Chapter 7

Small Islands, Big Opportunities

Small Island Developing States (SIDS) face **high levels of disaster risk** and have comparatively **low economic resilience**. Most of the countries with a **large proportion of** their total **produced capital at risk** to earthquakes, cyclone wind damage and tsunamis are SIDS. Solomon Islands, Dominica and Vanuatu all face **losses of over 30 percent** of the value of their produced capital in the case of a one-in-250 year earthquake.

14 of the 16 countries where **wind damage from** a one-in-250 year **tropical cyclone** would represent **more than 60 percent of annual capital formation** are SIDS or recognised small island territories; and **10 out of 13 countries in the case of earthquakes**.

With small and undiversified economies, **many SIDS are severely constrained** to participate successfully in the global economy. But SIDS are probably the group of countries where **investments in disaster risk reduction and climate change adaptation are likely to reap the greatest benefits**. Investing in disaster risk reduction is most likely the best chance these countries have to **attract investment, strengthen resilience and improve competitiveness and sustainability**.

7.1 Disaster risk in SIDS

In absolute terms, disaster risk in SIDS represents only a small proportion of global risk. However, because of their small size, often a very large proportion of their total produced capital is at risk to earthquakes, tropical cyclones and tsunamis.

The United Nations recognises 38 Small Island Developing States (SIDS) and a further 14 non-UN member states and territories with similar characteristics in three regions: the Caribbean; the Pacific; and the Indian Ocean.[i]

SIDS are highly exposed to a range of hazards. A large part of their population lives in the Low Elevation Coastal Zone,[ii] making them highly exposed to storm surges and tsunamis. Maldives, for example, has more than 80 percent of its population in this zone (Mahon et al., 2012). Volcanic islands often feature relatively large, steep river catchment systems. These have risks of significant flash flooding and debris flows.

The GAR global risk model allows the estimation of risks for a number of these hazards, permitting a better understanding of the levels of disaster risk faced by SIDS.

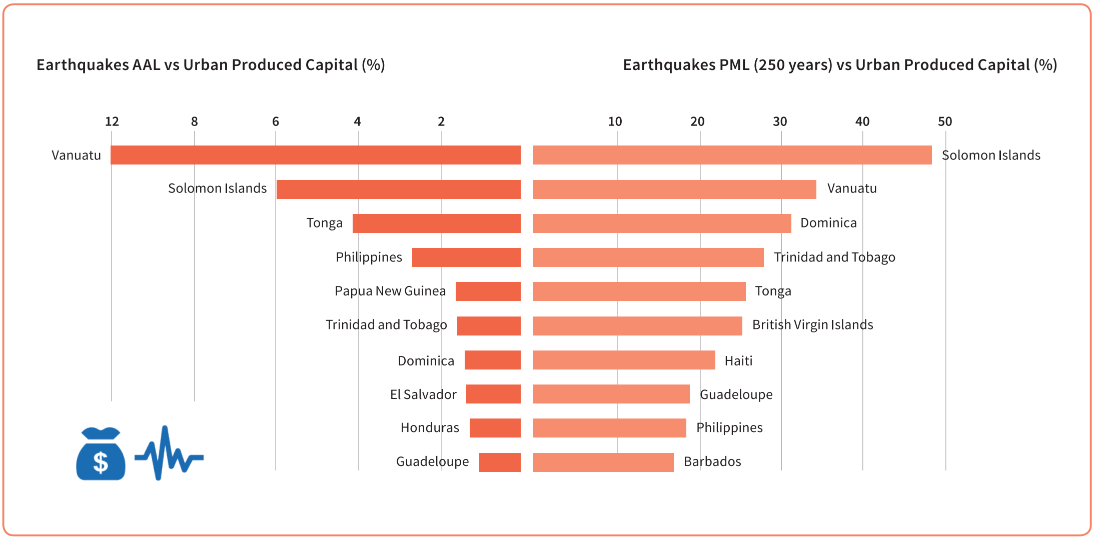
Given their small size, the expected annual average losses (AAL) from earthquakes and tropical cyclone wind damage represent respectively only 2 percent and 1.4 percent of the global total.

However, precisely because of their small size, often a very large proportion of their total produced capital is at risk. For example, as Figure 7.1 highlights, in the case of a 1-in-250 year earthquake, 8 of the 10 countries that would lose the largest proportion of the value of their urban produced capital are SIDS. In the Solomon Islands, Dominica and Vanuatu, between 30 percent and 50 percent of the value of their urban produced capital would be lost.

As Figure 7.2 shows, in the case of a catastrophic one-in-250 year cyclone, the top 10 countries in terms of losses in relation to the value of urban produced capital are all islands, 6 of which are SIDS. Turks and Caicos Islands, Cayman Islands and Guadeloupe could all expect to lose more than 30 percent of the value of their urban produced capital to wind damage.

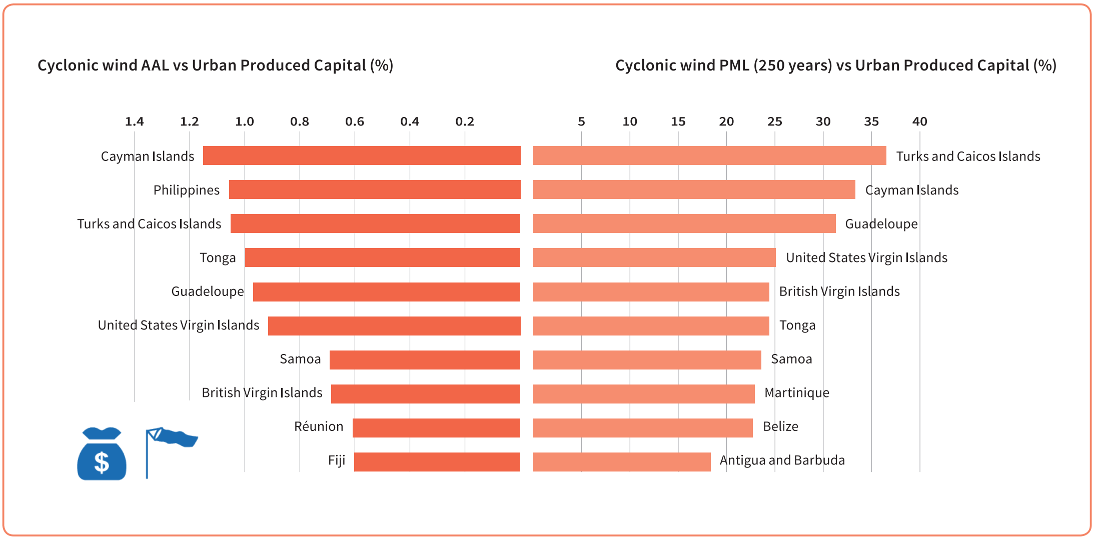
A significant proportion of their population and produced capital is also exposed to extreme tsunamis (Figure 7.3). The 2009 tsunami that affected Samoa,

Figure 7.1 Top 10 countries in terms of AAL (left) and probable maximum loss (PML) (right) from earthquakes as a percentage of urban produced capital



(Source: UNISDR, based on GAR global risk model)

Figure 7.2 Top 10 countries with highest AAL (left) and PML (right) from cyclonic winds

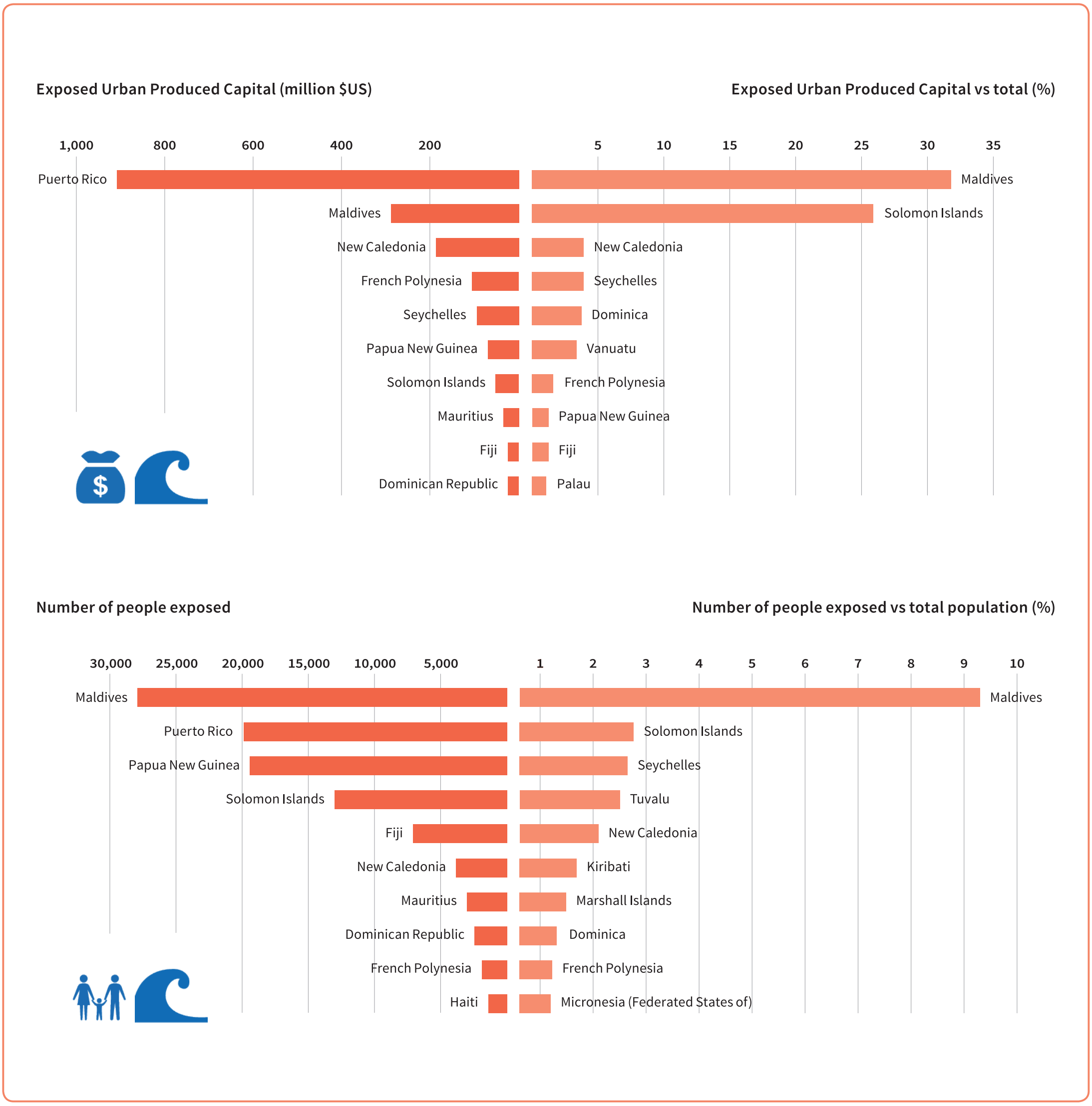


(Source: UNISDR, based on GAR global risk model)

American Samoa and Tonga in the Pacific demonstrated the kind of impacts that can be expected. Figure 7.3 shows the exposure of population and urban produced capital to a destructive one-in-500 year tsunami. Both Solomon Islands and Maldives have more than 25 percent of their urban produced capital exposed to tsunamis. And Maldives has nearly 10 percent of its population exposed.

SIDS also experience four types of flooding: flash floods,[iv] river floods, coastal floods and ponding floods. The island of Samoa, for example, has historically suffered coastal flooding. In 2008, it was estimated that the associated AAL could be up to US$25 million (Economics of Climate Adaptation Working Group, 2009). Ponding flooding is a serious hazard in some Caribbean SIDS. In these countries,

Figure 7.3 Absolute and relative urban produced capital (top) and population (bottom) exposed to tsunamis in SIDS[iii]



(Source: UNISDR, based on GAR global risk model)

Table 7.1 Annual average losses and probable maximum losses (250 years return period) from ponding flooding for selected Caribbean countries

	AAL/UPC (%)	AAL/GFCF (%)	PML_{250}/UPC (%)	PML_{250}/GFCF (%)
Grenada	0.02	0.11	0.09	0.61
Trinidad and Tobago	0.01	0.14	0.07	0.73
Puerto Rico	0.02	0.24	0.16	2.44
Barbados	0.04	0.32	0.30	2.33
Guadeloupe	0.02	NA	0.25	NA
Martinique	0.01	NA	0.10	NA

(Source: GAR global risk model)

floods are often associated with the accumulation of rainfall in low-lying areas.

Table 7.1 highlights AAL associated with ponding flooding for six Caribbean countries. Barbados has the highest proportion of its urban produced capital at risk, followed by Puerto Rico. In most countries, wind damage represents a more significant risk than ponding floods. However, in Barbados, the AAL of ponding floods is higher than that of wind damage. This type of flooding is particularly disruptive because it can last for several days, interrupting transport and posing health risks. Thus, although direct losses might be low compared with other hazards, indirect losses for local households and businesses might be significant.

7.2 Climate change impacts on SIDS

SIDS are among the countries that contribute least to climate change yet stand to suffer most from its negative impacts. Disaster losses are projected to increase, due to sea level rise, the increased severity of cyclones worsening water scarcity and drought and other factors.

SIDS contribute less than 1 percent of total carbon dioxide emissions.[v] But given their high exposure to weather-related hazards, they are likely to disproportionately suffer from the magnifying effect of climate change. These effects include sea level rise and associated flood and storm surge hazard, increasing cyclonic wind intensity, erosion, saltwater intrusion into coastal aquifers and worsening water scarcity and drought (CCRIF, 2010; Perch-Nielsen, 2009; UNWTO and UNEP, 2008; IPCC, 2012; Simpson et al., 2008).

For example, SIDS located in the Pacific can expect to experience extreme events such as storm surges, heavy rainfall, tropical cyclones, droughts and heat waves with significant negative impacts (Australian Bureau of Meteorology and CSIRO, 2011). In the Caribbean, changes in annual hurricane frequency and intensity could result in additional annual losses of US$446 million by 2080—incurred mainly from business interruption to the tourism sector (Toba, 2009).

Table 7.2 highlights likely climate change impacts on SIDS identified by the IPCC (2012).

7.3 Disaster losses and economic resilience

As a result of limited diversification and small market size, the economies of many SIDS are not resilient to disaster loss. Both estimated and observed losses represent a high proportion of annual capital formation and contribute to sluggish longer-term growth.

Disaster risks pose a serious threat to SIDS economies. Figure 7.4 shows that in the case of catastrophic earthquakes with a 250 year return period, 10 out of the 13 countries where losses would be greater

Table 7.2 Projected changes in climate extremes for SIDS

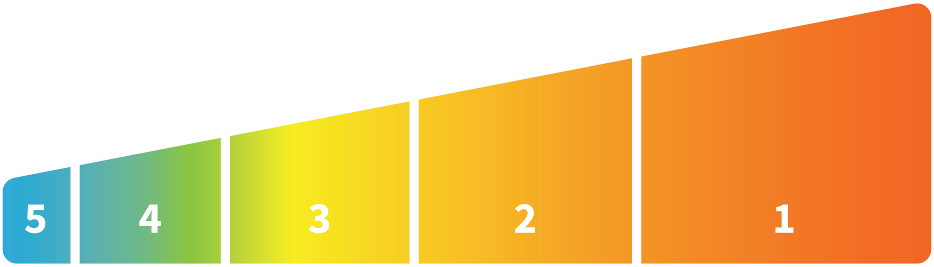
Example	Changes in climate extremes projected (to 2100)
Inundation related to extreme sea levels in tropical small islands developing states	*Very likely* that mean sea level rise will contribute to upward trends in extreme coastal high water levels. (Observed changes since 1950 show a ***likely increase*** in extreme coastal high water worldwide related to increases in mean sea level). *High confidence* that locations currently experiencing coastal erosion and inundation will continue to do so due to increasing sea level, in the absence of changes in other contributing factors.
Increasing losses from cyclones	*Likely increase* in average tropical cyclone maximum wind speed, although increase may not occur in all ocean basins. Coupled with the very likely sea level rise, the ***likely increase*** in tropical cyclone maximum wind speed is a specific issue for tropical small islands states. Heavy rainfall associated with tropical cyclones ***likely to increase***.

(Source: adapted from Mahon et al., 2012 (based on IPCC, 2012))

than 60 per cent of their annual capital formation are SIDS. In the case of cyclones, 13 out of 16 countries are SIDS or recognised small island territories.

Countries with low levels of investment and high AAL are in the long term less likely to be able to absorb losses even from more frequent, less severe events. Many SIDS have annual average losses from both earthquakes and cyclonic winds above 1 percent of their annual average capital formation (Figure 7.5). For the Solomon Islands, Tonga and

Figure 7.4 Probable maximum losses from one-in-250 year earthquakes (top) and cyclonic wind damage (bottom) as a percentage of gross fixed capital formation (SIDS highlighted in bold)



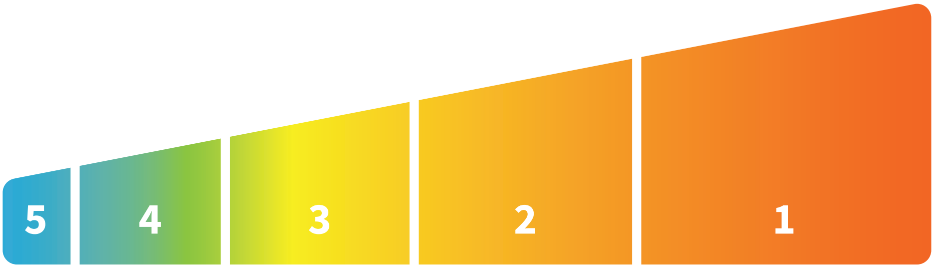
1 = More than 80%
Antigua and Barbuda, **Barbados**, **Dominica**, El Salvador, **Grenada**, **Puerto Rico**, Philippines, **Solomon Islands**, **Trinidad and Tobago**

2 = 60 - 80%
Dominican Republic, Honduras, **Saint Vincent and the Grenadines**, **Tonga**

3 = 40 - 60%
Aruba, Greece, Japan, Nicaragua

4 = 20 - 40%
Azerbaijan, Bhutan, Bolivia (Plurinational State of), **British Virgin Islands**, Colombia, Costa Rica, Cyprus, Djibouti, Ecuador, Georgia, Guatemala, Iceland, **Jamaica**, Liechtenstein, Malta, **New Caledonia**, Nepal, Peru, **Palau**, San Marino, Taiwan Province of China, **Vanuatu**, **Samoa**

5 = 10 - 20%
Afghanistan, Albania, Algeria, Armenia, Bangladesh, Bulgaria, Chile, **Fiji**, Iran (Islamic Republic of), Israel, Italy, Jordan, Kyrgyzstan, Lebanon, Monaco, Mexico, Oman, Pakistan, Panama, **Papua New Guinea**, **Saint Lucia,** Slovenia, Syrian Arab Republic, Tajikistan, Tunisia, Turkey, Uzbekistan, Venezuela (Bolivarian Republic of)



1 = More than 80%
Antigua and Barbuda, **Bahamas**, **Belize**, **Barbados**, Cayman Islands, **Samoa**, **French Polynesia**, **Micronesia (Federated States of)**, Philippines, **Puerto Rico**

2 = 60 - 80%
Aruba, **Comoros**, Honduras, **Jamaica**, **Mauritius**, **Tonga**

3 = 40 - 60%
Dominica, **Fiji**, **Grenada**, Hong Kong Special Administrative Region of China, Japan, Mexico, **Palau**, Republic of Korea, **Saint Vincent and the Grenadines**, Taiwan Province of China

4 = 20 - 40%
British Virgin Islands, **Dominican Republic**, Macao Special Administrative Region of China, **Trinidad and Tobago**

5 = 10 - 20%
Bangladesh, **Cuba**, Guatemala, Madagascar, Mozambique, **Saint Lucia**

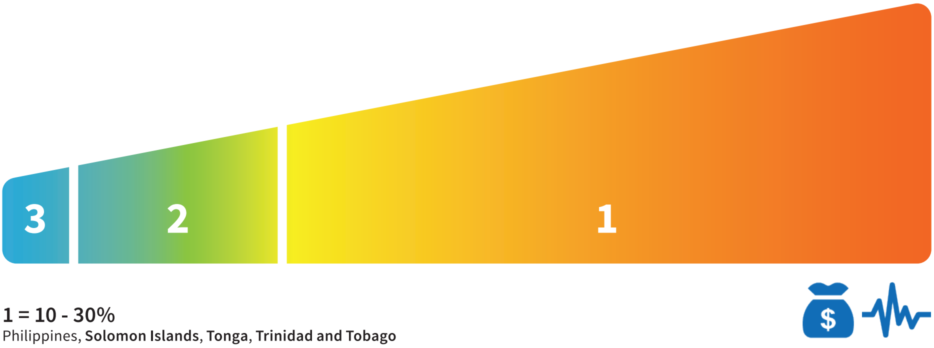
(Source: GAR global risk model)

Trinidad and Tobago, annual average losses from earthquakes exceeds one-tenth of annual produced capital.

The estimations of the risk model are confirmed in some countries by observed losses. For example, in Jamaica, observed total average losses between 1991 and 2011 were equivalent to 2.6 percent of its gross fixed capital formation.

The effects of disaster loss are amplified in SIDS by

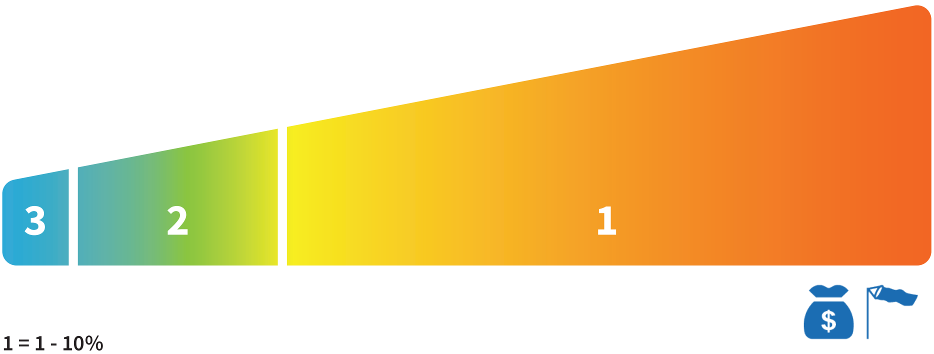
Figure 7.5 Annual average losses from earthquakes (top) and cyclonic winds (bottom) compared with gross fixed capital formation, with SIDS highlighted in bold



1 = 10 - 30%
Philippines, **Solomon Islands**, **Tonga**, **Trinidad and Tobago**

2 = 1 - 10%
Afghanistan, **Antigua and Barbuda**, Azerbaijan, **Barbados**, **British Virgin Islands**, Chile, Colombia, Costa Rica, **Dominica**, **Dominican Republic**, Ecuador, El Salvador, Georgia, Greece, **Grenada**, Guatemala, Honduras, Iran (Islamic Republic of), Japan, Kyrgyzstan, **New Caledonia**, Nicaragua, Pakistan, **Papua New Guinea**, Peru, **Puerto Rico**, **Saint Vincent and the Grenadines**, **Samoa**, Taiwan Province of China, Tajikistan, Turkey, Uzbekistan, **Vanuatu**

3 = 0.1 - 1%
Albania, Algeria, Argentina, Armenia, **Aruba**, Austria, **Bahrain**, Bangladesh, **Belize**, Bhutan, Bolivia (Plurinational State of), Brunei Darussalam, Bulgaria, Cayman Islands, **Comoros**, Croatia, **Cuba**, Cyprus, Djibouti, Egypt, **Fiji**, Germany, Hungary, Iceland, Indonesia, Iraq, Israel, Italy, **Jamaica**, Jordan, Kazakhstan, Kuwait, Lebanon, Liechtenstein, Malaysia, Malta, Mexico, Monaco, Montenegro, Morocco, Nepal, Netherlands, New Zealand, Oman, **Palau**, Panama, Qatar, Republic of Moldova, **Saint Lucia**, San Marino, **Singapore**, Slovakia, Slovenia, Switzerland, Syrian Arab Republic, The former Yugoslav Republic of Macedonia, Tunisia, Turkmenistan, United Kingdom of Great Britain and Northern Ireland, United Arab Emirates, United States of America, Venezuela (Bolivarian Republic of), Yemen



1 = 1 - 10%
Antigua and Barbuda, **Aruba**, **Bahamas**, **Barbados**, **Belize**, Cayman Islands, **Comoros**, **Dominica**, **Fiji**, **French Polynesia**, Honduras, Hong Kong Special Administrative Region of China, **Jamaica**, Japan, Macao Special Administrative Region of China, **Mauritius**, Mexico, **Micronesia (Federated States of)**, **Palau**, Philippines, **Puerto Rico**, Republic of Korea, **Samoa**, Taiwan Province of China, **Tonga**

2 = 0.1 - 1 %
Bangladesh, **British Virgin Islands**, Brunei Darussalam, China, **Cuba**, **Dominican Republic**, El Salvador, **Grenada**, Guatemala, Madagascar, Mozambique, **New Caledonia**, New Zealand, Nicaragua, **Saint Lucia**, **Saint Vincent** and **the Grenadines**, **Seychelles**, **Solomon Islands**, **Trinidad and Tobago**, United States of America, **Vanuatu**, Venezuela (Bolivarian Republic of)

3 = 0.01 - 0.1 %
Australia, Cambodia, Canada, Costa Rica, **Guyana**, **Haiti**, India, Indonesia, Lao People's Democratic Republic, Malawi, Malaysia, Nepal, Oman, Pakistan, Panama, **Papua New Guinea**, South Africa, Sri Lanka, **Suriname**, Swaziland, Viet Nam, Zimbabwe

(Source: GAR global risk model)

their small size, which means that hazard events may affect their entire territory and economy, because their economies are often concentrated in one or two sectors, and because many countries also have high levels of indebtedness and hence constrained fiscal space to invest. Additional common challenges include remoteness, narrow resource base, degradation of their marine and terrestrial environment and exposure to global environmental challenges, including climate change (UNDESA, 2010). Thirty-four SIDS have high or extreme levels of environmental vulnerability (UNEP-SOPAC, 2005).

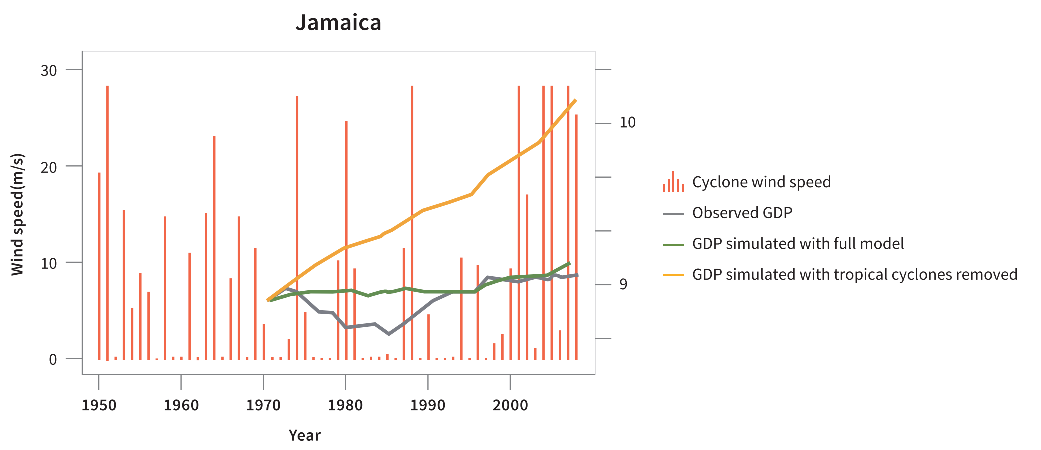
With small and undiversified economies, many SIDS are severely constrained to participate successfully in the global economy. Geographic distance, lower trade and transport volumes and weak infrastructure generally mean that SIDS have higher overall logistics and transport costs—undermining their competitiveness. In the case of Jamaica (Figure 7.6), for example, the impact of repeated tropical cyclones may have contributed to sluggish growth over decades.

These challenges also present opportunities, however. Regional initiatives such as the Caribbean Catastrophe Risk Insurance Facility (CCRIF) and more recently the PCRAFI (see Box 7.1) are facilitating greater awareness of the fiscal risk posed by disasters in the Caribbean and Pacific Island SIDS; they are also providing options for countries to reduce their financing gap. To be effective and sustainable in the medium term, these programmes need to be accompanied by commensurate investments to reduce disaster risks. In providing comprehensive risk assessments, they are also providing tools to do so.

On their own, it would be difficult for many SIDS to address their high levels of disaster risk, low levels of economic resilience and challenged competitiveness and sustainability. As the PCRAFI highlights, through effective regional mechanisms, the critical mass of technical and financial resources to reduce disaster risk becomes more readily available.

If these resources can be mobilised, then the biggest challenge for SIDS can also be their best opportunity. From one perspective, disaster risk presents a serious threat to these countries' economic competitiveness. However, precisely because of this combination of high risks and low resilience, SIDS are probably the countries where investments in disaster risk reduction and climate change adaptation are likely to reap the greatest benefits. Investing in disaster risk reduction is most likely the best chance

Figure 7.6 Impact of tropical cyclones on GDP growth in Jamaica



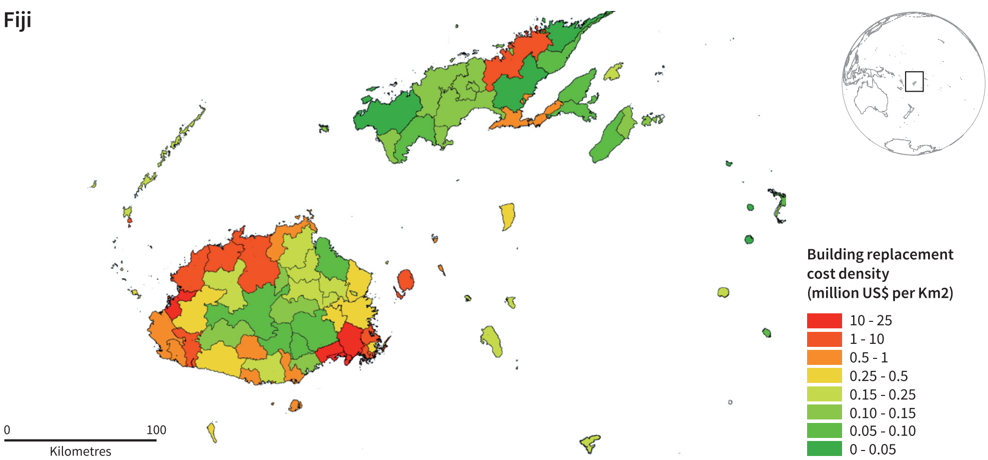
(Source: Hsiang and Jina, 2012)

Box 7.1 Comprehensive risk assessment in the Pacific

Based on the experience of the Caribbean Islands, the Pacific Island countries decided to set up a risk transfer facility for the region. This gave birth to the Pacific Catastrophe Risk Assessment and Financing Initiative (PCRAFI).[vi] PCRAFI provides Pacific Island countries with disaster risk modelling and assessment tools (SOPAC, 2010). It also encourages dialogue among countries on integrated financial solutions for reducing their financial vulnerability to disasters and to climate change.

Initially, PCRAFI provided 15 countries with disaster risk assessment tools (see Figure 7.7 below). Among these tools are regional historical hazard and loss databases; probabilistic hazard models for major hazards including cyclones, earthquakes and tsunamis; and a comprehensive exposure database.

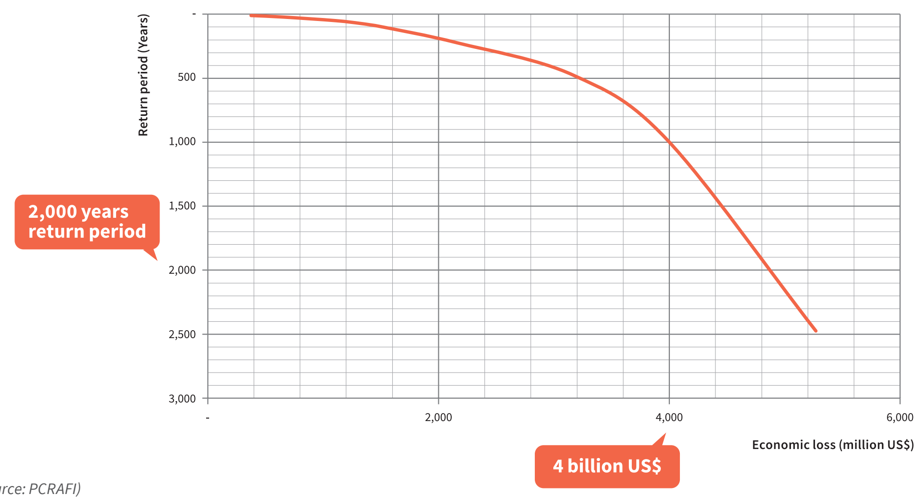
Fig 7.7 Map of annual average losses in Fiji



(Source: PCRAFI)

Country-specific catastrophe risk models have been developed using these tools, along with catastrophe risk profiles (Figure 7.8).

Figure 7.8 Loss exceedance curve for Fiji



(Source: PCRAFI)

(Source: UNISDR)

these countries have to attract investment, strengthen resilience and improve competitiveness and sustainability.

Notes

i http://www.un.org/special-rep/ohrlls/sid/list.htm.

ii Defined as the continuous area along the coast that is less than 10 metres above sea level.

iii Exposure here is calculated by overlapping the total capital stock and the population with the footprint of the tsunami run-up for a return period of approximately 500 years (see Chapter 2).

iv Ponding flood is also referred to as 'pluvial flood' as it is the type of flooding that derives from direct run-off of rainfall water and caused by the lack (or overcharge) of a natural drainage system (www.floodsite.net).

v United Nations Statistics Division's Millennium Development Goals Indicators: http://mdgs.un.org/unsd/mdg/SeriesDetail.aspx?srid=749&crid=.

vi PCRAFI is a joint initiative of the Secretariat of the Pacific Community (SPC)/Applied Geoscience and Technology Division (SOPAC), the World Bank and the Asian Development Bank (ADB).