

Choosing a Multidimensional Vulnerability Index for Caribbean Countries

ECLAC

What is vulnerability?

- The concept of vulnerability is applied in many different fields.
 - Computer science (computer security)
 - Economy (sectorial, current account and external vulnerability)
 - Environmental and climate change (social adaptation to climate change and natural hazards)
 - Military (as a subset of survivability)
 - Psychology (cognitive vulnerability, emotional vulnerability)
 - Social vulnerability (stressors and shocks i.e. abuse, social exclusion and natural hazards)
- Nevertheless, there is not a clear conceptual framework of the term.
 - Timmerman (1981) notes that *“vulnerability is a term of broad use as to be almost useless for careful description at the present, except as a rhetorical indicator of areas of greatest concern”*.

Vulnerability can manifest itself in multiple dimensions.

- **Physical:** relates to buildings, infrastructure and agriculture. Vulnerability analysis should examine the risk faced by critical facilities (hospitals, emergency services, transport, communication systems, essential services, etc.)
- **Social:** refers to vulnerable groups such as women, children, elderly persons, mentally and physically handicapped, poor people, refugees, etc.
- **Economic:** Hazard-causing losses to economic assets and processes, either direct (damages or destruction to physical and social infrastructure and its repair or replacement cost, crop damages, etc.) or indirect (losses in production, employment, vital services, increasing income disparities)

Climate change and natural hazards are highly relevant in Caribbean countries.

- There is a consensus that the global climate is changing, and more importantly, that the negative consequences of climate change threaten all countries – with developing regions and Small Island Developing States (SIDS) being the most vulnerable.
- Caribbean SIDS economic development has been restrained due to a variety of factors: lack of economies of scale in production; trade and external dependency; structural unemployment; falling labor productivity; limited access to financial resources and debt as a result of large primary and current account deficits.
- Moreover, climate change and climate related disasters reduces both output and government revenue and demands high levels of expenditures on disaster preparedness and reconstruction.

SIDS vulnerability

SIDS are the countries most prone to disasters in the world due to their geographical location, limited physical size and high-population density in low-elevation coastal areas.

In relation to their capital stock, investment and social expenditure, SIDS face the highest potential losses associated with several hazards.

SIDS would be expected to lose 20 times more of their capital stock each year compared to Europe and Central Asia.

SIDS combined Average Annual Losses is equivalent to 10 per cent of their total annual capital investment, compared to less than 2 per cent in East Asia and the Pacific and around 1.2 per cent in Europe and Central Asia.

The Average Annual Losses in SIDS is equivalent to almost 20 per cent of their total social expenditure, compared to only 1.19 per cent in North America and less than 1 per cent in Europe and Central Asia.

SIDS vulnerability

For this analysis, we divided SIDS into three groups:

1. Caribbean includes the following countries: Antigua and Barbuda, Bahamas, Barbados, Belize, Cuba, Dominica, Dominican Republic, Grenada, Guyana, Haiti, Jamaica, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Suriname, Trinidad and Tobago.
2. The Pacific region is comprised of 13 countries: Fiji, Kiribati, Marshall Islands, Micronesia (Federated States of), Nauru, Palau, Papua New Guinea, Samoa, Solomon Islands, Timor-Leste, Tonga, Tuvalu, Vanuatu.
3. Atlantic, Indian Ocean, Mediterranean and South China Sea (AIMS) comprises 9 countries: Bahrain, Cabo Verde, Comoros, Guinea-Bissau, Maldives, Mauritius, Sao Tomé and Príncipe, Seychelles and Singapore.

SIDS vulnerability

Among groups of SIDS, the Caribbean is the most prone to disasters as we will show in four dimensions:

- Number of disasters
- Type of disasters
- Affected Population
- Damage

Number of Disasters

	Caribbean	AIMS	Pacific
Number of Disasters	341	66	203
Average annual disasters			
1990-99	8.7	2.1	6.9
2000-09	13.9	3.1	7.0
2010-18	12.8	1.6	7.1

Source: EM-DAT

Type of Disasters

	Caribbean	AIMS	Pacific
Biological*	18	23	14
Droughts	19	6	17
Floods	112	11	39
Geophysical**	8	9	45
Other***	6	2	11
Storms	178	15	77

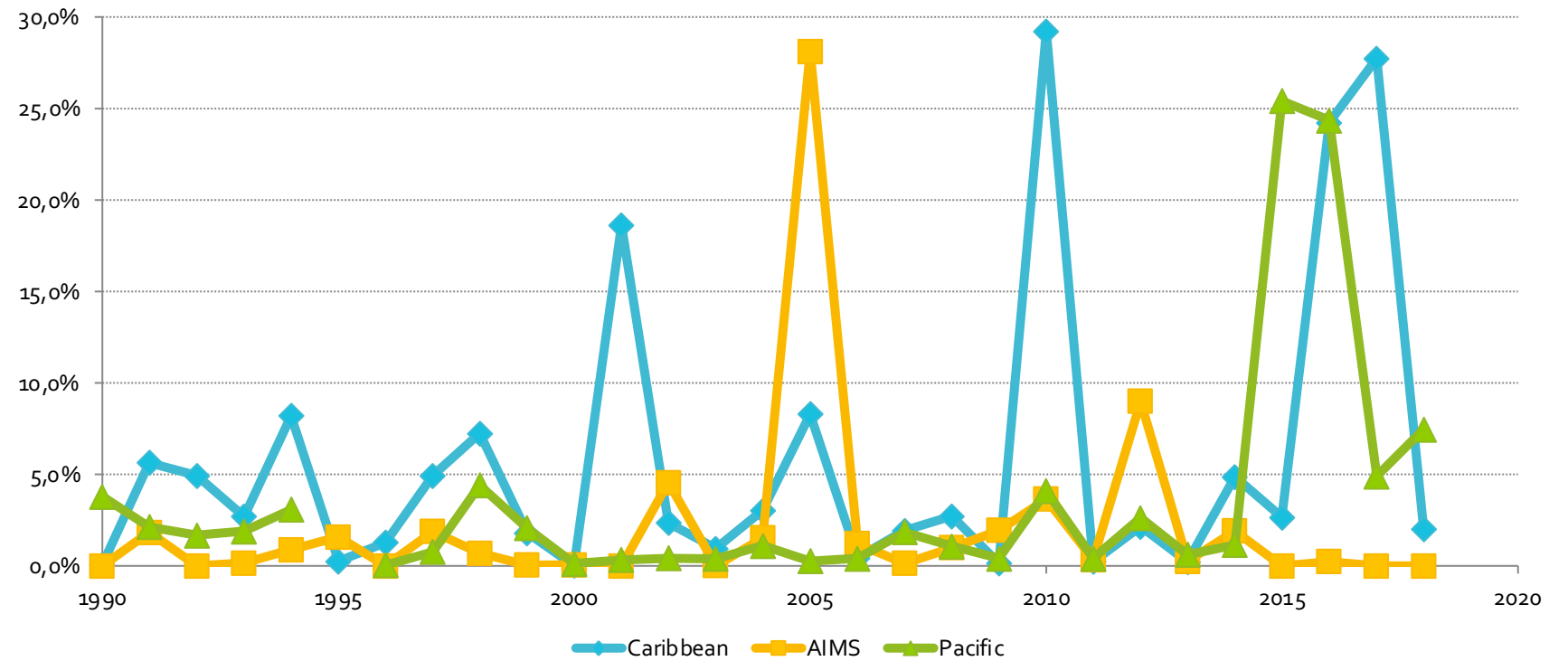
Source: EM-DAT

Affected Population

The indicator to measure affected population is the ratio total affected population to total population. This indicator shows the average percentage of the affected population in the countries that had a disaster in a specific year.

To compare the three groups of SIDS, we use for each year a weighted average of the ratio affected population in island in relation to the total population in island. For each island, the weight is the ratio of the total population in island to the sum of the populations of all islands in its region that suffered a disaster that year.

Affected Population



Source: ECLAC on the basis of EM-DAT

Affected Population

The average of this indicator for the Caribbean SIDS is 5.8 per cent. In six years 2001, 2005, 2010, 2015, 2016 and 2017, the indicator was greater than 15 per cent. The maximum value, 29.2 per cent, was reached in 2010.

For the Pacific SIDS, the average is lower at 3.5 per cent. Only in two years, 2014 and 2015, the average was greater than 15 per cent. The maximum value was 25.4 per cent reached in 2015.

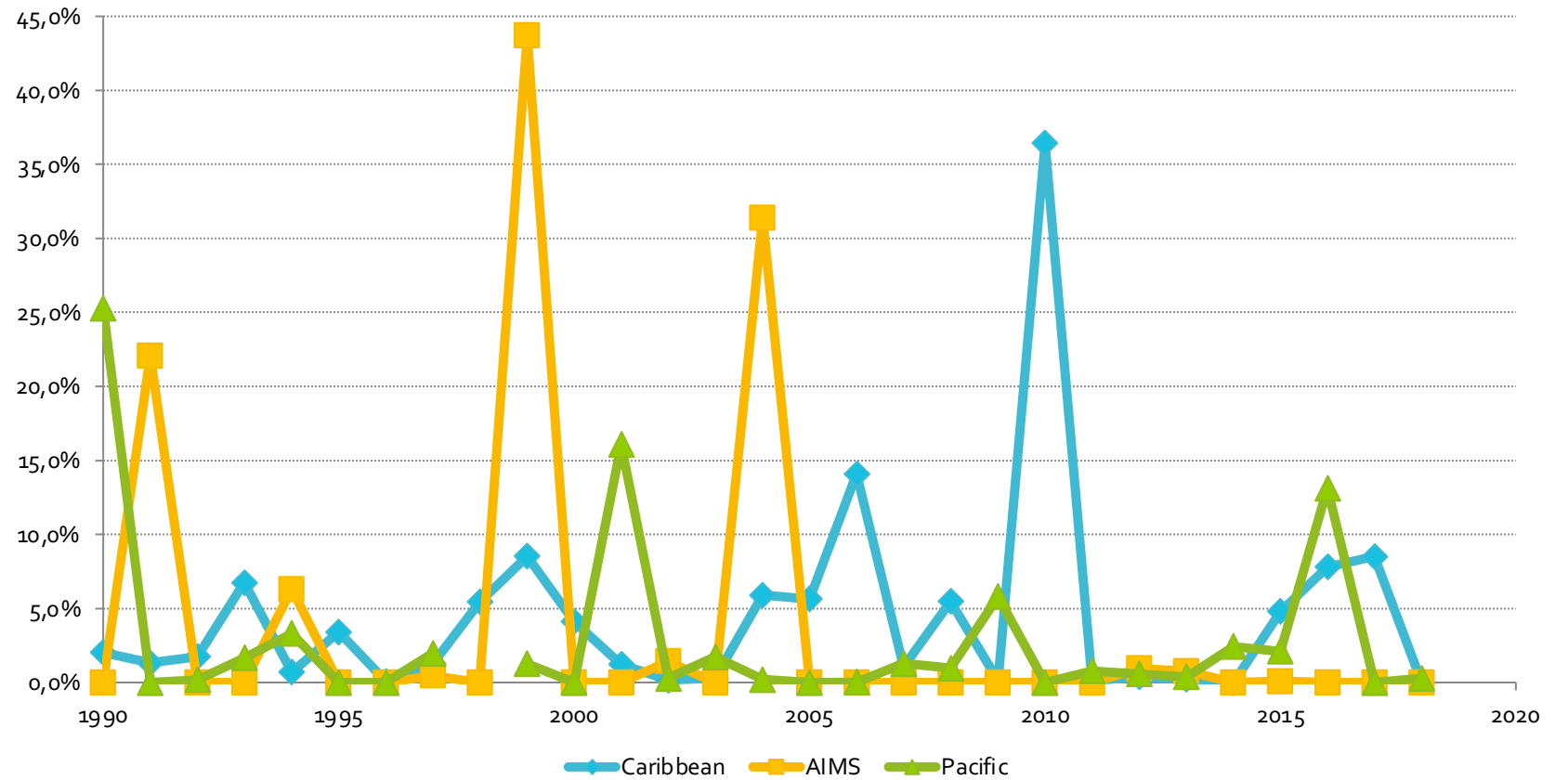
In the case of the AIMS, the average of this indicator was 2.1 per cent. Only in one year was this indicator greater than 15 per cent, reaching 28.1 per cent in 2005.

Damage

The indicator used to compare damage among these three groups is the Damage to GDP Ratio. This indicator shows the percentage of damage in relation to the regional average GDP of affected countries per year, considering the countries that reported damage in that year.

To compare the damage in relation to the GDP for the three regions, for each year t , the damage to GDP ratio was estimated considering a weighted average of the ratio in relation to the sum of the GDP in countries that suffered a disaster that year. The weighting factor, in this case, is the GDP of the affected country over the sum of the GDP of all affected countries on that year.

Damage



Source: ECLAC on the basis of EM-DAT

Damage

During the 1990-2018 period, the largest average ratio corresponds to the Caribbean SIDS, 4.4 per cent, followed by the AIMS, 3.7 per cent, and Pacific, 2.8 per cent. These averages demonstrate that the recurrent impacts of damages might be more detrimental to the Caribbean.

Granted that this is a relative measure, absolute numbers give us an even better perception of how impactful storms are in the Caribbean. It is important to note that although the average for the year 2010 is high in the region due to the earthquake in Haiti, the 2017 hurricane season had a devastating economic impact in the Caribbean with the largest recorded damage reaching more than 15 billion in SIDS alone. Moreover, nearly every year, at least one country in the region has experienced damage higher than 10 per cent of its GDP.

Despite common dimensions, there are competing frameworks of vulnerability, resulting in different means of vulnerability measurement as well.

- Füssel (2007) illustrates the divisions among conceptual clusters by asking a **hypothetical question**: “which of two regions is more vulnerable to climate change and variability: Florida State (USA) or Tibet?”
- While some scholars would answer Tibet due to resource limitations, political instability, and its less diverse economy, others would say Florida due to its low elevation and exposure to hurricanes and sea level rise. Moreover, others may have difficulty answering the question or may choose not to answer the question unless provided with sufficient information, “preferably probabilistic, scenarios of regional climate change and sea level rise”.
- This has led to inconsistencies in the meaning of vulnerability within the academic community. Historically, more attention has been paid to vulnerability from a risk-threat perspective, so its deployment in climate change research and policy has focused primarily on mitigation rather than adaptation.
- Also, has led to differences between countries in international forums about the meaning of vulnerability and the level of vulnerability in a particular country or region. (Oculi, 2018)

As a result of the differences, the vulnerability measures differs across the indexes. We exemplify this from two of them.

Country	CVI (Commonwealth)	WRI (World Risk)	Agreement
Antigua and Barbuda	High	High	100%
Bahamas, The	High	Medium Low	33%
Barbados	Medium High	Low	33%
Belize	High	Medium High	66%
Cuba	#N/A	Medium Low	
Dominica	High	High	100%
Dominican Republic	Medium Low	High	33%
Grenada	High	Low	0%
Guyana	High	High	100%
Haiti	Medium High	High	66%
Jamaica	Medium High	High	66%
St. Kitts and Nevis	High	#N/A	
St. Lucia	High	Medium Low	33%
St. Vincent and the Grenadines	High	Low	0%
Suriname	High	Medium High	66%
Trinidad and Tobago	Medium Low	Medium High	66%
		Mean agreement	54%

The six indexes we analyzed

Commonwealth Vulnerability Index (CVI), Commonwealth Secretariat (2000),
<https://thecommonwealth.org/small-states-resources>

Economic and Environmental Vulnerability Index (EVI), UN Committee for Development Policy (2008), Least Developed Countries (LDCs) | Department of Economic and Social Affairs,
<https://www.un.org/development/desa/dpad/least-developed-country-category/ldc-criteria.html>

Economic and Environmental Vulnerability Index (EVI) Modified. UNDP (2021),
<https://www.undp.org/content/dam/undp/library/km-gap/UNDP-Towards-a-Multidimensional-Vulnerability-Index.pdf>

Vulnerability Index to climate change in the Latin American and Caribbean Region, Development Bank of Latin America (CAF), <https://scioteca.caf.com/handle/123456789/509>

Multidimensional Vulnerability Index for the Caribbean, Caribbean Development Bank (CDB),
<https://www.caribank.org/publications-and-resources/resource-library/working-papers/measuring-vulnerability-multidimensional-vulnerability-index-caribbean>

World Risk Index, Institute for International Law of Peace (IFHV), Bündnis Entwicklung Hilft y Network on Humanitarian Action (NOHA), <http://www.ifhv.de/index.php/publications/worldriskreport>

Bibliographic references

A.Dubrie and others, "Synthesis of the Caribbean subregion midterm review report of the Small Islands Developing States (SIDS) Accelerated Modalities of Action (SAMOA) Pathway", Studies and Perspectives series ECLAC Subregional Headquarters for the Caribbean, No. 83 (LC/TS.2019/117-LC/CAR/TS.2019/6), Santiago, Economic Commission for Latin America and the Caribbean (ECLAC), 2019.

Brown, Dennis A.V. .Vulnerabilidad sociodemográfica en el Caribe: examen de los factores sociales y demográficos que impiden un desarrollo equitativo con participación ciudadana en los albores del siglo XXI, Autor(es) Institucional(es):NU. CEPAL. CELADE, Fecha de publicación:2002-04, Serie Población y Desarrollo No.25, 62 p. : tabs.Símbolo ONU:LC/L.1704-P

CEPAL | Universidad de Cantabria , Efectos del cambio climático en la costa de América Latina y el Caribe: vulnerabilidad y exposición, Autor(es) Institucional(es):NU. CEPAL | Universidad de Cantabria. Instituto de Hidráulica Ambiental, Fecha de publicación:2012-04 Serie:Documentos de Proyectos No.460, 174 p.: graf., ilus., tabs.Símbolo ONU:LC/W.460

Dercon, S. (2005). Risk, poverty and vulnerability in Africa. *Journal of African Economies*, 14(4), 483-488.

Escobar, Jairo, Fenómenos climáticos y vulnerabilidad: la ecuación determinante de los desastres: el caso de los pequeños estados insulares en desarrollo.Autor(es) Institucional(es):NU. CEPAL. División de Recursos Naturales e Infraestructura Fecha de publicación:1999-09-14, 42 p.: diagrs, tabs. LC/R.1935 handle <http://hdl.handle.net/11362/3135>

ECLAC-UNDRR , The coronavirus disease (COVID-19) pandemic: an opportunity for a systemic approach to disaster risk for the Caribbean, Foreword by the Executive Secretary of the Economic Commission for Latin America and the Caribbean (ECLAC), ECLAC-UNDRR, March 2021. <https://www.cepal.org/en/publications/46732-coronavirus-disease-covid-19-pandemic-opportunity-systemic-approach-disaster-risk>

Füssel, Hans-Martin, 2007. Vulnerability: a generally applicable conceptual framework for climate change research. *Global Environ. Change* 17 (2), 155-167.

Jacob Assa (HDRO, jacob.assa@undp.org) and Riad Meddeb (SIDS, riad.meddeb@undp.org), Towards a Multidimensional Vulnerability Index, UNITED NATIONS DEVELOPMENT PROGRAMME, Discussion Paper, February 2021. https://www.undp.org/content/undp/en/home/librarypage/poverty-reduction/development_cooperationandfinance/Towards-a-Multidimensional-Vulnerability-Index.html

Kaztman, Rubén (Ed.) Activos y estructuras de oportunidades: estudios sobre las raíces de la vulnerabilidad social en Uruguay Autor(es) Institucional(es):NU. CEPAL. Oficina de Montevideo |PNUD Fecha de publicación:1999-05, 357 p. : diagrs., tabs. LC/MVD/R.180, <http://hdl.handle.net/11362/28651>

Neil Oculi, Scott R. Stephenson, Conceptualizing climate vulnerability: Understanding the negotiating strategies of Small Island Developing States, *Environmental Science & Policy*, Volume 85, 2018, Pages 72-80, ISSN 1462-9011, <https://doi.org/10.1016/j.envsci.2018.03.025>.

Pizarro Hofer, Roberto, Vulnerabilidad social en América Latina y el Caribe, CEPAL. CELADE |Fondo de Población de las Naciones Unidas1999-05-30, 49 p.LC/DEM/R.298, <http://hdl.handle.net/11362/31258>

Rhiney, Kevon, Geographies of Caribbean Vulnerability in a Changing Climate: Issues and Trends, *Geography Compass*, VL - 9, IS - 3, ISSN - 1749-8198, <https://doi.org/10.1111/gec3.12199>

Scandurra, G., Romano, A. A., Ronghi, M., & Carfora, A. (2018). On the vulnerability of small island developing states: A dynamic analysis. *Ecological Indicators*, 84, 382-392

Virendra Proag,The Concept of Vulnerability and Resilience,Procedia Economics and Finance,Volume 18,2014, Pages 369-376, ISSN 2212-5671, [https://doi.org/10.1016/S2212-5671\(14\)00952-6](https://doi.org/10.1016/S2212-5671(14)00952-6).