

# Country vulnerability profiles and their relevance to decision makers

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# Summary

- What is vulnerability
- Vulnerability and risk
- Country-level measures of risk
- Country level measures of vulnerability
- Key indicators of vulnerability at the national level

# What do we mean by vulnerability?

- broadly speaking, susceptibility to harm
- In terms of climate variability and change, the susceptibility of a system to harm arising from the occurrence of a climate hazard
- The ability to cope with and recover from climate hazards

## IPCC I (Report of Working Group II - glossary)

“The degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes.

Vulnerability is a function of the character, magnitude, and rate of climate variation to which a system is exposed, its sensitivity, and its adaptive capacity.”  
(IPCC, 2001, p. 995)

Emphasises that vulnerability depends on the nature of climate variability and/or change, also on ability of system to adapt over time.

## IPCC II (Report of Working Group II - Chapter 18)

- the “degree to which a system is susceptible to injury, damage, or harm (one part - the problematic or detrimental part - of sensitivity)” (IPCC, 2001, p. 854)
- Emphasises the sensitivity of a system, arising from the internal properties of that system. In this definition vulnerability represents the internal state of a system when it experiences a hazard - “inherent” or “social” vulnerability.

# Types of vulnerability

- Determinants of vulnerability depend on which outcomes we are talking about
  - e.g. factors determining extent of financial losses from storms are different from those determining mortality from storms.
- Different factors make societies vulnerable to different hazards (e.g. building standards highly important for storms but not for drought)

# Differentiated vulnerability

- Vulnerability
  - is geographically and socially differentiated
  - results from complex interactions of a wide variety of factors and processes
  - is highly context specific
  - is realised at local scales
  - varies dramatically at the sub-national scale
  - is not directly observable
  - is extremely difficult to measure

# Natural hazards/risk management view:

**outcome risk = f (event risk, vulnerability)**

- Event risk represents probability of occurrence of a climate hazard
- where vulnerability is consistent with IPCC definition II - inherent or socially constructed vulnerability. IPCC definition I is more like the definition of risk.
- Probabilistic formulation (risk may also be measured in terms of outcome magnitude)

# Historical climate risk and climate change

- Many countries routinely suffer damage from climate *variability*
- Climate change likely to be associated with changes in frequency and severity of historically familiar hazards in near term
- Building capacity to cope with existing hazards prerequisite to coping with/adapting to climate change
- Recent historical risk & vulnerability as proxies for near-term risk from & vulnerability to climate change.

# Measuring risk

- We can directly measure outcomes, which are (retrospective) proxies for risk
- E.g. mortality from climate related disasters using EM-DAT)
  - Simple indicators based on % of population killed, absolute numbers killed, % killed or otherwise affected, killed/affected ratio
  - -composite indicators based on rankings in simple indices, and examination of consistency in country rankings, can identify “most at risk” countries based on recent historical data

Brooks and Adger, forthcoming (submitted to *Ambio*)

1971-1980			1981-1990			1991-2000		
	RISK <sup>1</sup> <sub>L,t</sub>	RISK <sup>2</sup> <sub>L,t</sub>		RISK <sup>1</sup> <sub>L,t</sub>	RISK <sup>2</sup> <sub>L,t</sub>		RISK <sup>1</sup> <sub>L,t</sub>	RISK <sup>2</sup> <sub>L,t</sub>
Ethiopia *	0.91088	300173 (1)	Mozambique **	0.74701	101152 (3)	Honduras *	0.26988	15259 (5)
Somalia **	0.45960	19000 (4)	Ethiopia *	0.71262	308922 (1)	Venezuela	0.13846	30245 (3)
Honduras *	0.35867	10821 (5)	Sudan	0.70881	152104 (2)	Bangladesh **	0.12370	148154 (1)
Maldives	0.15985	219 (35)	Sao Tome Princ.	0.18100	181 (60)	Guinea Bissau	0.10792	1172 (35)
Dominica	0.05642	40 (64)	Swaziland *	0.08392	553 (34)	Niger	0.08104	7415 (11)
Bangladesh **	0.04867	37275 (3)	Somalia **	0.04892	3203 (12)	Nicaragua	0.07431	3289 (23)
Bahrain	0.04237	111 (44)	Vanuatu **	0.04493	58 (85)	Burkina Faso *	0.06444	6436 (12)
Kiribati	0.03766	20 (72)	Afghanistan *	0.04375	6909 (8)	Somalia **	0.04992	4095 (15)
Gambia *	0.03650	200 (37)	Solomon Is.	0.03741	101 (74)	Peru **	0.04878	11480 (8)
Liberia	0.02896	466 (26)	St Lucia *	0.03606	45 (90)	Djibouti *	0.04193	252 (74)
Dom. Rep.	0.02851	1439 (16)	Bangladesh **	0.02831	27756 (5)	Tajikistan	0.03330	1944 (27)
Fiji *	0.02309	133 (41)	Mali	0.02291	1693 (20)	Bhutan	0.03194	222 (76)
Iran	0.01306	4338 (7)	Puerto Rico	0.01854	626 (31)	Nepal **	0.02793	5942 (13)
Oman	0.01263	107 (46)	Botswana	0.01767	191 (59)	Vanuatu **	0.02257	38 (112)
Peru **	0.01173	1779 (13)	Philippines **	0.01704	9318 (7)	Zambia	0.02248	2019 (26)
Guam	0.01053	10 (81)	Comoros	0.01636	62 (84)	Cape Verde Is *	0.02016	77 (97)
Hong Kong	0.01009	440 (27)	Burkina Faso *	0.01405	1107 (26)	Haiti *	0.01945	1394 (33)
St. Lucia *	0.00830	9 (82)	Peru **	0.01186	2311 (14)	Togo	0.01827	751 (50)
Mozambique **	0.00817	858 (19)	El Salvador *	0.01185	565 (33)	Laos	0.01807	832 (47)
Philippines **	0.00806	3472 (9)	Guatemala	0.01181	914 (27)	Gambia *	0.01746	194 (80)
Haiti *	0.00785	386 (29)	Nepal **	0.01174	1938 (16)	Cameroon	0.01736	2289 (25)
India	0.00637	39103 (2)	Sierra Leone	0.01149	412 (40)	Mozambique **	0.01731	2738 (24)
Sri Lanka	0.00596	804 (20)	Greece	0.01147	1139 (25)	Afghanistan *	0.01705	3739 (17)
Iceland	0.00550	12 (78)	Fiji *	0.01033	72 (80)	Philippines **	0.01700	11622 (7)
Colombia	0.00433	1098 (17)	Cape Verde Is. *	0.01032	32 (97)	Zimbabwe	0.01670	1838 (28)
Korea (Rep)	0.00426	1503 (15)	Angola	0.01031	825 (28)	Cent. Afr. Rep.	0.01597	525 (59)
P. N. Guinea	0.00414	113 (42)	Fr. Polynesia	0.00994	17 (105)	Swaziland *	0.01578	142 (84)
Vanuatu **	0.00408	4 (87)	Djibouti *	0.00895	35 (94)	Iceland	0.01269	34 (114)
Nepal **	0.00398	510 (25)	Benin	0.00876	354 (44)	El Salvador *	0.01265	717 (52)
Belize	0.00389	5 (84)	Namibia	0.00849	100 (74)	Nigeria	0.01255	13960 (6)

HIGH RISK	Honduras, Bangladesh, Peru, Niger, Nepal, Afghanistan, Philippines, Burkina Faso, Ecuador, Somalia, Venezuela, Guinea Bissau, Nigeria, Cameroon, Zambia, Haiti, Vietnam, Togo, Papua New Guinea, Zimbabwe, Guatemala, Tanzania, Kenya, Nicaragua, Pakistan, Tajikistan, Mozambique, Democratic Republic of Congo, Central African Republic, Sudan, Gambia, India, Laos, Bolivia, China, Benin, Bhutan, Djibouti, Cambodia
MEDIUM-HIGH RISK	Mali, Sierra Leone, Indonesia, Senegal, Guinea, Madagascar, Ghana, Malaysia, Burundi, Vanuatu, Iceland, El Salvador, Angola, Uganda, Iran, Cyprus, Turkey, Ethiopia, Cape Verde, Swaziland, Congo, Mexico, Gabon, French Polynesia, Korea (Republic), Yemen, Malawi, Colombia, Panama, Russia, Egypt, United States, Brazil, Saudi Arabia, South Africa, Kyrgyzstan, Morocco, Liberia, Mongolia, Dominican Republic, Algeria, Thailand, Comoros, Hong Kong, Croatia, Fiji, Romania, Chile, Spain, Japan
MEDIUM RISK	Italy, Paraguay, Cote d'Ivoire, Micronesia, Costa Rica, St Kitts & Nevis, Uzbekistan, Virgin Islands (US), Greece, Seychelles, Mauritania, Namibia, Sri Lanka, Korea (Democratic Republic), Trinidad & Tobago, Antigua & Barbuda, Poland, France, Samoa, Belize, Ukraine, Puerto Rico, Lesotho, Israel, Guyana, Albania, St Vincent & The Grenadines, Moldova, Australia, Marshall Islands, Argentina, Lithuania, Switzerland, Kazakhstan, Austria, St Lucia, Portugal, Botswana, Slovakia, Jordan, Cuba, Canada, Bahamas, Myanmar, Solomon Islands, Bulgaria, Netherlands Antilles, Netherlands, Ireland, Dominica, United Kingdom, Czechoslovakia, Hungary, Belarus, Jamaica, Bosnia-Herzegovina, Kuwait, Lebanon, Azerbaijan, Germany, Belgium, Uruguay, Kiribati, Mauritius, Guam
MEDIUM-LOW RISK	Czech Republic, New Zealand, American Samoa, Georgia, Armenia, Eritrea, Maldives, Norway, Denmark, Tonga, Syria, Macau
LOW RISK	Grenada, Bahrain, Barbados, Bermuda, Finland, Macedonia, Iraq, Latvia, Luxembourg, Oman, Sao Tome et Principe, Suriname, New Caledonia, Sweden, Tunisia, Turkmenistan, Yugoslavia

# Vulnerability indicators

- More abstract concept than outcome/risk
- Must identify indicators/proxies
- Indicator - a single variable representing the state of a system, e.g. the vulnerability of a country to climate hazards
- Indicators must reduce complexity while capturing the most important information
- May be composites of several variables (e.g. HDI) or might be a single measurable proxy for the unobservable quantity in question (e.g. GDP for economic strength of an economy).

# The importance of scale

- Different indicators represent different scales - e.g. GDP represents national scale, but yields no information about geographical or social differentiation of wealth or growth.
- Indicators of vulnerability at the national level may ignore highly vulnerable groups or sectors within society

# Measuring historical vulnerability

- Recognise that outcomes are *partially determined* by vulnerability
- Develop a “long list” of vulnerability proxies and examine the strength of their statistical relationship with historical outcomes
- Recent vulnerability to climate hazards as proxy for vulnerability to climate change....

# Methodology

- **Outcome variable:** numbers killed by climate related disasters per decade (1971-2000) expressed as % of national population (EM-DAT: [www.cred.be/emdat](http://www.cred.be/emdat))
- **Vulnerability variables:** “long list” of 46 variables representing socio-economic conditions, environmental context, health and governance.
- Novelty of this approach is that it is empirically based.

Brooks, Adger and Kelly, forthcoming (submitted to *Global Environmental Change*)

# Shortlist of significant variables

Significant correlation with mortality at 10 % level or better

- Pop. with sanitation
- Lit. rate, 15-24 yrs
- Maternal mortality
- Lit. rate, 15+ yrs
- Calorie intake
- Voice & accountability
- Civil liberties
- Political rights
- Gov. effectiveness
- Lit. ratio (fem/male)
- Life expectancy at birth

No GDP!

# Interpretation

- Health, governance and literacy are more significant for *national level* vulnerability than economic indicators, although these quantities are not independent.
- Shortlist includes variables indicative of “instantaneous” vulnerability (at onset of a hazard) and also of capacity to respond and adapt to hazards over time

# Results

- Composite index created by assigning country scores based on quintiles for each of the 11 indicators, then weighting and aggregating scores.
- 13 different sets of weights from focus group
- Following countries in top quintile of composite index for all sets of weights:
  - Afghanistan, Angola, Burundi, Central African Rep., Democratic Republic of Congo, Eritrea, Ethiopia, Equatorial Guinea, Gambia, Guinea Bissau, Haiti, Mauritania, Mozambique, Niger, Pakistan, Rwanda, Sierra Leone, Somalia, Sudan, Togo, Turkmenistan , Chad, Gabon, Iraq, Liberia, Malawi, Brunei Darussalam, Burkina Faso, Guinea, Yemen, Cote d'Ivoire, Qatar, Kenya, Laos, North Korea, Yugoslavia, Nigeria
- Red: sub-Saharan Africa; Blue: Small islands

# Some words of caution...

- Shortlist derived from bulk analysis of many countries (all for which data available)
- Is highly generalised - not necessarily best indicators for all countries (e.g. SISs)
- Does not address sub-national scale distribution of vulnerability
- Only addresses aggregated mortality

## But

- Based on readily available empirical data comparable across countries