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POLICY BRIEF
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Improving Climate Risk Metrics for Policy Action

Navigating Conceptual Confusion and Methodological Trade-offs

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Background

As climate change intensifies, policymakers urgently need reliable tools to identify who and what locations are most at risk. Risk indices aim to meet this demand by translating complex, multidimensional realities into accessible, comparative scores. In principle, they can support evidence-based decisions: targeting adaptation finance, prioritizing hotspots, and tracking progress.

Yet today's landscape is fragmented: indices differ in how they define exposure, vulnerability, and risk, in the data they draw on, and in how they combine indicators into a single score. Some prioritize global comparability; others focus on local realities. Most cite the Intergovernmental Panel on Climate Change (IPCC) as a conceptual anchor, but alignment with successive IPCC frameworks varies considerably. As a result, indices are often hard to compare, replicate, or apply across contexts.

This brief helps navigate this complex terrain. We examine how climate-related risk indices conceptualize and operationalize their key components, assess what these differences mean for comparability and policy relevance, and outline ways forward. We highlight selected indices to illustrate key points, without aiming to provide an exhaustive overview of all existing metrics. Particular attention is given to the subnational level, where the need for targeted, context-sensitive tools is most acute.

Highlights

Climate-related risk indices are widely used to guide adaptation, but they diverge in how they define and measure vulnerability, exposure, and risk.

Successive shifts in the IPCC framework - from vulnerability-focused to risk-oriented models - have not been consistently adopted in practice.

Methodological choices on indicator selection, weighting, aggregation and validation strongly shape results yet often lack transparency.

Most indices are produced at the national level, overlooking subnational disparities where climate risks are most acute.

More transparent, IPCC-aligned, and subnationally relevant metrics are essential to ensure resources reach those most in need.

Note: In this brief, we use the terms "risk", "climate risk" and "climate-related risk" indices interchangeably to denote risks arising from climate change impacts. When referring directly to the IPCC, we follow their terminology of "risk," while noting that although the IPCC does not formally define "climate risk" in its glossary, AR6 occasionally employs the term informally.

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The Evolving IPCC Risk Framework: From Vulnerability to Risk

Over the past two decades, IPCC assessments have moved from a vulnerability-centred to a risk-based approach, reshaping how core concepts are defined and applied in risk indices related to the impacts of climate change.

Pre-2012: Vulnerability-Centred Framing

In the IPCC's Third Assessment Report (TAR, 2001) and Fourth Assessment Report (AR4, 2007), **vulnerability** was the central concept, defined as "*the degree to which a system is susceptible to, or/and unable to cope with, adverse effects of climate change, including climate variability and extremes*" (IPCC, 2001; 2007). Vulnerability was conceptualised as a function of three elements: (i) **exposure**, understood as "*the nature and degree to which a system is exposed to significant climate variations*" (TAR, 2001; not separately defined in AR4); (ii) **sensitivity**, defined as "*the degree to which a system is affected, either adversely or beneficially, by climate variability or change*" (AR4, 2007); and (iii) **adaptive capacity**, defined as "*the ability of a system to adjust to climate change (including climate variability and extremes), to moderate potential damages, to take advantage of opportunities, or to cope with the consequences*" (AR4, 2007). This tripartite model, which treated exposure as an integral part of vulnerability, underpinned many early vulnerability assessments and indices (see Figure 1, left panel).

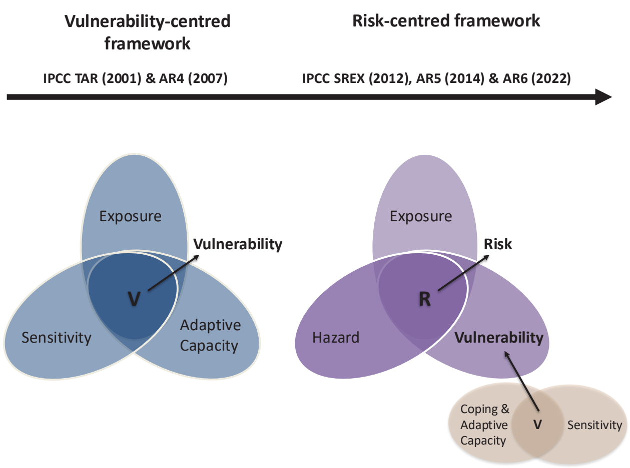

Figure 1: Evolving IPCC framework: from Vulnerability to Risk

Source: Author's own creation inspired by IPCC AR6 WGII Figure 1.5a.

Post-2012: Risk-Centred Framing

The IPCC's 2012 Special Report on Managing the Risks of Extreme Events (SREX) and the Fifth Assessment Report (AR5, 2014) pivoted from a vulnerability-centred approach to a risk-based one. **Risk** was now defined as the interaction of three distinct components: hazard, exposure and vulnerability (illustrated in the right-hand panel of Figure 1), where (i) **hazard** refers to the potential occurrence of physical events or trends that may cause harm; (ii) **exposure** describes the presence of people, assets or ecosystems in places that could be adversely affected; and (iii) **vulnerability** captures the propensity or predisposition to be adversely affected, encompassing sensitivity or susceptibility to harm and limited coping or adaptive capacity (for full definitions, see IPCC, 2014: Glossary). Separating exposure from vulnerability clarifies the distinction between external physical hazards and the social conditions that shape vulnerability.

AR6: Deepening and Broadening the Risk Framework

The Sixth Assessment Report (AR6, 2022) retains the hazard-exposure-vulnerability framework but emphasises that risk emerges from the dynamic interactions among these components. **Vulnerability** is reaffirmed as the propensity to be adversely affected, yet AR6 highlights that this is not a fixed property: it varies across space and time, shaped by intersecting socio-economic development patterns – including poverty, unsustainable ocean and land use, inequity, marginalization, (weak) governance, and historical legacies such as colonialism (AR6, 2022: SPM, B.2). **Exposure** is also socially shaped, with processes such as migration, urbanisation and widening inequality influencing who and what ends up in harm's way (AR6, 2022: SPM, B.2.5). AR6 also broadens the **hazard** concept to recognize compound and cascading events, where multiple climate hazards occur together and interact (AR6, 2022: SPM, B.5). It further warns that poorly designed adaptation or mitigation measures can themselves generate new risks. In short, AR6 frames climate risk as dynamic, systemic, and socially shaped – highlighting why indices must capture more than biophysical exposure to hazards if they are to guide policy effectively.

Existing Indicators: Conceptual and Operational Divergences

Although the IPCC provides a widely cited conceptual framework, climate risk indices interpret and operationalize it in strikingly different ways. Definitions of hazard, exposure, and vulnerability vary not only across IPCC reports, but also between disciplines and methodologies (Otto et al., 2017). These divergences matter: how risk is defined directly shapes what is measured, compared and prioritized. As a result, indices often lack comparability, and their policy value is weakened.

Key Global Risk Indices and their Conceptualisation

Global indices – typically constructed at the national scale – illustrate these divergences in how IPCC frameworks are interpreted and applied. For example, the ND-GAIN Global Adaptation Index, developed by the University of Notre Dame (Chen et al. 2015), reflects the pre-2012 IPCC model, embedding exposure within vulnerability and applying this tripartite approach across six life-supporting sectors (e.g. health, food, water). It also adds a separate "readiness" component that captures countries' economic, governance and social capacity for adaptation. By contrast, the INFORM Risk Index (Marin-Ferrer et al. 2017), partially aligns with the post-2012 risk framework, but defines vulnerability more narrowly, focusing on socio-economic fragility and vulnerable groups, while treating coping capacity as a distinct dimension rather than part of vulnerability. In line with the newer post-2012 IPCC framework, the World Risk Index (WRI) (Welle & Birkmann 2015), separates exposure from vulnerability and defines vulnerability as a composite of susceptibility, lack of coping capacity, and lack of adaptive capacity. The Global Data Lab Global Vulnerability Index (GVI) (Smits & Huisman, 2024), takes a different approach by measuring only socioeconomic vulnerability using indicators such as health, education, and governance, while omitting hazard or exposure altogether. Although simpler in design, it conceptually aligns with the newer IPCC vulnerability framing by capturing sensitivity to harm as well as coping and adaptive capacities. Other indices focus mainly on the physical hazard/exposure dimension and ignore social vulnerability. The Physical Vulnerability to Climate Change Index (PVCCI) (Feindouno et al. 2020), for instance, deliberately restricts itself to geophysical and climatic factors, and the Germanwatch Global Climate Risk Index (Eckstein et al. 2019) is based on past weather-related losses rather than a comprehensive vulnerability score. A cross-index comparison by Garschagen et al. (2021) confirms this diversity, finding major inconsistencies in country rankings for risk and exposure, but stronger agreement on socio-economic vulnerability and coping/adaptive capacity. Together, these examples show that what is measured under the label of 'risk' or 'vulnerability' varies widely, undermining comparability and clarity for policymakers, and highlighting the need for greater conceptual clarity and transparency in index design.

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Subnational and Context-Specific Climate Risk Indices

National-level indices often mask hotspots of climate risk that occur within countries at subnational and community scales. Hazards, exposures, sensitivities, and adaptive capacities are highly place-based, so local realities can diverge sharply from national averages, especially in low-resource or ecologically fragile areas. To address this, a growing body of work develops subnational and sectoral indices tailored to particular communities, sectors, or livelihoods.

Many local indices build on the pre-2012 IPCC's vulnerability framework, combining exposure, sensitivity, and adaptive capacity to assess specific contexts. Examples include the Small Island Community Vulnerability Index (SIVI) for Ternate Volcanic Island in Indonesia (Lessy et al., 2025), livelihood vulnerability indices for fisheries (Allison et al., 2009), coastal fishing communities in Bangladesh (Jakariya et al., 2020a; 2020b), farmers in India (Kumbrottil Sundaran et al., 2024), rural households in Eastern Sudan (Mohmmed et al., 2018), and district-level assessments in Mozambique (Hahn et al., 2009). Each adapts the exposure–sensitivity–capacity framework to its local setting and often calculates vulnerability as a function of these three elements. Other subnational tools follow the post-2012 hazard-exposure-vulnerability framework. Bhutan's Glacial Lake Outburst Flood (GLOF) risk index (Rinzin et al., 2023), for instance, combines hazard modelling, geospatial exposure, and local social vulnerability data to capture localized flood risk. The Physical Vulnerability to Climate Change Index (PVCCI) has also been extended to the subnational scale (Goujon et al., 2022), applying its biophysical logic to capture structural physical vulnerability while deliberately excluding socio-economic dimensions.

These local indices are typically more data-rich and context-sensitive, drawing on household surveys, remote sensing, or geospatial modelling. They often reveal risk or vulnerability patterns invisible at the national scale. Yet, they remain fragmented in design, rely on different conceptual models (vulnerability vs. risk), and lack standardization, comparability or replicability across settings, limiting their broader policy utility.

From Conceptualization to Operationalization: Why Methods Matter for Policy

Turning abstract concepts like exposure, vulnerability, sensitivity, and adaptive capacity into measurable indices requires a series of methodological decisions: which indicator to include, how to handle missing data, how to weight and aggregate them, and whether to validate outcomes against observed impacts.

Indicator selection is shaped by theoretical framing but often constrained by data availability, with the number of indicators ranging from fewer than ten to more than fifty depending on the scope and available data. Some indices combine broad sets of socioeconomic, environmental, and institutional variables (e.g. INFORM, ND-GAIN), while others target specific sectors or hazards (Allison et al., 2009; Kumbrottil Sundaran et al., 2024; Rinzin et al., 2023). Also, the treatment of missing data – through imputation, substitution, or omission – can affect reliability yet is rarely justified. Aggregation and weighting are equally influential. Additive aggregation, the most widely used, implies that strengths in one area can compensate for weaknesses in another (e.g. high adaptive capacity can offset high sensitivity to harm). Other approaches include multiplicative formulas, geometric means, fuzzy logic, or multi-criteria decision analysis. Weighting strategies vary from equal weights, often chosen for simplicity, to expert-based or data-driven alternatives (such as PCA and factor analysis), which highlight how sensitive results can be to underlying assumptions (Anderson et al., 2019; Edmonds et al., 2020). Finally, validation against observed impacts remains the exception rather than the rule, which undermines the credibility and policy relevance of many indices (Birkmann et al., 2022).

These methodological decisions are not minor technicalities. They shape how reliably indices identify vulnerable or at-risk regions, whether they can be compared across contexts, and how well they inform adaptation planning. Greater transparency in indicator choices, aggregation, weighting, and missing-data treatment, combined with systematic sensitivity or robustness checks, would significantly strengthen both the comparability and policy utility of climate risk indices.

Ways Forward

Reframing Vulnerability Within Climate Risk Framework

The way forward is to reframe vulnerability assessments within the IPCC's risk framework, which recognizes risk as the interaction of hazards, exposure, and vulnerability. Vulnerability – probably the most challenging risk component to assess – does not simply reside in the inherent characteristics of populations of places but is produced and reinforced by poverty, inequality, weak governance and historical processes of marginalization (Adger, 2006; Cardona, 2004; Nguyen et al., 2016). Yet many indices still treat vulnerability in isolation, detached from hazards and exposure. To remain policy-relevant, future assessments must capture how these components interact, recognizing that hazards are increasingly compound and cascading, and that exposure is socially produced through processes such as urbanization, migration, land use, and inequality. Approaches that integrate local knowledge, highlight inequities, and examine the social processes that drive both exposure and vulnerability can provide a more complete picture of risk and offer clearer entry points for equitable and effective adaptation planning.

Bridging Global and Local Assessments

Many indices also rely on aggregated national scores, which obscure local realities and mask the places where climate risk is most acute. Global indices are valuable for cross-country comparison and identifying broad patterns, but they often fail to reflect how risk is experienced on the ground. Local indices, meanwhile, capture context-specific vulnerabilities and risks, but are difficult to compare across settings. The way forward is to bridge these scales: develop frameworks that connect local case studies to global patterns, for instance, through archetypical risk profiles (Kok et al., 2016; Vidal Merino et al., 2018). This would allow indices to remain both context-sensitive and globally relevant.

Ensuring Methodological Robustness and Transparency

Finally, climate risk indices will only inform policy if they are credible and transparent. This requires systematic sensitivity testing, robustness checks, and, where possible, validation against observed impacts (Birkmann et al., 2022). Documenting choices – from indicator selection to weighting – is essential for building trust and ensuring indices can guide adaptation planning.

Policy recommendations

1. Adopt IPCC-aligned definitions in guidance and terms of reference.

Require a clear statement of whether an index targets risk or vulnerability, with consistent use of hazard, exposure, and vulnerability.

2. Make methods auditable.

Publish indicator lists, sources, normalisation, weighting, aggregation, missing-data rules, and provide code or reproducible notebooks where feasible.

3. Fund subnational comparability.

Support a light, replicable subnational module (common core + context add-ons) to map within-country hotspots across multiple countries.

4. Mandate basic robustness checks.

Before using scores for prioritisation, require sensitivity tests (weights/indicators/aggregation) and a short validation note linking results to observed impacts

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