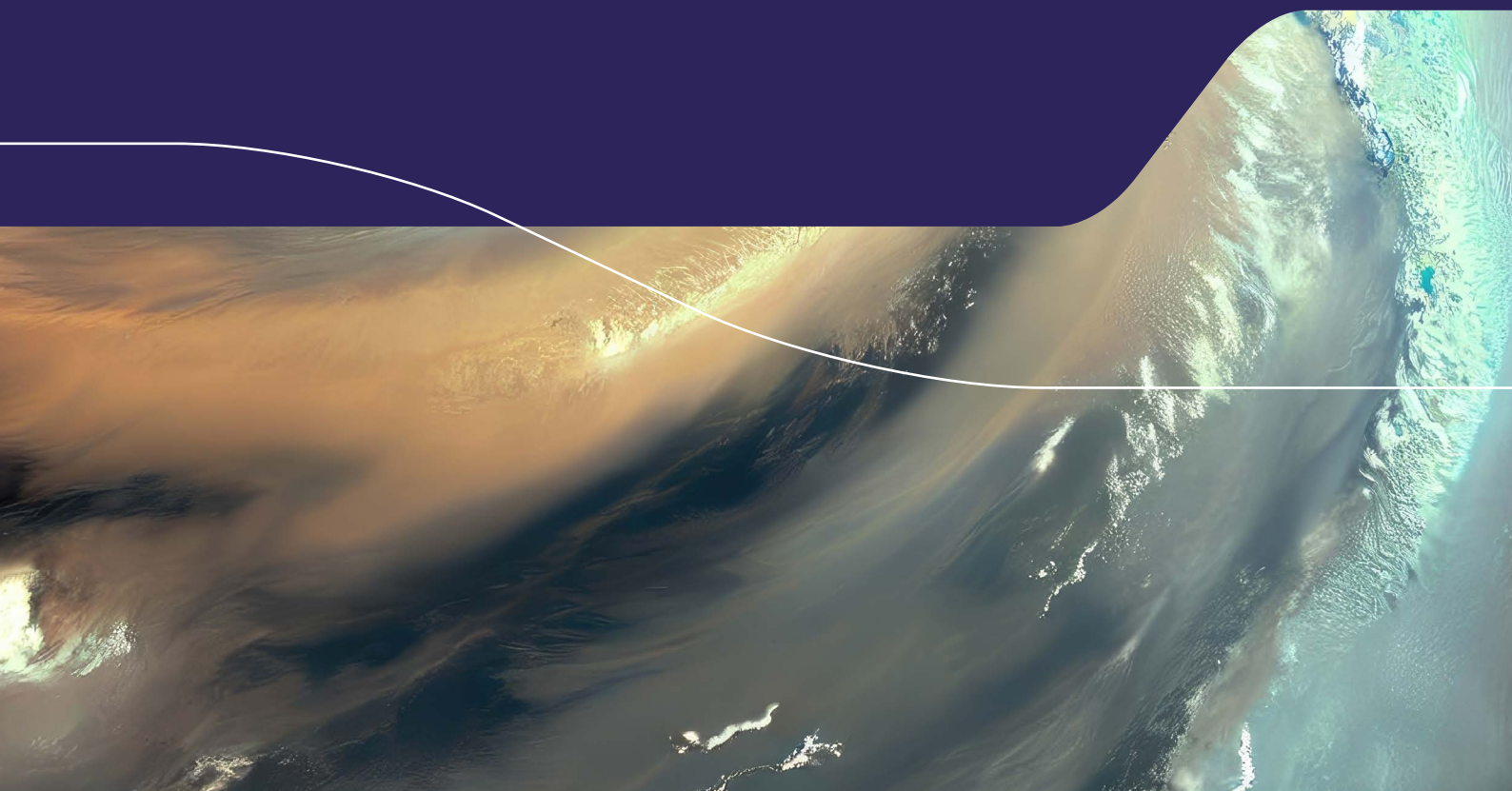
INSTITUTE FOR SUSTAINABILITY LEADERSHIP

ACHIEVING ZERO

Risk Sharing for Loss and Damage

Scaling up protection for the Global South



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Executive Summary

This briefing offers a breakthrough in the design of the global financial architecture for Loss and Damage. It demonstrates how the economic efficiency of risk-sharing systems can convert modest annual financial flows from donors into major contractual entitlements from the risk capital markets for vulnerable countries when disasters strike, now and through to 2050.

After 30 years of negotiations, governments agreed at COP27 to support financially the most climate-vulnerable developing countries, in the process known as Loss and Damage (L&D). It was also recognised that L&D will require multiple, complementary approaches, a "mosaic of solutions".[1] As part of this mosaic, in August 2023, Small Island Developing States (SIDS) and Least Developed Countries (LDCs) identified risk-sharing systems in the recommendations proposed to operationalise L&D.[2]

These developments highlight an urgent need to define how risk-sharing systems can be implemented for L&D, including the climate risk analysis necessary to inform funding requirements and access financial markets. This briefing addresses this gap by analysing a diverse sample of countries that illustrate approaches relevant to all LDCs, SIDS and the Vulnerable Twenty (V20). We provide **three new contributions** to the design of the global financial architecture for L&D:

- **Quantifying current and future climate risks, across national economies to 2050,** with the methods and metrics used by risk capital markets, so that climate financial risks from the Global South can be shared internationally.
- **Quantifying the estimated costs of securing national economies and designing a strategic vision for protecting vulnerable countries from the impacts of climate shocks on their gross domestic product (GDP).** We introduce into L&D the well-established financial concept of umbrella stop-loss, meaning that losses above a defined level are protected by pre-arranged financing.
- **Illustrating a first step for implementation of L&D risk-sharing systems.** We evaluate how an initial allocation of USD 10 million donor funds per country could generate immediate protection, at scale, through the risk capital markets.

Key messages

- Risk-sharing systems, supported by donors, that transfer the financial burdens of climate risks from the Global South to the international risk capital markets should be a central pillar of the L&D architecture.
- As an immediate step to establish a L&D global risk-sharing mechanism, LDCs, V20 and donor-qualifying SIDS should be allocated **USD 10 million** annually in premium support from L&D related funds. Each country would receive on average USD 200 to 300 million in pre-arranged annual protection to support their highest priority needs for more frequent climate shocks: eg humanitarian response; recovery of schools, hospitals and critical infrastructure; sovereign debt repayments; agricultural support; and restoration of marine and terrestrial ecosystems. **Across 100 countries, this would provide approximately USD 25 billion of pre-arranged finance for an annual cost of around USD 1 billion.**
- Using the economic efficiency of risk-sharing systems for climate risks, the international community should commit to an **L&D strategic objective of introducing umbrella stop-loss mechanisms** to protect the national economies of vulnerable countries in the Global South, with thresholds set at appropriate levels depending on the size of the economy and levels of risk.
- As an initial umbrella stop-loss commitment, **the smallest and most vulnerable countries, such as those under one million population, should be protected from losing more than 10 per cent of their annual GDP from climate-related events.** At present, most of these countries are at risk of losing more than 100 per cent of their annual GDP from climate shocks.
- These L&D interventions could be implemented through existing institutions including national governments, development institutions, regional risk pools, international donors and global risk capital markets.

Additional findings for V20 Small Island Developing States (SIDS)

The analytical part of this study has been carried out on a group of 11 V20 SIDS, with populations under one million, representing very different geographies, economies and perils. Key findings:

- These SIDS now face **foreseeable losses of between 50 per cent and over 100 per cent of GDP** from extreme climate events, such as severe droughts, tropical cyclones and floods. With climate change, these risks are set to grow between 10 and 15 per cent by 2050, approximately 0.5 per cent per year. This is an intolerable burden of financial risk to achieve sustainable development, prosperity and security. Such extreme events can strike tomorrow and the SIDS are currently bearing these risks.
- Overall economic losses from climate shocks to the 11 SIDS in this study could be limited to a maximum of 10 per cent of GDP equivalent per year, with approximately **USD 300 million annually** from L&D donors **to unlock contractual entitlements of up to USD 25 billion** across these countries from the risk capital markets. This would cover a large range of risks, from the more frequent events (eg 5 per cent annual probability) to the most extreme shocks (0.1 per cent annual probability). The umbrella stop-loss would be achieved through a range of parametric programmes with specific hazard triggers for defined climate-related events which would contribute to losses equivalent to more than 10 per cent of GDP.
- As a first step, this study shows **that USD 10 million of annual pure premium** (price of risk without additional defined expenses) per SIDS could generate an average annual protection of approximately **USD 250 million** per country, from more frequent risks (more than USD 2.5 billion across the 11 countries).
- Despite growing risks from climate change, this study has revealed that **the economies of these countries remain insurable to 2050**, while displaying some of the highest annual average losses in the world.[3,4] The viability of pre-arranged protection gives these SIDS more time to adapt and reduce vulnerabilities, greater financial security to prosper and quantified knowledge to make more informed decisions for resilient development.
- A geographically diverse L&D umbrella facility for the economies of these countries, implemented through the **regional risk pools,** would create a large, **diversified portfolio** to unlock the global risk capital markets at the lowest price for donors.

Part 1: Introduction: Risk sharing in the Loss and Damage mosaic

This briefing focuses on the aspect of Loss and Damage (L&D) that refers to the allocation of funds from wealthier countries to support economic losses of most climate-vulnerable developing countries. L&D has been identified as an essential component of climate action, together with mitigation and adaptation, to address the impacts stemming from inescapable climate risks.[5,6]

Loss and Damage in a new global financial architecture

After 30 years of negotiations, COP27 delivered a breakthrough agreement to create a L&D fund, and the Transitional Committee was established to make recommendations for its operationalisation. It is also recognised that there is no silver bullet for L&D and it will require multiple, complementary approaches, a 'mosaic of solutions'.[7]

Within this mosaic, risk sharing among countries emerges as a cornerstone, not just as a financial strategy but as a moral obligation, echoing the sentiments of the "moral imperative"[8] of L&D through a robust international system.

The final submission of the Transitional Committee (August 2023) includes insurance and risk-sharing mechanisms within the proposals presented by Least Developed Countries (LDCs) and Small Island Developing States (SIDS): "The Board of the Fund will develop and deploy a range of additional financial instruments that limit the financial burden on countries suffering climate loss and damage: highly concessional loans, guarantees, direct budget support and policy-based finance, equity, insurance mechanisms, risk sharing mechanisms…"[9]

The need for risk sharing has also been reinforced by world leaders in the New Global Financing Pact Summit: "We need a stronger global safety net, based on prearranged approaches… this implies climate and other disaster-resilient deferral mechanisms, insurance nets and emergency-response financing, including a more sustainable financing model of humanitarian aid."[10]

Risk-sharing systems for L&D

Risk-sharing systems are pre-arranged facilities that provide a contractual entitlement to resources in response to defined loss events, such as (re)insurance, catastrophe bonds or financial guarantees, collectively referred to in this report as risk capital markets. All risk-sharing systems require the formation of pools of shared capital to protect the participants when disasters strike. There are three sources of capital for risk pools: public sector, private and mutual insurance sector, and financial markets.

These three funding sources come together in global risk-sharing systems for L&D. The logic works as follows: the burden of defined financial risks of communities and governments in the Global South is transferred to the insurance and capital markets. The access to these markets is ensured by the provision of premium, which in this context of L&D is not paid by the affected countries themselves, but by international sources (Part 4 illustrates some examples of these practices).

Building upon international risk-sharing experience and institutions, these mechanisms provide significant tiles on the emerging mosaic of solutions for L&D.

Concept of umbrella stop-loss

We identify the essentials of risk sharing applicable to all countries, and we introduce to the L&D discourse the well-established financial concept of 'umbrella stop-loss', meaning that losses above a threshold are protected. Umbrella stop-loss provides a practical concept to the L&D common stance that "it is an international responsibility that countries and individuals should not suffer, due to climate change, above a certain limit".[11] While we study Vulnerable Twenty (V20) SIDS under one million people, the approach in this briefing is applicable to any other set of countries and to the global community as a whole.

By focusing on gross domestic product (GDP), we address the overall economic impact of risk sharing at a national scale (Parts 6 to 10). The umbrella stop-loss concept would then be implemented through a range of parametric instruments with specific peril triggers (Part 11). These instruments would be locally designed to address each individual country's priorities, including the protection of the poorest and most vulnerable communities, allowing funds to be directed in a planned manner.

As part of a broader disaster risk management strategy, risk-sharing systems include the following benefits for both donors and recipient countries.

Part 2: Benefits for recipient countries

Pre-arranged finance generates several benefits to governments and populations. The alternative to pre-arranged finance protection is that national governments will have to fund these contingent liabilities in some other way, by maintaining larger reserves or by relying on an uncertain aid response, post-event taxation or borrowing.

Financial benefits

1. Risk-sharing mechanisms provide **a contractual entitlement** to receive pre-agreed funds in response to defined events. This entitlement represents a contingent capital asset.
2. Contingent capital assets allow for more **predictable annual budgeting**, with greater security from the effects of climate-related disasters.
3. Contingent capital assets make lenders more secure, and the country could benefit from **better credit quality and greater fiscal space**.[12]

Adaptation benefits

Risk-sharing systems are part of the adaptation continuum, as addressed in the PCL Framework (Preventative adaptation, Contingent arrangements, Loss acceptance) explained in the box. Well-designed risk-sharing systems contribute to adaptation in four ways:

1. **Understanding risk:** evaluating the components of climate and natural disaster risk to understand what is driving losses to different communities and how resilience interventions can be targeted (examples in Part 9).
2. **Risk reduction and sustainability of the risk pool:** effective risk-sharing systems encourage members to implement risk-reduction measures (such as flood defences or drought-resistant crops) so that risk protection continues to be affordable. This, in turn, encourages sustainable communities.
3. **Governance:** by working in co-ordination with government agencies and relevant authorities in communities, payouts after a disaster can be deployed transparently and used to enhance resilience (eg redeveloping with stronger building codes or rebuilding in a planned relocation).
4. **Growth and investment:** pre-arranged financing creates a more secure environment to encourage investor confidence and adaptation finance.

The PCL Framework

(by Dr Nassef, Head of Adaptation, UNFCCC)

The framework is a complementary policy approach to guide participatory decision-making and choices, for which risk modelling, as described below, is essential. The PCL Framework starts by societies defining their level of 'loss tolerability', which is "a value-driven consultative assessment by society in which it determines which losses it considers tolerable and which ones intolerable".[13] It then guides decision-making in three steps:

P – Preventative adaptation: undertaken for all potential losses that are deemed intolerable, and for those losses for which preventative measures are the most cost-effective.

C – Contingent arrangements: excess risk is managed through all forms of risk sharing.

L – Loss acceptance: when the loss is smaller than the costs of risk reduction or contingent arrangements.

The PCL Framework addresses the difficulties in designing and operating socially fair, politically viable and economically sustainable decisions. At the heart of the PCL Framework is a system to address the essential choices facing everyone, from families to heads of government and L&D negotiating parties: what the risk is; what should be protected; how the risk should be reduced, managed and shared; how these elements can work together to encourage resilience and prosperity.

Part 3: Benefits for L&D funds and donors

Pre-arranged financing provides the following benefits to donors and funding facilities supporting the premium:

1. Transferring the responsibility to the private sector

Once the premium is received, it becomes the contractual responsibility of the private sector to pay the agreed amounts.

The private sector carries the risk and payouts could far exceed annual premiums. For example, days after the devastating September 2023 earthquake, the Government of Morocco was set to receive around USD 275 million from global reinsurance markets.[14] The scheme had only been created in 2019. It is designed to provide financial compensations to populations affected by earthquake and flood events, including isolated rural areas.

It is the responsibility of the financial regulators of the private sector to ensure that there are sufficient funds to pay, even in years of extreme losses, which drives risk-adjusted pricing (ie the premium reflects the true risk) to ensure solvency. Likewise, it is in the interest of all parties to build and maintain long-term, multi-year relationships.

2. Better value for donors and L&D funds

The premium unlocks access to large financial resources from the risk capital markets. This is an advantage for donors as they are only responsible for funding the premium. For example, broadly speaking:

For events with 5 per cent annual likelihood (eg category 3 tropical cyclone):

USD 10 million pure premium = USD 200 million coverage

USD 100 million pure premium = USD 2 billion coverage

For events with a 1 per cent annual likelihood (eg category 5 hurricane):

USD 10 million pure premium = USD 1 billion coverage

USD 100 million pure premium = USD 10 billion coverage

3. More security for L&D funds against major losses

Without pre-arranged finance in place, global funds assigned to L&D will be insufficient, as well as quickly depleted, in scenarios such as: years of multiple catastrophic events in the same season in different regions; a severe run of years; the same event devastating multiple regions simultaneously. For instance, Cyclone Pam in 2015 had significant impacts on various countries including Fiji, Tuvalu, Vanuatu and Kiribati.[15]

4. Efficient and predictable administration of donor funds

Donor governments are accountable to their taxpayers for efficient usage of public funds. Without pre-arranged finance in place, demands on donors are unpredictable and potentially very large if major events occur.

Can risk-sharing systems cope with the scale needed for Loss and Damage?

The system has significant risk capital and can generate more in line with growing demand. What is needed is premium (in the case of insurance) or premium-like payments (in the case of catastrophe bonds) to produce it. For example, the New Zealand Earthquake Commission (EQC) currently purchases USD 7.6 billion of annual protection from reinsurance and risk capital markets for very extreme events.[16]

In 2022, insurance payouts from Hurricane Ian in Florida and floods in Australia and Europe reached USD 120 billion, with annual insurance natural catastrophe claims of over USD 100 billion ‘the new normal’.[17]

Part 4: Building on existing foundations

The concept of risk-sharing systems for L&D builds on existing practices and institutions that have already demonstrated how these mechanisms are possible: Global North donor to Global South recipient, South to South co-operation, regional risk pools and well-tested methodologies to access the risk capital markets. This section briefly touches on these foundations.

International momentum for donor support

International donor support for pre-arranged financing has developed significantly over the last decade. Donor governments, humanitarian agencies and philanthropies are providing a growing source of premium support for exposed countries.

For example, the InsuResilience Global Partnership was launched in 2017 to provide financial protection against climate and disaster risk in vulnerable countries for 500 million people annually by 2025.[18] It developed the SMART premium principles, adopted by G7 donors, to guide the allocation of resources: Sustainable impact for the most vulnerable, value for Money, Accessibility, Resilience-building incentives, Transparency and consistency.[19]

Other examples include the Tripartite Agreement of the Insurance Development Forum (IDF), United Nations Development Programme (UNDP) and the German Federal Ministry for Economic Cooperation and Development (BMZ), which collaborate to provide funding, technical assistance and climate risk insurance solutions to 20 countries by 2025.[20] In COP27, the G7 and V20 announced the Global Shield Against Climate Risks, which includes premium support through its financing structure: the Global Shield Solutions Platform, the V20 Joint Multi-Donor Fund and the World Bank Global Shield Financing Facility.

Seeing the role that pre-arranged financing plays in risk management before and after disaster, multiple governments in developed and developing countries have created public–private insurance facilities to manage natural disaster risks. For example, the World Forum of Catastrophe Programmes (WFCP) includes membership from 15 countries, such as Norway, Turkey, Morocco, Taiwan, France and the UK.[21]

Regional risk pools

Four regional risk pools have been established by groups of national governments, with the help of donors and international institutions, to manage and share the financial impacts of natural catastrophe risks: African Risk Capacity (ARC), Caribbean Catastrophe Risk Insurance Facility Segregated Portfolio Company (CCRIF SPC), Pacific Catastrophe Risk Insurance Company (PCRIC) and Southeast Asia Disaster Risk Insurance Facility (SEADRIF).

Member countries have created these risk pools to manage risks by paying premiums for defined protection (sometimes subsidised and supported by donors). This architecture can be expanded to support international L&D functions.

Each regional sovereign risk pool uses the global (re)insurance market to manage their exposures, through which local risks are shared across the global community.

They play a growing role in enhancing disaster resilience in their regions and could provide existing capabilities to implement L&D risk-sharing programmes. Each risk pool establishes transparent governance mechanisms, which can include guidelines on how payouts can be used, as well as reporting and monitoring mechanisms. For example, CCRIF SPC has published a summary of how many people have benefitted since its creation in 2007 and how governments have administered the payouts.[22]

The regional risk pools have created the Sovereign Catastrophe Risk Pools Alliance to share knowledge and best practices on parametric product development, training, data management and disaster risk financing.[23] This Alliance could provide a central docking point for international L&D processes.

Well-established risk-modelling techniques

To access the world's public and private risk capital markets, and to ensure there is sufficient capital in the system to cover all foreseeable payouts, a risk-sharing system needs to use a well-established and robust modelling approach. This type of natural hazard risk assessment, also called catastrophe (cat) risk modelling, blends four disciplines: engineering metrics and expertise, actuarial science, physical and human geography, and climate science. It has been the basis of reinsurance, risk modelling and solvency regulation since the early 1990s.

These modelling methodologies, explained in Annex 1, consist of three key elements (hazard, exposure and vulnerability), which generate two fundamental metrics: Annual Average Loss (AAL) and return period loss estimates (the probability of an event in a given time frame, such as 5% annual probability expressed as 1 in 20 year return period). These metrics are employed by all branches of the disaster risk-sharing sector, such as insurers and reinsurers, catastrophe bond markets, and the pre-arranged financing facilities provided by development banks and supported by donors.

As well as accessing risk capital markets, these modelling techniques are being adapted to serve new, wider demands, such as: physical climate risk disclosure by corporates, global risk assessment mandates of agencies such as the UN Office for Disaster Risk Reduction (UNDRR), humanitarian finance by relief charities, resilient infrastructure investment and national government-led risk assessments. For example, cross-sector collaborations such as the Global Risk Modelling Alliance (GRMA) and the Global Resilience Index Initiative (GRII) provide decision-makers with capacity development, metrics and risk assessment tools, to serve a wide range of needs, using (re)insurance methodologies and open data approaches.

The following pages apply these metrics and methodologies. An explanation of the terminology is available in Annex 1.

Part 5: V20 SIDS in this study

This study analyses the 11 SIDS members of the V20 Group with populations of under one million. Seven are located in the Pacific, three in Caribbean and one in the Indian Ocean. Despite a shared identity as SIDS, these countries exhibit a spectrum of geographies, populations, economies and climate hazards. They provide a diverse sample to illustrate approaches relevant to all climate vulnerable countries, as reflected in the recommendations of this briefing.

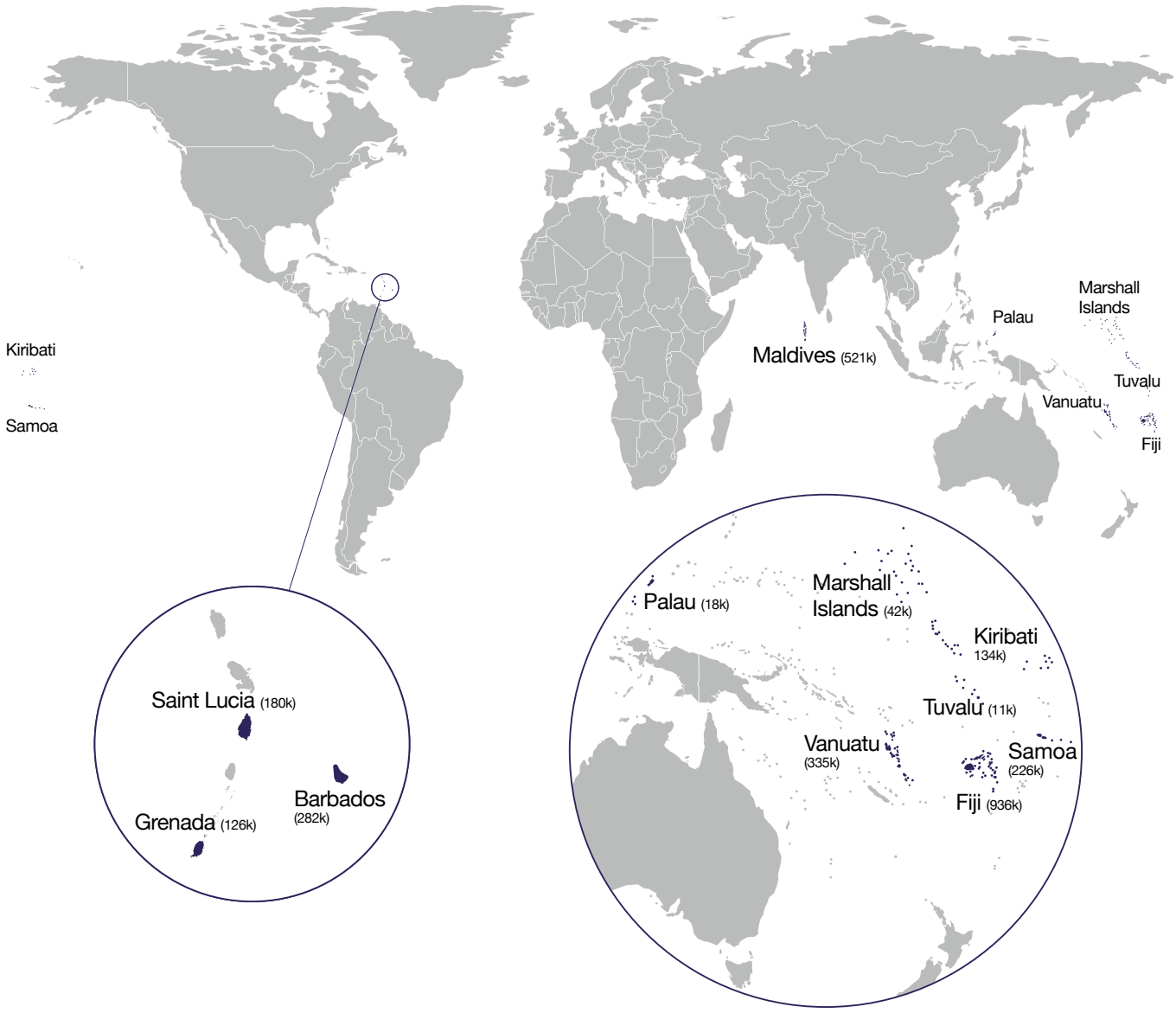


Table 1: *National reference statistics*

Country	Population (thousands) 2023	GDP (USD million) 2023	GDP per capita (USD thousands) 2023	Human Development Index 2021	Sovereign debt as % of GDP 2022	Credit rating (SWI*) 2023
Fiji	936	4,943	5,279	0.73	93%	A-
Kiribati	134	223	1,670	0.624	15%	BBB
Marshall Islands	42	280	6,667	0.639	21%	n.r.
Palau	18	218	12,072	0.767	86%	n.r.
Samoa	226	832	3,687	0.707	44%	BBB
Tuvalu	11	60	5,265	0.641	8%	n.r.
Vanuatu	335	984	2,942	0.607	46%	BBB-
Maldives	521	6,190	11,881	0.747	115%	BB
Barbados	282	5,638	19,993	0.79	121%	BB+
Grenada	126	1,256	9,954	0.795	65%	BB+
Saint Lucia	180	2,065	11,456	0.715	83%	BBB-

Sources: Worldometer data based on UN revisions (Jul 2023),[24] 2 and 3) World Bank and own projections (Jul 2023),[25] 4) UNDP (2021),[26] 5) IMF, World Bank and Government estimates (2020–22),[27] 6) Wikirating (2023 updates),[28] most ratings end of 2020.
*SWI = Sovereign Wikirating Index

These countries also share a high vulnerability to the impacts of climate change and experience some of the largest Annual Average Losses in the world as percentage of GDP.[29,30] The V20 as a whole displays a 98 per cent financial protection gap against climate and disaster risks.[31]

This study builds on both their commonalities and their differences: their shared vulnerability can be protected through the strengths of risk pools and a donor-supported umbrella-protection vision. Implementation, however, is flexible, decided at the national level to suit each country's individual circumstances and priorities.

Part 6: Current risk (2023)

This part summarises current risk across the 11 SIDS, using the risk-modelling techniques and metrics referred to in Part 4, explained in further detail in Annex 1 and applicable to all countries worldwide. The risk-modelling methodology has included an assimilation of information from a range of existing probabilistic risk models, climate model projections, open source country risk-modelling studies and historic records. While sources and more in-depth details are specified in Annex 2, the fundamental steps undertaken are as follows:

1. The study assesses the main climatic hazards for these islands: flood (fluvial and pluvial), drought, storm surge, tropical cyclone, with bushfire added to Samoa as the only country in the group with a significant risk from this peril. Earthquake and volcano have not been included because of the focus on climate-related hazards in a context of providing solutions for Loss and Damage funded by international donors. On this basis, tsunami, though affected by sea level rise, has not been included in this pathfinder study due to its seismic nature. Seismic hazards, as well as climate hazards not analysed in this study, such as heat, can be modelled using the same techniques.
2. This analysis has simulated 10,000 years of events to be able to identify the extent and probability of unprecedented events that could happen today, and which far exceed the worst events in history. The scale of this actuarial sample also enables greater confidence in the probability of the many years with very low losses. As explained in Part 4, this is the standard methodology used in reinsurance and catastrophe bond markets.
3. The sample size of 10,000 simulated years provides underwriting confidence to evaluate events with a 1 per cent or a 5 per cent annual probability.
4. The results of the hazard analysis have been applied to attributes of exposure and vulnerability in each of the 11 countries to obtain the key metric of Annual Average Loss (AAL). AAL is an average that includes all types of years, that is: many years of very low losses, some years of moderate losses and infrequent years of extreme losses. AAL does not mean that the country is losing that amount consistently every year. It is a metric that allows the commodification of risk so that it can become integrated in the financial system.
5. The calculation of AALs has considered two major factors:
   - Direct losses, also known as capital damage: property, infrastructure and direct economic impacts to all sectors included in the Nomenclature of Economic Activities (NACE).
   - Indirect losses: the cascading impacts that arise as a result of direct damages, such as business interruptions and flow-on effects.
6. The AAL represents the annual pure premium (ie pure price of risk) required to insure each of these countries against disaster losses in the analysis.
7. Finally, AALs have been expressed as percentage of current year GDP impacts to illustrate the value of rapid L&D payouts and reduce longer term macroeconomic effects. The figures produced in this study do not include: direct estimates of mortality and morbidity; impacts on natural capital and ecosystems; wider macroeconomic ripple effects such as future years' growth, employment and international trade. This can be incorporated in more detailed studies following the same methodologies.

Figure 1: *AAL of individual perils per country for 2023 (as % of GDP)*

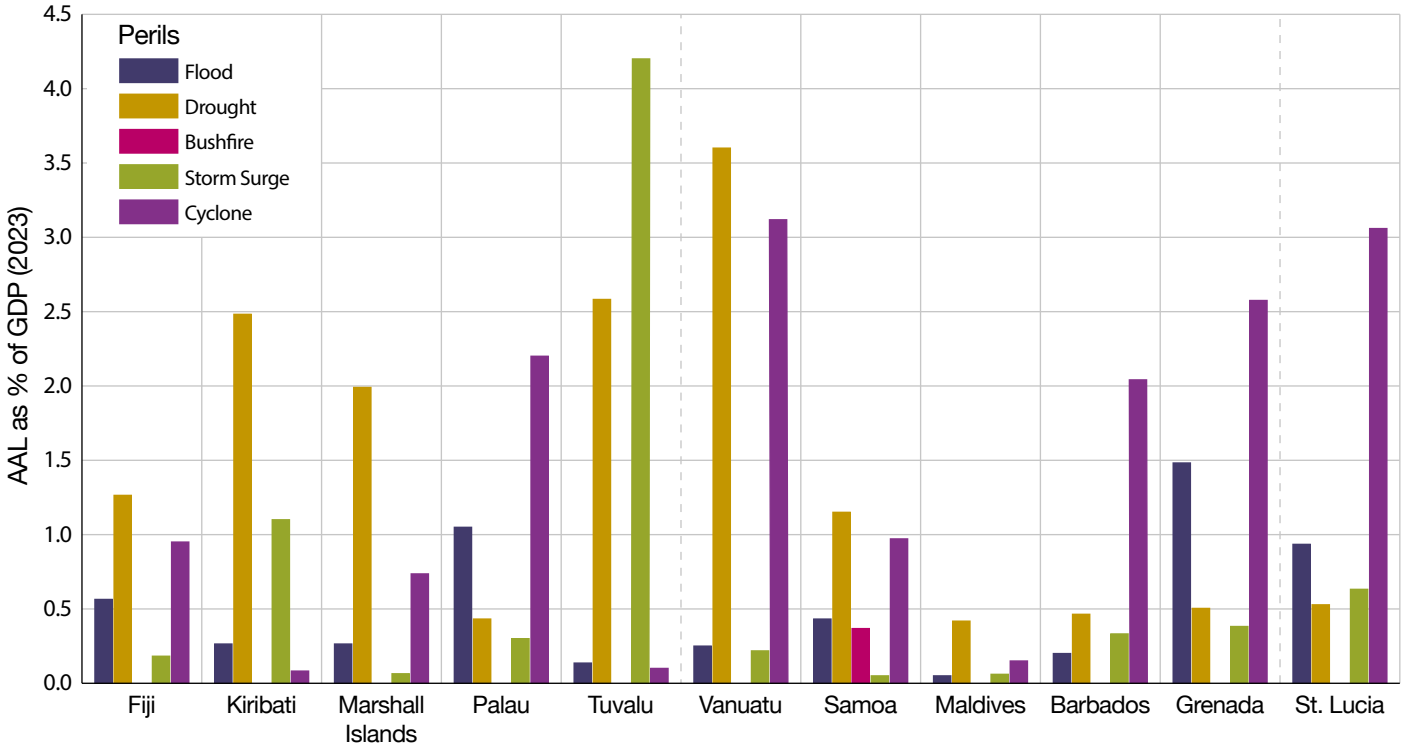


Table 2: *Estimate of the Annual Average Loss (AAL) for each country (2023)*

Country	GDP USD million	Driving peril	AAL USD million	AAL as % of GDP	1 in 20 year loss as % of GDP	1 in 100 year loss as % of GDP	1 in 1,000 Year loss as % of GDP
Fiji	4,943	Drought/ Cyclone	146	3.0%	14%	33%	104%
Kiribati	223	Drought	9	3.9%	25%	45%	171%
Marshall Islands	280	Drought	9	3.1%	20%	38%	141%
Palau	218	Cyclone	9	4.1%	10%	82%	304%
Samoa	832	Drought/ Cyclone	25	3.0%	13%	38%	104%
Tuvalu	60	Storm Surge/ Wave	4	6.9%	36%	88%	153%
Vanuatu	984	Drought/ Cyclone	71	7.2%	42%	77%	118%
Maldives	6,190	Drought	42	0.7%	4%	9%	49%
Barbados	5,638	Cyclone	172	3.1%	12%	68%	134%
Grenada	1,256	Cyclone	62	4.9%	24%	104%	190%
Saint Lucia	2,065	Cyclone	106	5.2%	24%	94%	158%

AALs include all the perils in the study. The table identifies the perils that drive the extreme losses in each country: in the Caribbean tropical cyclone and flooding, and in the Pacific drought, in addition to tropical cyclone.

Part 7: Future risk (2050)

Using the same methodology and metrics described in the previous section, this study offers an assessment of the risk to these SIDS in 2050. The aim is to quantify the effects of climate change and the viability of insuring these countries in the mid-21st century. The same approach can be used for all countries worldwide. To isolate the effects of climate change, we have kept the exposed assets and economy unchanged from current-day estimates.

Using climate models and other physical science projections and inputs, we have re-run the loss models to take account of expected changes to the frequency, severity and geographical distribution of climatic events in these regions. This is the standard approach used for climate-conditioning of reinsurance-related risk models to extrapolate future loss projections under climate change.

Sources and assumptions for the projected effect of climate change on each peril are detailed in Annex 2. While these are subject to judgement, and the future scenarios for some perils have greater contention and uncertainty than others, the following numbers are plausible, based on a temperature increase of about 2 degrees by 2050 compared to the pre-industrial era.

Table 3: *Expected increase in losses due to climate change by 2050 as percentage of GDP*

Country	AAL in 2023	AAL in 2050	1 in 20 2023	1 in 20 2050	1 in 100 2023	1 in 100 2050	1 in 1,000 2023	1 in 1,000 2050
Fiji	3.0%	3.3%	14.4%	15.3%	33.3%	34.9%	104.3%	106.4%
Kiribati	3.9%	4.5%	24.5%	26.9%	45.3%	48.0%	171.3%	187.0%
Marshall Islands	3.1%	3.9%	20.0%	25.5%	38.2%	41.8%	140.7%	171.1%
Palau	4%	4.2%	9.6%	11.4%	81.7%	90.8%	304.1%	321.6%
Samoa	3.0%	3.1%	13.3%	13.9%	38.0%	41.5%	104.2%	105.8%
Tuvalu	6.9%	11.7%	36.7%	51.7%	88.3%	113.3%	153.3%	203.3%
Vanuatu	7.2%	8.0%	42.4%	44.0%	77.1%	80%	118.3%	123.4%
Maldives	0.7%	0.8%	4.1%	4.3%	9.2%	10%	48.5%	53.0%
Barbados	3.1%	3.7%	12.5%	15.4%	68.4%	73.8%	133.9%	136.2%
Grenada	4.9%	5.7%	23.9%	28.0%	104.1%	107.2%	189.8%	198.7%
Saint Lucia	5.2%	6.2%	24.1%	28.0%	94.1%	104.8%	158.1%	177.5%

Figure 2: *AAL of individual perils per country for 2050 as % of GDP*

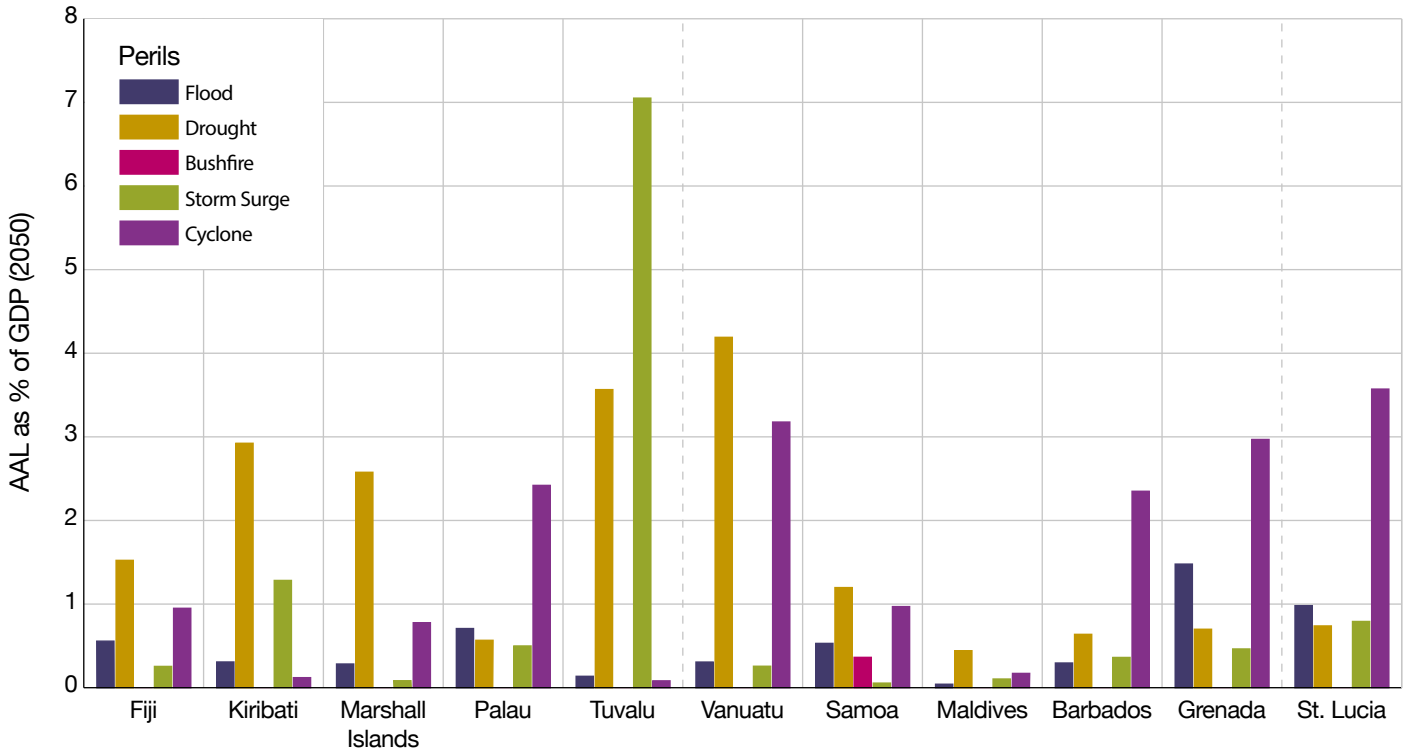
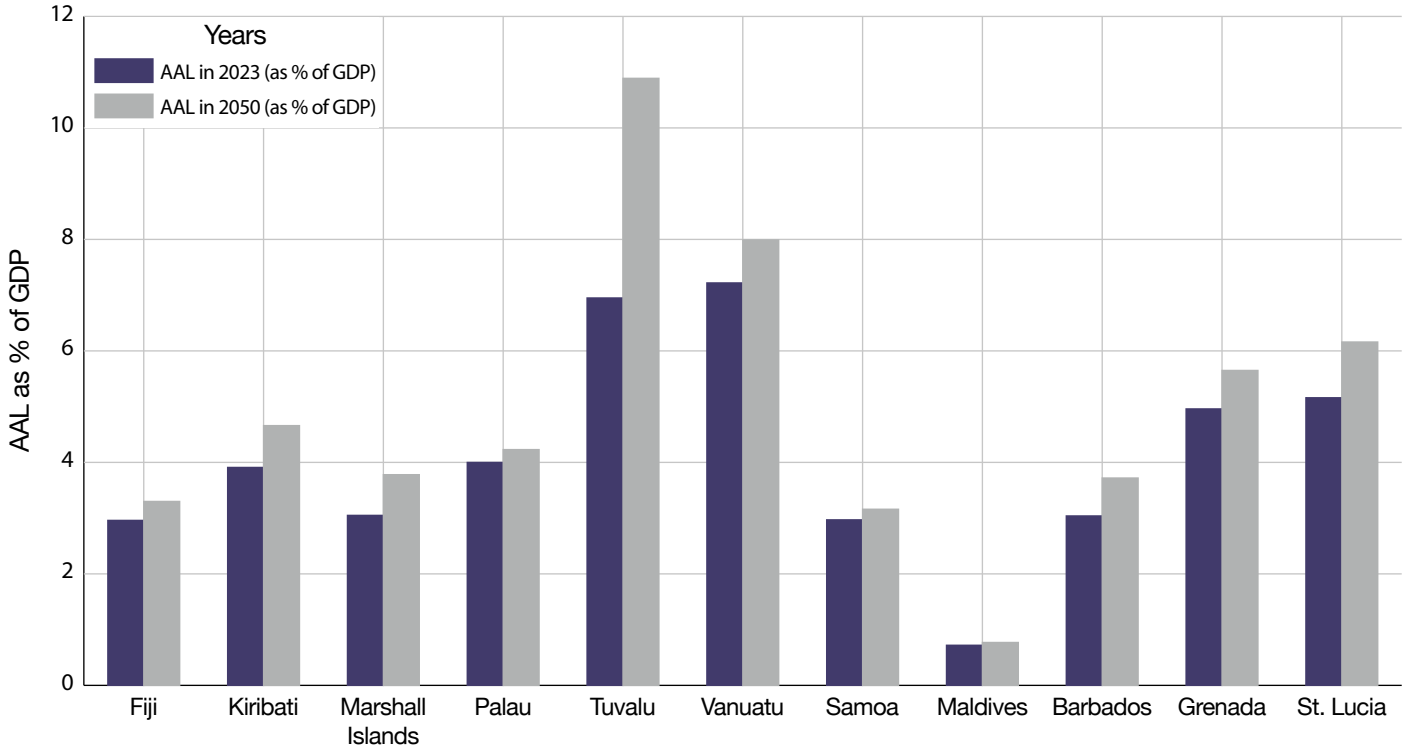


Figure 3: *Total AAL per Country for 2023 vs 2050 as % of GDP*



Part 8: Managing risk through adaptation and diversification

Once climate-related vulnerabilities are understood, they need to be managed through a combination of adaptation measures and risk sharing. This part explains how insurance-based risk quantification can support adaptation, and how risk sharing is more effective through diversification.

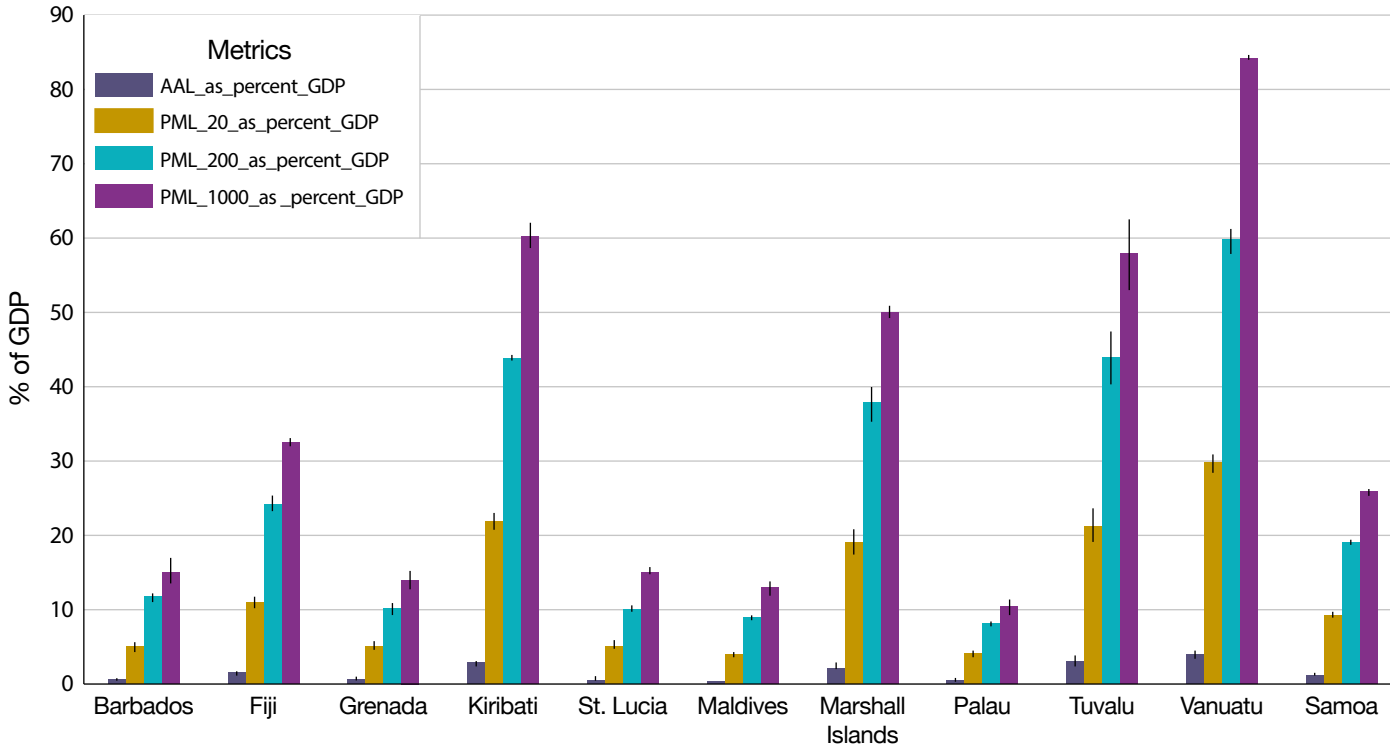
The adaptation and risk-sharing continuum

The risk analysis in this study provides information to advise short and long-term decisions on adaptation and resilience priorities to protect social, economic, cultural and environmental well-being.

Informed by risk modelling, the PCL Framework introduced in Part 2 is a powerful approach to guide these choices, which form the heart of national adaptation plans.

For example, current and projected drought and water stress are a critical risk across many SIDS in the coming decades. Our analysis illustrates that extreme events and losses are expected to increase significantly over this period. This will likely require a panoply of interventions across water consumption and supply (eg adaptation investments in desalination plants), agricultural practices and land use.

Figure 4: *Modelling results on drought extremes across the SIDS as % of GDP (2050)*



Risk pooling and diversification

Risk pools, such as insurance and reinsurance markets, generate further capacity per premium dollar through diversification. In essence, not all members of diversified risk pools have losses in the same year. In addition, countries from different geographies, such as those in this study, will benefit significantly from the diversification effect, allowing each dollar of L&D funds to provide greater protection.

For example, if the annual risk of a USD 100 million loss from a tropical cyclone in a Caribbean country is 1 per cent, the annual pure premium required to cover this risk is USD 1 million. If a Pacific island has an annual 1 per cent chance of a USD 100 million drought, the pure premium required is also USD 1 million. But, if these risks were entirely independent (uncorrelated), the chance of these losses both happening in the same year is 100th of 1 per cent, or 0.01 per cent.

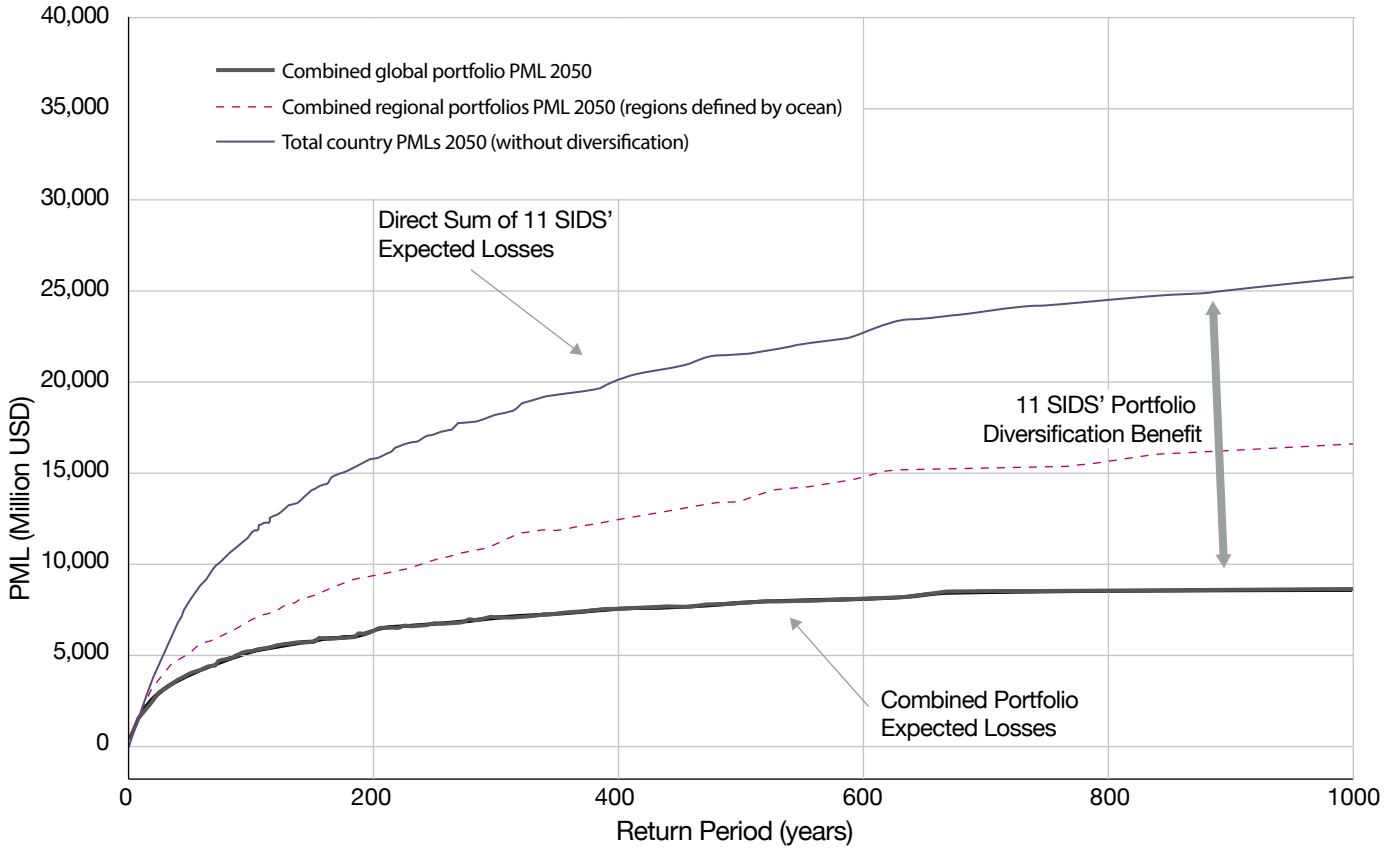
Members of risk pools take advantage of diversification to provide financial protection efficiently. The largest risk pool for natural disaster risk is the global insurance, reinsurance and catastrophe bonds market.

Underwriters, regulators and credit rating agencies ensure that risk carriers have access to sufficient capital to pay the maximum probable losses their portfolios could sustain. The minimum threshold is 1 in 200 year resilience but most (re)insurers have considerably larger solvency margins. Portfolio correlation and accumulation risk is a key factor in this supervision.

Global South countries have important advantages when they enter the global risk market. Individually they can diversify global underwriters' portfolios that have the vast majority of their risks in major economic centres across North America, Europe, Japan and China. Collectively, LDCs, SIDS and V20 are strongly diversified by geography and peril. While there are risks of tropical cyclones and droughts affecting neighbouring countries, regional and global groups are highly diversified.

From a climate risk perspective, in this study we have assessed the diversification of the eleven countries across the three oceans and five perils. The results are illustrated in the graph, which confirms that diversification benefits are significant and further increase with more extreme events. At the return periods that the modelled programmes are active, we estimate the diversification benefit to be up to 30 per cent less than the total pure risk price for each country individually.

Figure 5: *Diversification benefits of regional and global risk pooling*



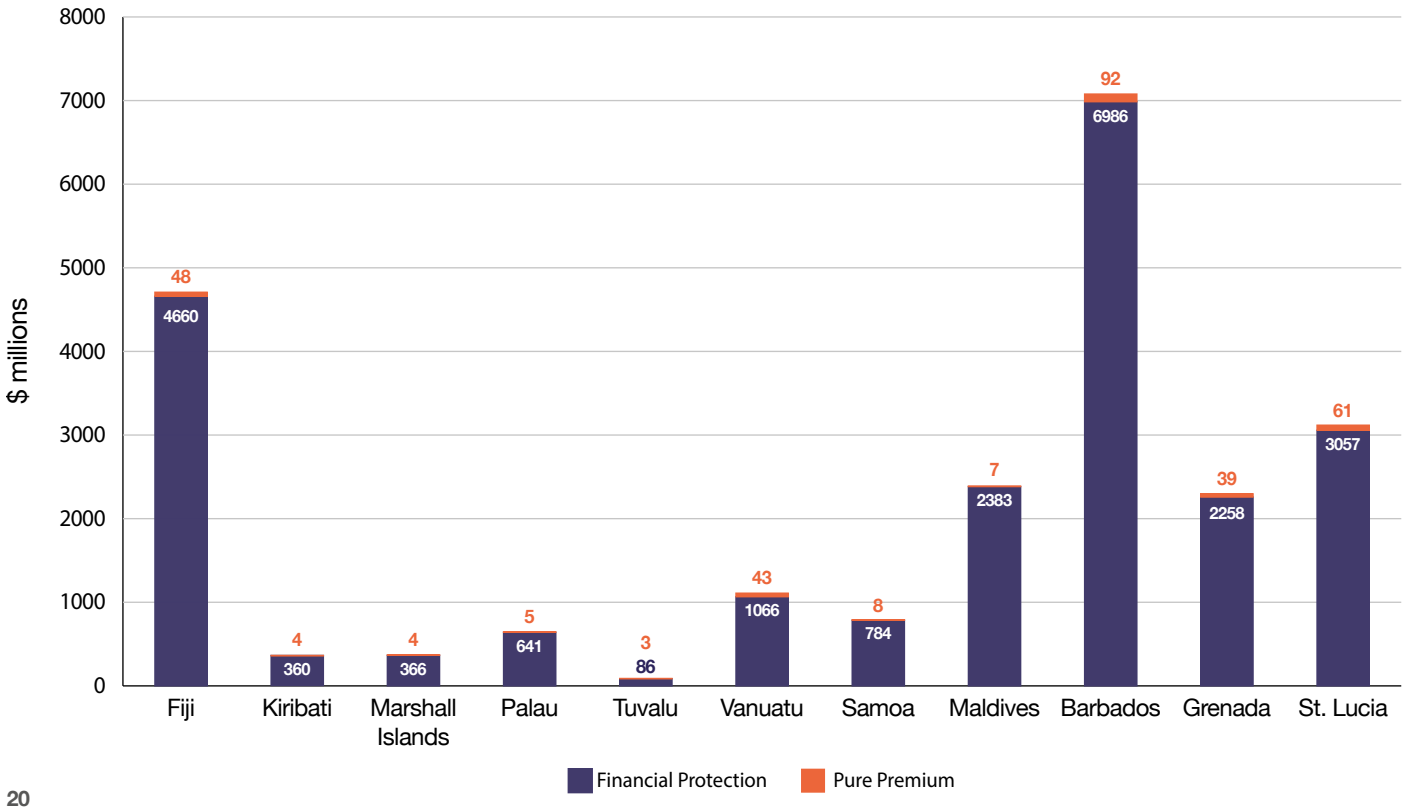
Part 9: Pathfinder design of an umbrella stop-loss programme

This section models the economic outcomes of protecting the 11 SIDS from losing more than 10 per cent equivalent of their GDP per year from climate events. In practice, L&D donors and national governments across LDCs and SIDS will set the stop-loss thresholds that are appropriate for their circumstances.

While each country has distinct levels of risk, for these SIDS the 10 per cent equivalent loss level tends to represent events that, on average, have a 5 per cent annual likelihood of occurring.

1. From the risk assessment illustrated in Part 7, we import the expected losses from each country, without insurance, including the AAL, and the losses that have a 5 per cent, a 1 per cent and a 0.1 per cent annual probability of occurring (1 in 20, 1 in 100 and 1 in 1,000 year return periods).
   - The total uninsured AAL of all the 11 countries is approximately USD 650 million.
   - The aggregate risk across the group for events that have a 5 per cent annual probability of occurrence is approximately USD 3.1 billion, and for events with a 1 per cent annual probability is approximately USD 10.8 billion.
   - The total uninsured annual Probable Maximum Loss (PML) for each of the 11 countries, at 0.1 per cent annual probability (up to 1 in 1,000 year events), is approximately **USD 25 billion.** The umbrella stop-loss concept assessed here covers that full amount, less the 10 per cent of GDP deductible.
2. We then model the effect of a stop-loss facility for each country to protect, from different perils, against annual losses exceeding 10 per cent equivalent of GDP driven by moderate, severe and catastrophic events.
3. The estimated pure premium required by each country to enable this level of protection is illustrated in the following graphic.
   - The total pure premium for this umbrella of financial security across each of the 11 SIDS is approximately **USD 314 million** per year.
   - This pure premium buys approximately **USD 22.6 billion** of protection from the more frequent events (eg 5% annual probability) to the most extreme shocks (0.1% annual probability).

Figure 6: *Annual pure premium and annual financial protection (USD million)*



The following table also collects the results of the same exercise as above, but for 2050. In summary:

By 2050, overall physical climate risks to these countries grows by approximately **10–15 per cent** with an emphasis towards more extreme events.

The pure premium required to protect the economy (at current figures) from losses exceeding 10 per cent GDP equivalent in current US dollars is estimated for 2050 to be **USD 365 million** per year, about USD 4.6 million more per SIDS.

Table 4: *Protection from estimated risks (2023 and 2050)*

SIDS			Expected Losses (with 10% GDP Umbrella Stop-Loss Protection)									
			2023					2050				
Country	GDP	AAL - 2023	Probable Maximum Loss	Umbrella Stop-Loss - 10% GDP	Financial Protection	Pure Premium	Residual AAL to SIDs	Probable Maximum Loss	Umbrella Stop-Loss - 10% GDP	Financial Protection	Pure Premium	Residual AAL to SIDs
Fiji	$4943m	$146.1m (3%)	$5154m (104%)	$494m	$4660m	$47.9m (0.9%)	$98.1m	$5258m (106%)	$494m	$4764m	$53.9m (1%)	$109.1m
Kiribati	$223m	$8.7m (3.9%)	$382m (171%)	$22m	$360m	$4.4m (1.2%)	$4.3m	$275m (123%)	$22m	$253m	$5.2m (1.9%)	$5.2m
Marshall Islands	$280m	$8.5m (3.1%)	$394m (141%)	$28m	$366m	$4.1m (1%)	$4.4m	$479m (171%)	$28m	$451m	$5.2m (1.1%)	$5.3m
Palau	$218m	$8.7m (4%)	$663m (304%)	$22m	$641m	$5m (0.8%)	$3.7m	$701m (322%)	$22m	$679m	$5.4m (0.8%)	$3.8m
Tuvalu	$60m	$4.2m (6.9%)	$92m (153%)	$6m	$86m	$2.5m (2.7%)	$1.7m	$122m (202%)	$6m	$116m	$4.3m (3.6%)	$2.2m
Vanuatu	$984m	$70.9m (7.2%)	$1164m (118%)	$98m	$1066m	$43.4m (3.7%)	$27.5m	$1214m (123%)	$98m	$1116m	$48.3m (4%)	$30.2m
Samoa	$832m	$24.6m (3%)	$867m (104%)	$83m	$784m	$8.3m (1%)	$16.3m	$880m (106%)	$83m	$797m	$9m (1%)	$17.2m
Maldives	$6190m	$42.4m (0.7%)	$3002m (49%)	$619m	$2383m	$6.6m (0.2%)	$35.7m	$3002m (49%)	$619m	$2383m	$6.2m (0.2%)	$40.7m
Barbados	$5638m	$172.1m (3.1%)	$7550m (134%)	$564m	$6986m	$92.1m (1.2%)	$80m	$7677m (136%)	$564m	$7113m	$110.2m (1.4%)	$97.8m
Grenada	$1256m	$62.1m (4.9%)	$2384m (190%)	$126m	$2258m	$39m (1.6%)	$23.1m	$2496m (199%)	$126m	$2370m	$44.4m (1.8%)	$26.6m
St. Lucia	$2065m	$106.4m (5.2%)	$3264m (158%)	$207m	$3057m	$60.6m (1.9%)	$45.8m	$3666m (178%)	$207m	$3459m	$72.9m (2%)	$54m
Totals	**$22690m**	**$655m**	**$24917m**	**$2269m**	**$22648m**	**$314m**	**$340m**	**$25771m**	**$2269m**	**$23502m**	**$365m**	**$392m**

The table shows outcomes from the methodologies used by the risk capital markets to underwrite sovereign climate risks with parametric instruments. Maximum Probable Losses calculated at 1 in 1,000 year return period.

Part 10: A first step to implementation

This vision of an umbrella stop-loss programme for SIDS will be achieved by building blocks of specific parametric programmes protecting national priorities from climate risk. The same logic and steps illustrated on these pages could be applicable to all climate vulnerable countries.

To illustrate the process of commencing the umbrella stop-loss vision in a significant way, we have estimated the protection that could be provided by USD 10 million of annual pure premium for each of the 11 V20 SIDS.

As stated earlier, pure premium is the pure price of risk that does not include additional transaction-related costs incurred from underwriters, intermediaries, data providers and regional risk pools (Annex 4). In Loss and Damage related programmes, for transparency of donor funds, it would seem appropriate to distinguish between the pure premium and any additional costs.

In summary, the results are:

- For USD 10 million annual pure premium per SIDS, USD 110 million in total, the level of protection would be USD 2.6 billion.
- By 2050, the same pure premium of USD 110 million provides a total maximum payout of USD 2.4 billion, based on the expected 10 to 15 per cent increased risk over that period.

The size and frequency of expected payouts depends on the perils affecting each country. The driving peril also differs for each country depending on the return period of concern.

For example, some Pacific SIDS experience frequent and moderately severe droughts (eg 1 in 15 year return periods, 6.6 per cent annual probability) which would incur more frequent, lower level payouts to agricultural losses. Conversely, the primary peril on a Caribbean island is hurricane, which would happen less frequently (over 3 per cent annual probability, 1 in 30 year return period, for a category 3 hurricane, depending on location) but with higher payouts due to losses affecting buildings and infrastructure.

While each country would decide how to administer the USD 10 million pure premium, the calculations in this study have been made for protection from the primary climate-related peril in each country. Payouts, as explained in the next section, can support any pre-planned post-disaster priorities of each country.

The summary protection for each country is illustrated in the following graphic, and detailed in the table below. Annual protection varies from USD 80 million per year in Tuvalu, reflecting the frequency of storm surge events, to USD 640 million in Grenada, reflecting the rare but devastating effects of tropical cyclones in the far south of the Caribbean.

Figure 7: *Modelled Parametric Protection (2023) from USD 10m Pure Premium*

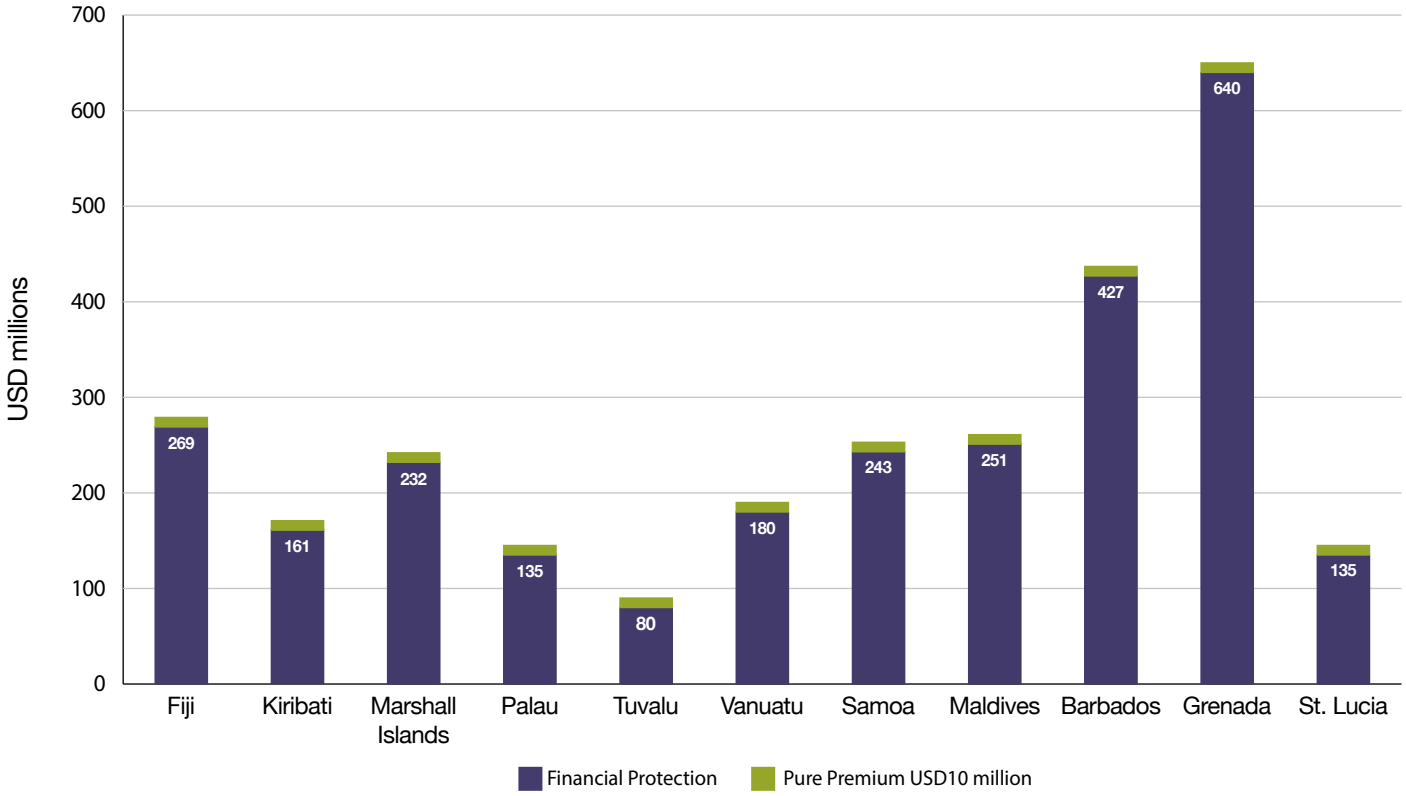


Table 5: *Estimation of protection (2023 and 2050) from USD 10 million of annual pure premium per country*

Country	GDP ($)	Ann. Prem ($)	Driving Peril	Maximum Annual Payout (2023)	Maximum Annual Payout (2050)
Fiji	$4943m	$10m	Drought	$269m	$225m
Kiribati	$223m	$10m	Drought	$161m	$135m
Marshall Islands	$280m	$10m	Tropical Cyclone	$232m	$216m
Palau	$218m	$10m	Tropical Cyclone	$135m	$122m
Tuvalu	$60m	$10m	Storm Surge	$90m	$80m
Vanuatu	$984m	$10m	Drought	$180m	$154m
Samoa	$832m	$10m	Drought	$243m	$193m
Maldives	$6190m	$10m	Drought	$251m	$233m
Barbados	$5638m	$10m	Tropical Cyclone	$427m	$369m
Grenada	$1256m	$10m	Tropical Cyclone	$640m	$551m
St. Lucia	$2065m	$10m	Tropical Cyclone	$135m	$114m
Totals	**$22690m**	**$110m**		**$2663m**	**$2392m**

Part 11: Implementation pathways

As summarised in Part 4, the capabilities and institutions exist to provide a choice of delivery channels for risk-sharing systems for L&D. The process requires the following functions:

1. The insured: a country, group of countries or sub-sovereign entity.
2. Intermediary: provides risk advice to the insured, transaction design and structuring, competitive tendering and placement in risk capital markets, administration of premium payments to underwriters and collection of payouts to the insured.
3. Underwriters: insurers, reinsurers and capital markets that make funds available to provide financial protection.
4. Premium source: in a Loss and Damage context, premium would be supported by donors directly or via development banks or other agencies.
5. Implementation: the regional risk pools ARC, CCRIF SPC, PCRIC and SEADRIF could play a key role to co-ordinate implementation, as explained in Part 4.
6. Donors, international financial institutions and development agencies have dedicated disaster risk financing capabilities, which can support the ongoing allocation and administration of funds (examples provided in Part 4).

Priorities for payouts

Each country will decide the priorities for parametric payouts. These can be pre-allocated, along with implementation plans, to ensure that payouts can be turned into tangible benefits quickly and efficiently. Some payout funds are usually left flexible to address unforeseen needs and impacts. The following areas provide examples of potential uses of payout funds:

- Immediate disaster response: to support humanitarian post-event urgent requirements.
- Social protection: direct health, welfare and social insurance payments to support urban and rural communities, businesses, public services and disadvantaged groups.
- Recovery and reconstruction: including schools, hospitals, critical infrastructure and regenerative farming.
- Natural capital: support to rehabilitate marine and terrestrial ecosystems.
- Sovereign debt payments and public finances: to cover repayments during a pre-agreed period to maintain credit worthiness and fiscal space, as part of wider multi-layered debt relief measures.[32]

Recommendations for the L&D mosaic

For donor governments, humanitarian and development institutions and philanthropies

Pre-arranged climate and disaster risk finance should be a pillar of sustainable development, humanitarian strategy and economic recovery.

- Create L&D financing facilities for SIDS, LDCs and V20. As a first step, these countries should be allocated USD 10 million each for protecting their highest priority climate risks.
- Commit significant L&D resources to pre-arranged finance systems, including umbrella stop-loss mechanisms to protect national economies above defined thresholds of GDP. As an initial commitment, the smallest, most vulnerable countries, such as those under one million population, should be protected from losing more than 10 per cent of their annual GDP equivalent from climate-related events.
- Further support local risk modelling, data capabilities and technical assistance.

For SIDS, LDCs and V20 governments

Prioritise risk-sharing systems, supported by international donors, as a key pillar of Loss and Damage to generate large and predictable financial entitlements in response to climate shocks.

- Work with local and overseas risk assessment expertise to inform adaptation and risk-sharing interventions.
- Include L&D pre-arranged climate and disaster risk financing in National Adaptation Plans.

For UNFCCC and climate and financial policymakers

Prioritise risk-sharing systems to access the risk capital markets for scale, efficiency and predictability of funds.

- Include risk-sharing mechanisms to operationalise the L&D fund.
- Use the risk modelling of pre-arranged finance systems to inform integrated adaptation and L&D interventions.
- Integrate the interdependent global risk management mandates of climate policymakers with global and national financial system policymakers.

For regional risk pools and implementing institutions

Scaling up of existing capabilities and resources for integrating pre-arranged climate and disaster risk financing into Loss and Damage implementation.

- Regional risk pools should be supported to meet L&D responsibilities with their member governments, donors and implementing institutions.
- Development banks and agencies should expand disaster risk financing capabilities and instruments to support L&D.
- Risk advisers, risk modellers and (re)insurance brokers should align their capabilities to support L&D objectives and institutions.

For risk capital markets

To recognise L&D as a distinctive landscape of demand for climate and disaster risk finance with specific needs.

- Risk capital markets should expand their products to meet the needs of L&D related demands, including multi-year programmes.
- Risk capital markets should prioritise the allocation of stable, long-term capacity to L&D coverage.
- Align administrative norms with the needs of L&D stakeholders, including transparency of costs.

For international financial institutions, regulators, standard setters and credit rating agencies

To take climate risks into account and price in the economic value of pre-arranged L&D finance.

- International financial institutions and standard setters, including credit rating agencies, should use the types of metric applied in this study to assess the climate risks of countries and financial institutions.
- Concessional pre-arranged finance should be applied transparently to ensure that risk signals are still conveyed.
- The value of L&D pre-arranged finance should be incorporated into sovereign credit ratings and evaluation of financial system stability.

Annex 1: Risk modelling: metrics for resilience and risk sharing

Risk modelling consists of three key elements called modules:

1. **Hazard:** annual probability of a hazard (eg tropical cyclone of category 3 severity) occurring at a specific location.
2. **Exposure:** scale and attributes of exposed locations to natural hazards (eg size and demography of a location, physical assets, infrastructure, economic activity, natural capital).
3. **Vulnerability:** fragility of exposed assets to the level of hazard. This function determines how much loss is expected under different levels of threat (eg increasing wind speeds or flood depths).

How catastrophe risk models work

The probability of the hazard is calculated by integrating historical data with physical sciences of the hazard and climate change models to inform statistical simulation. Usually models simulate 10,000 years or more to provide a statistical data base large enough for results to be reliable. This reveals, for example, how frequently we can expect (now or in future years) loss-causing events of any severity, such as a category 3 or 5 tropical cyclone in a certain location.

Estimates of the impact of climate change can be made by amending the characteristics and training of the statistical simulations to reflect the future expectations of climate science.

The results of the hazard module are applied to the exposure and vulnerability modules through a financial calculation engine, which converts the probability of hazard severity and frequency to a financial loss to obtain two other key metrics: Annual Average Loss and return periods (eg 1 in 20, 1 in 100).

Return periods

This metric refers to *the probability* of an event occurring within a given time frame, such as a 1 in 20 year return period and 1 in 100 year return period.

A 1 in 100 year return period means that it has a 1 per cent chance of occurring every year. It does not mean that it happens once every century. If, for example, an island is struck by a 1 in 100 event this year, it still has the same 1 per cent chance of being struck by the same type of event next year. By the same logic, a 1 in 20 event has a 5 per cent probability of happening every year.

Annual Average Loss

This metric allows us to understand the level of loss that can be expected in a location. It is the average of all losses across the sample of simulated years, and that includes years of no losses, years of medium losses and years of very high losses. For example, to say that a country has a 5 per cent AAL of its GDP, it does not mean that it is losing 5 per cent every year. Some years can be much less than that (or nothing), other years can be much greater.

The AAL is driven by: the probability and severity of potential events (eg category 3 hurricane), the value of the exposure (eg number of buildings), and the vulnerability (eg building materials). The same category 3 hurricane striking a set of neighbouring areas can create totally different AALs.

Annex 2: Risk assessment methodology

To carry out this assessment, we employed a multi-faceted approach including:

Historical data: We utilised primarily CATDAT data, which catalogues past damages and losses for each event in the past, and through extreme value statistics in many cases Exceedance Probability (EP) curves were created.

We defined the worst and second worst extreme events since 1900. Historic fatalities or other metrics are not meaningful comparators with economies and populations growing significantly over decades and centuries.

Table 6: *Historic events*

Country	Worst event	2nd worst event
Fiji	Cyclone Winston 2016 (Cat 4/5)	Drought 1998 (12 months +)
Kiribati	Drought 1998–99 (12 months +)	Cyclone Pam 2015 (Storm Surge)
Marshall Islands	Typhoon 1905 (Cat 3, Storm Surge)	Typhoon Pakka 1997 (Cat 0/1, rain) or Typhoon of 1918 (Cat 2+/storm surge)
Palau	TC Marie 1976 (Cat 1)	Typhoon Surigae 2021 (Cat 0/1, rain)
Samoa	Cyclone Val 1991 (Cat 3/4)	Cyclone Apia 1889 (Cat 2/3)
Tuvalu	Cyclone Pam 2015 (Storm Surge)	Drought 1998 (12 months +)
Vanuatu	Cyclone Pam 2015 (Cat 4+/5)	Cyclone Judy + Kevin 2023 (Cat 4)
Maldives	Tsunami 2004 (1 to 4m)	Storm 1991 (Cat 1+ equiv.)
Barbados	Great Hurricane 1780 (Cat 5+)	Great Hurricane 1831 (Cat 4)
Grenada	Hurricane Ivan 2004 (Cat 4)	Hurricane Lenny (Storm Surge)
Saint Lucia	Hurricane Allen 1980 (Cat 3+)	Hurricane Tomas 2010 (Cat 2)

Sources: CATDAT

Existing risk models: In addition, we integrated risk models from existing global and regional studies, using stochastic event sets typical of catastrophe models in order to assess the AAL and PML. Our primary data repositories included CATDAT, along with contributions from other reputable organisations such as the UN, World Bank, consortiums, universities and others. The exposure and vulnerability functions were maintained for a 2023 baseline and have been built using the methodology within Gunasekera et al.,[33] allowing for capital stock and production characterisation of each country.

Climate change projections informed our assessment for the years 2023, 2030 and 2050, providing a stocktake of potential future impacts. We paid particular attention to scenarios where multiple countries could be simultaneously affected, especially by cyclones traversing the Pacific.

When assessing the impact of climate change on various environmental hazards, a multifaceted approach was employed. The Climate Change CMIP6 SSP2-4.5 model served as the backbone for adjusting the hazard components in future analyses.

A comprehensive range of studies and parameters were compiled for different types of perils such as droughts, cyclones and floods to arrive at a median viewpoint on how losses might change over time. To ensure accuracy, a 20-year time frame surrounding a given time stamp is analysed for the metrics involved.

For drought prediction, a variety of indices were considered, including an averaged drought climate index, the Water Stress World Resources Institute, and heat duration data.

Sea level changes were projected using C3S Copernicus sea level data in conjunction with CMIP6 Nextgen projections.

For cyclones, over 600 different studies were consulted to extract values for metrics such as rainfall, intensity and frequency. This area witnesses a variety of scholarly opinions, with researchers like Knutson, Jewson, Murakami, Bloemendaal and Sugi providing different perspectives for each basin.

Flood risks were assessed through rainfall rate modelling, based on cyclone-derived data and other baselines like Rx5day and Rx1day from CMIP6.

Storm surges were evaluated using Deltares' CMIP6 global flood models, adjusted for sea level changes.

Annex 3: Country list

	Country	Population thousands	Classifications and memberships				
1	Niue	2	SIDS	AOSIS			
2	Tuvalu	11	SIDS	AOSIS	V20	LDC	IDA
3	Nauru	12	SIDS	AOSIS			
4	Cook Islands	17	SIDS	AOSIS			
5	Palau	18	SIDS	AOSIS	V20		
6	Marshall Islands	41	SIDS	AOSIS	V20		IDA
7	St Kitts & Nevis	47	SIDS	AOSIS			
8	Dominica	73	SIDS	AOSIS			IDA
9	Antigua & Barbuda	94	SIDS	AOSIS			
10	St Vincent & Grenadines	103	SIDS	AOSIS			IDA
11	Seychelles	107	SIDS	AOSIS			
12	Tonga	107	SIDS	AOSIS			IDA
13	Grenada	126	SIDS	AOSIS	V20		IDA
14	Kiribati	133	SIDS	AOSIS	V20	LDC	IDA
15	St Lucia	180	SIDS	AOSIS	V20		IDA
16	Samoa	225	SIDS	AOSIS	V20		IDA
17	Sao Tome & Principe	231	SIDS	AOSIS		LDC	IDA
18	Barbados	282	SIDS	AOSIS	V20		
19	Vanuatu	334	SIDS	AOSIS	V20		IDA
20	Bahamas	400	SIDS	AOSIS			
21	Belize	410	SIDS	AOSIS			
22	Maldives	521	SIDS	AOSIS	V20		IDA
23	Micronesia	544	SIDS	AOSIS			IDA
24	Cabo Verde	599	SIDS	AOSIS			IDA
25	Suriname	632	SIDS	AOSIS			
26	Solomon Islands	740	SIDS	AOSIS		LDC	IDA
27	Bhutan	787			V20	LDC	IDA
28	Guyana	813	SIDS	AOSIS	V20		IDA
29	Comoros	825	SIDS	AOSIS	V20	LDC	IDA
30	Fiji	936	SIDS	AOSIS	V20		IDA

	Country	Population millions	Classifications and memberships				
31	Djibouti	1.1				LDC	IDA
32	Eswatini	1.2			V20		
33	Mauritius	1.3	SIDS	AOSIS			
34	Timor Leste	1.4	SIDS	AOSIS	V20	LDC	IDA
35	Trinidad & Tobago	1.5	SIDS	AOSIS			
36	Kosovo	1.8					IDA
37	Guinea-Bissau	2.1	SIDS	AOSIS		LDC	IDA
38	Lesotho	2.3				LDC	IDA
39	Gambia	2.8			V20	LDC	IDA
40	Jamaica	2.8	SIDS	AOSIS			
41	Mongolia	3.4			V20		
42	Eritrea	3.7				LDC	IDA
43	Mauritania	4.9				LDC	IDA
44	Costa Rica	5.2			V20		
45	Lebanon	5.3			V20		
46	Palestine	5.4			V20		
47	Liberia	5.4			V20		IDA
48	Central African Republic	5.7				LDC	IDA
49	Singapore	6	SIDS	AOSIS			
50	Congo	6.1					IDA
51	Kyrgyzstan	6.7			V20		IDA
52	Nicaragua	7			V20		IDA
53	Laos	7.6				LDC	IDA
54	Sierra Leone	8.8				LDC	IDA
55	Togo	9.1				LDC	IDA
56	Papua New Guinea	10	SIDS	AOSIS	V20		IDA
57	Tajikistan	10					IDA
58	Honduras	11			V20		
59	Cuba	11	SIDS	AOSIS			
60	South Sudan	11			V20	LDC	IDA
61	Dominican Republic	11	SIDS	AOSIS			
62	Haiti	12	SIDS	AOSIS	V20	LDC	IDA
63	Tunisia	12			V20		
64	Burundi	13				LDC	IDA
65	Benin	14			V20	LDC	IDA

	Country	Population millions	Classifications and memberships		
66	Guinea	14	V20		IDA
67	Rwanda	14	V20	LDC	IDA
68	Zimbabwe	17			IDA
69	Cambodia	17	V20	LDC	IDA
70	Chad	18	V20	LDC	IDA
71	Guatemala	18	V20		
72	Senegal	18	V20	LDC	IDA
73	Somalia	18		LDC	IDA
74	Zambia	21		LDC	IDA
75	Malawi	21	V20	LDC	IDA
76	Sri Lanka	22	V20		IDA
77	Burkina Faso	23	V20	LDC	IDA
78	Syria	23			IDA
79	Mali	24		LDC	IDA
80	Niger	27	V20	LDC	IDA
81	Cameroon	29			IDA
82	Côte D'Ivoire	29	V20		IDA
83	Madagascar	30	V20	LDC	IDA
84	Nepal	31	V20	LDC	IDA
85	Ghana	34	V20		IDA
86	Mozambique	34		LDC	IDA
87	Yemen	35	V20	LDC	IDA
88	Uzbekistan	35			IDA
89	Angola	37		LDC	
90	Morocco	38	V20		
91	Afghanistan	42	V20	LDC	IDA
92	Sudan	48			IDA
93	Uganda	49	V20	LDC	IDA
94	Colombia	52	V20		
95	Kenya	55	V20		IDA
96	Myanmar	55		LDC	IDA
97	Tanzania	67	V20	LDC	IDA
98	Viet Nam	99	V20		
99	Democratic Republic of the Congo	102	V20	LDC	IDA
100	Philippines	117	V20		

	Country	Population millions	Classifications and memberships		
101	Ethiopia	127	V20	LDC	IDA
102	Bangladesh	173	V20	LDC	IDA
103	Nigeria	224			IDA
104	Pakistan	240			IDA

	Associate SIDS members	Population thousands
1	Montserrat	4
2	Anguilla	16
3	British Virgin Islands	31
4	St Maarten	32
5	American Samoa	43
6	Turks & Caicos	46
7	Northern Marianas	50
8	Bermuda	64
9	Cayman Islands	69
	10 US Virgin Islands	99
11	Aruba	106
12	Guam	172
13	Curaçao	192
14	New Caledonia	293
15	French Polynesia	308
16	Martinique	366
17	Guadeloupe	395
18	Puerto Rico	3.2 million

Population source: UN Population Division 2022 Revisions. Date accessed: 30 October 2023
Population by Country (2023) - Worldometer (worldometers.info)

Annex 4: Components and costs of parametric transactions

In this study premium figures refer to **'pure premium'**, also known as 'technical rate', which is defined as the price of risk, or expected losses (payouts/claims) without additional underwriting costs and transaction-related expenses. This section summarises these additional cost components for parametric transactions placed in i) re/insurance markets and ii) capital markets (eg cat bonds).

This study has not estimated these additional expenses. There is no precedent for a donor-funded market operating at large scale, with broad Global South scope and the long-term nature of a prospective L&D risk-sharing market. These attributes suggest that additional costs and expenses would be a relatively low percentage of pure premium compared to, for example, existing disaster risk financing transactions, which are generally small in scale and often one-off transactions.

In the context of donor-funded L&D risk-sharing transactions, it would be advantageous if all cost components of transactions were broken down and, in most cases, published. This openness would provide valuable data for research and analysis; encourage competition, confidence and trust in the market; and help establish shared norms, standards and transparency on transaction expenses.

Components of parametric transactions in insurance and reinsurance markets:

- **Pure premium** (*technical rate)***:** the price of risk equal to expected payouts.
- **Uncertainty loading:** additional premium applied for uncertainty of technical rate.
- **Cost of capital:** regulators require that each risk underwritten is supported by a proportionate level of underwriting capital. Investors and creditors require defined returns.
- **Underwriting expenses:** staff, analytics and wider costs of an insurance operation.
- **Underwriting profit:** target profit margin added to pure premium and cost.
- **Broking fees:** advice, analytics, transaction structuring, market-making and placement, administering premiums and payouts.
- **Calculation agent:** independent body verifying if parametric thresholds are triggered and the quantum of payout due.

Components of parametric transactions in capital markets (including cat bonds):

- **Bond underwriting fees:** to structure, price and sell the bond issuance to investors.
- **Bond legal fees:** for structuring and ensuring compliance with regulatory requirements.
- **Bond administration fees:** record-keeping, financial reporting and back-office functions.
- **Rating agency fees:** paid for the rating of the cat bond by established rating agencies.
- **Special Purpose Vehicle (SPV) fees:**
    - **Initial and ongoing management fees:** to the management firm that sets up and manages the SPV or entity issuing the cat bond.
    - **Audit fees:** to ensure accurate financial reporting and compliance.
    - **Trustee fees:** to the trustee who oversees the SPV and ensures that it complies with the terms of the bond and protects the interests of the investors.
- **Collateral management fees:** if the bond uses collateral (such as Treasury bills) to secure the payments, there are fees for managing this collateral.
- **Liquidity facility fees:** if a liquidity facility is used (to enhance the liquidity of the bond), fees are paid for this service.
- **Risk-free element of the coupon:** paid from the returns on the risk-free securities (eg Treasury bills) held in the collateral fund.

Acronyms

AAL – Annual Average Loss

AOSIS – Alliance of Small Island States

ARC – African Risk Capacity

CCRIF SPC – Caribbean Catastrophe Risk Insurance Facility Segregated Portfolio Company

CEDIM - Centre for Disaster Management and Risk Reduction Technology

EP – Exceedance Probability

EQC – New Zealand Earthquake Commission

GDP – Gross Domestic Product

GRII – Global Resilience Index Initiative

GRMA – Global Risk Modelling Alliance

IDA – International Development Association

IDF – Insurance Development Forum

IIED - International Institute for Environment and Development

L&D – Loss and Damage

LDCs – Least Developed Countries

NACE – Nomenclature of Economic Activities

PCL – Preventative adaptation, Contingent arrangements, Loss acceptance

PCRIC – Pacific Catastrophe Risk Insurance Company

PML – Probable Maximum Loss

SEADRIF – Southeast Asia Disaster Risk Insurance Facility

SIDS – Small Island Developing States

UNDP – United Nations Development Programme

UNDRR – United Nations Office for Disaster Risk Reduction

UNFCCC – United Nations Framework Convention on Climate Change

V20 – Vulnerable Twenty

WFCP – World Forum of Catastrophe Programmes

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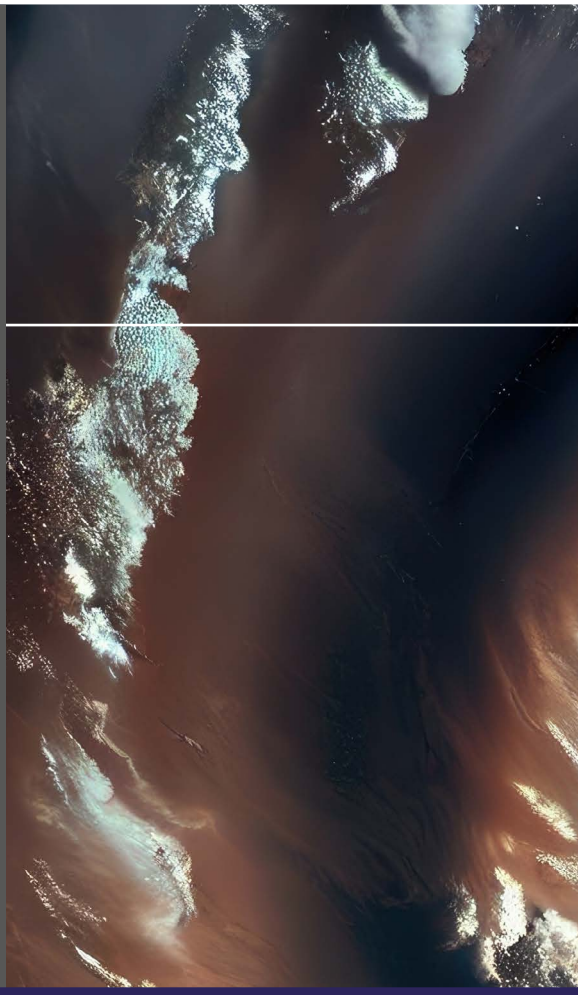

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