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Book

From risk to resilience : climate vulnerability assessments in India

Provided in Cooperation with:
Observer Research Foundation (ORF), New Delhi

Reference: Arora, Gopalika (2023). From risk to resilience : climate vulnerability assessments in India. New Delhi, India : ORF, Observer Research Foundation. https://www.orfonline.org/wp-content/uploads/2023/08/ORF_OccasionalPaper_408_ClimateRiskAssessments.pdf.

This Version is available at:
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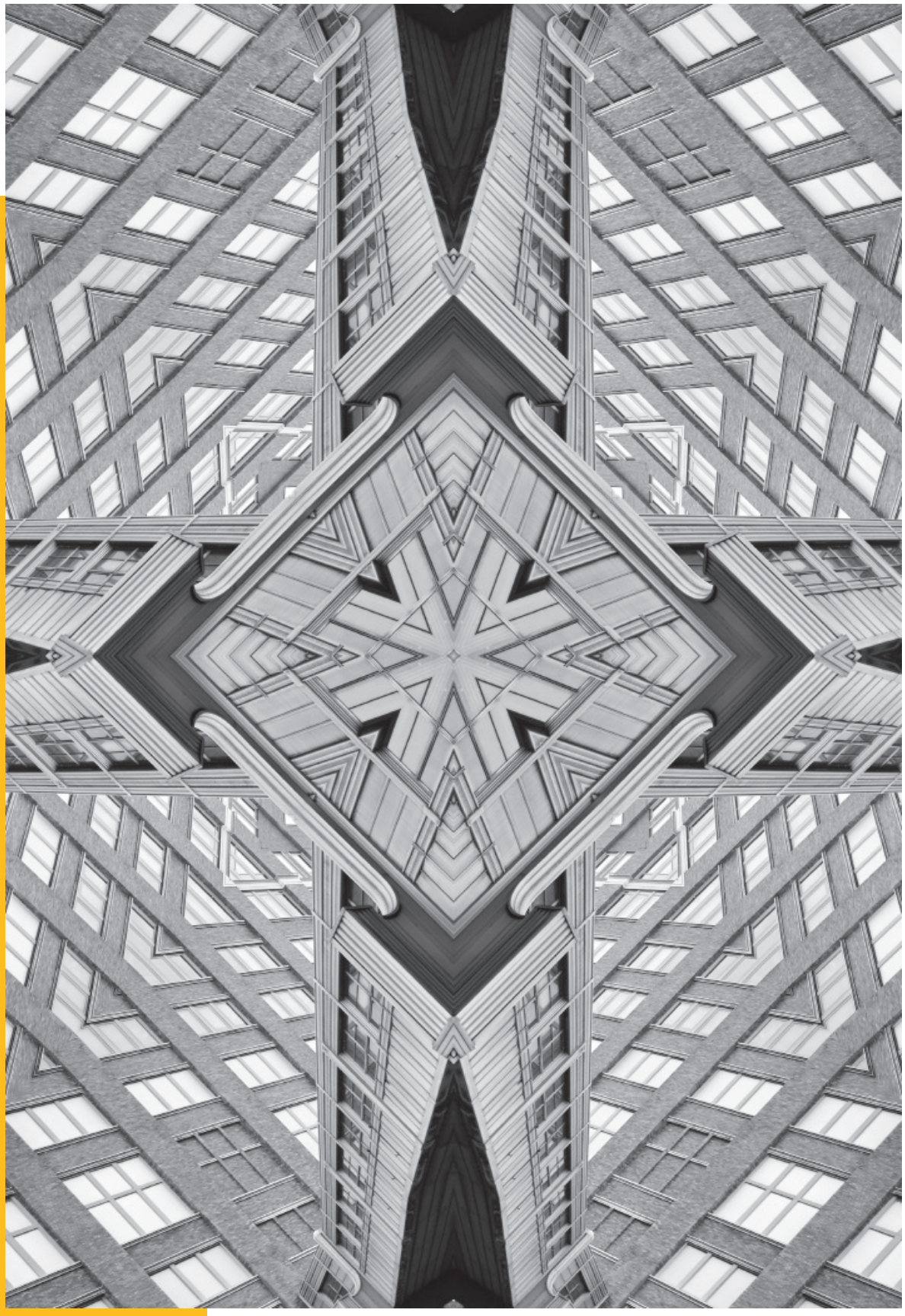


ISSUE NO. 408 AUGUST 2023

From Risk to Resilience: Climate Vulnerability Assessments in India

Gopalika Arora

Abstract

Climate adaptation has been at the forefront of UN climate negotiations over the past decade, given the increasing frequency of extreme weather events at the global, national, and sub-national levels. Climate vulnerability and risk assessments (VRA) are essential for adaptation planning, as they help identify areas, populations, and systems that are most at-risk from the impacts of climate change. They can also be used as a tool to develop adaptation projects and mobilise multilateral finance. However, in India, there are hardly any development programs or projects that are being implemented based on climate VRA. Moreover, climate resilience is still struggling to find space in the sub-sections of investment proposals in India. This paper evaluates India's existing vulnerability and risk assessments, their varied scopes and methodologies, and offers recommendations informed by global best practices, that could be scaled up at national and sub-national levels.

Attribution: Gopalika Arora, "From Risk to Resilience: Climate Vulnerability Assessments in India," *ORF Occasional Paper No. 408*, August 2023.

Introduction

Climate change has had a global impact, even with just 1.1 degree Celsius of warming since the pre-industrial era. From devastating droughts and scorching heatwaves to unprecedented floods and sea-level rise, climate change–induced hazards pose an imminent threat to the food security and livelihoods of millions of people across the world. Developing countries are particularly vulnerable to the impacts of slow-onset processes such as sea-level rise, desertification, salinisation, and extreme weather events.[1] The increasing frequency of these events has been resulting in growing climate risks all over the world.[2]

India, owing to its vast population and geography, is confronting a broad spectrum of disastrous consequences. The country is already experiencing increasing and intensifying trends of extreme climate events, such as heavy precipitation, floods, drought-like conditions, and extreme heat.[3,4] The Global Climate Risk Index (CRI) classifies India amongst the top 10 countries most vulnerable to climate events; India was ranked seventh in the 2021 CRI report.[5] Approximately 75 percent of the districts in India are identified as extreme event hotspots, while around 40 percent of districts have shown a significant shift in weather patterns.[6] This shift entails a reversal of historical trends, where regions previously prone to flooding are now experiencing more frequent and severe droughts, and vice-versa. At the same time, the country is facing multiple development challenges, such as poverty, limited access to basic necessities and healthcare, and weak governance. This has not only increased the sensitivity to climate stressors but has also significantly impacted the country's capacity to adapt to, or recover from climatic shocks.

As climate adaptation becomes embedded in the climate polices and plans of the country, there is a need to move from planning to implementation. Adaptation efforts have been largely incremental and focusing mostly on current climate risks. In addition, the sustainability of climate-linked resources and the susceptibility of supporting infrastructure are provoking concern. With increasing magnitudes of loss and damage from climate-induced hazards, it is essential to implement targeted adaptive measures informed by vulnerability and risk assessments at scale.

Introduction

Vulnerability and risk assessments have emerged as an important tool to identify structural weaknesses within a system, explore the capacity of people and systems to adapt, and prioritise adaptation funding and implementation. A number of recent assessments have been published in India that evaluate climate vulnerability and risk across sectors at various levels of governance.[7,8,9] However, their conceptual, methodological, and disciplinary underpinnings and outcomes have not been examined. Attempts have been made to bring about policy shifts and scale-up these assessments at various levels of governance. The National Action Plan on Climate Change (NAPCC), launched in 2008, encourages states to include the results of climate vulnerability assessments in their State Action Plans on Climate Change (SAPCCs).[10] The Ministry of Environment, Forest and Climate Change (MoEF&CC) of India also mandates states to use the results of these assessments to prioritise adaptation measures and target resources for the most vulnerable communities and sectors.

These assessments are essential for a better understanding of climate hazards and the exposure, sensitivity, and adaptive capacity of human populations and systems to climate change. Additionally, these assessments can help decision-makers understand the relationships between different sectors and identify opportunities for co-benefits and synergies in adaptation planning.[11] However, the complex nature of institutional, social, technical, and environmental interactions has led to limited uptake of these assessments by decision-makers, who can influence the resilience of communities and sectors towards climate change. In order to have the desired impact on policy, research findings of these assessments and reports must reach a wider audience.

This paper reviews existing climate vulnerability and risk frameworks in India to understand their varied scope and methodologies. It provides recommendations based on a review of literature and global best practices for scaling up these assessments at the national and sub-national levels.

The Evolution of Climate Vulnerability Assessments

There is no universally accepted definition of 'vulnerability'; the concept is multifaceted, and can vary depending on the context and perceptions of research communities. It is used in various disciplines, from engineering sciences and economics, to anthropology and psychology.[12] The initial understanding of vulnerability derived from the concept of 'tipping points', also known as 'threshold', which identifies 'hotspots' that require immediate intervention. Vulnerability is also conceptualised as an outcome or the adverse conditions after the establishment of bio-physical impacts, future projections and scenarios, and adaptation interventions, and is assessed before and after exposure to a hazard.[13] However, for climate-change adaptation, operationalising vulnerability as an inherent condition is more suitable. This inherent condition is the result of certain social, political, and economic processes that significantly impact the resilience of individuals and communities against climatic shocks.[14]

Types of Climate Vulnerability Assessments

Climate vulnerability assessments are a crucial tool for recognising inherent weaknesses in the structure of a system, evaluating the ability of individuals within the system to cope with these vulnerabilities, prioritising adaptation and mitigation measures, and determining resource allocation needs.[15] Initially, these assessments focused on physical vulnerability, such as the exposure of communities and sectors to specific hazards such as sea-level rise and extreme weather events. These assessments typically used simple, data-driven methods such as mapping to identify vulnerable areas and populations.

More recent climate vulnerability assessments have integrated multiple forms of vulnerability, including those in the social, economic, and ecological domains. These assessments use more complex methods such as scenario-based modelling to identify the potential impacts of climate change on communities and sectors.[16] In recent years, there has been growing emphasis on involving communities and stakeholders in the climate vulnerability assessment process. This approach, known as participatory vulnerability assessment, involves engaging with communities and stakeholders to understand their perspectives on climate change and to identify their specific needs and priorities.[17]

The latest development in climate vulnerability assessments are climate risk assessments, which not only identify communities and sectors vulnerable to the impacts of climate change but also quantify the potential financial, social, and environmental losses and damages that may occur due to such impacts. This approach further aids in prioritising adaptation and mitigation measures and informing investment decisions.[18]

Conceptual Frameworks for Assessing Climate Vulnerability

The ameliorating impacts of climate change vary spatially and temporally across regions and level of governance, economic and development sectors, social groups and communities, and type of systems.[19]

The understanding of vulnerability and the methodological frameworks to assess it have evolved based on scientific knowledge collated by the Intergovernmental Panel on Climate Change (IPCC). In the fourth assessment report of the IPCC, vulnerability is defined as the "the degree to which geophysical, biological and socio-economic systems are susceptible to, and unable to cope with, adverse impacts of climate change, including climate variability and extremes."[20] Within this framework, vulnerability is defined as a function of exposure, sensitivity, and adaptive capacity.

This approach has been widely used in national level assessments as well as sector-specific studies to identify the most vulnerable districts and states of India based on the potential impact and adaptive capacity. However, this framework does not take into account future risks and hazards and only focuses on a system's current inherent state.

Key Definitions

Vulnerability = Function [Exposure (+), Sensitivity (+), Adaptive Capacity (-)]

- **Exposure**: Disturbance to the system due to climate-induced disaster. Exposure is directly linked to the magnitude and duration of climate stressors. Different geographical regions may be exposed to different climate stressors as well as different hazard durations and magnitude. For example, average increase in temperature may expose urban centers where the urban 'heat island' effect worsens the situation.

- **Sensitivity:** Degree to which a particular system is affected by climate-related stressors. Sensitivity might stem from the inherent characteristics of a system and may be direct (change in crop yield due to change in temperature patterns) or indirect (damages caused by flooding due to sea level rise).

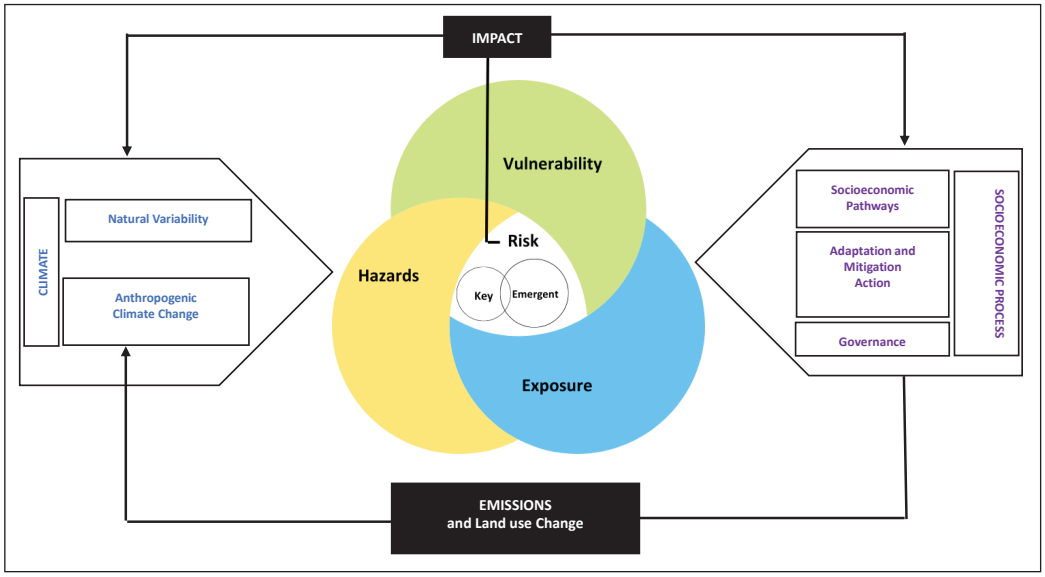
- **Adaptive Capacity:** The ability of a system to adapt or recover from climate-related extreme weather events. It is the pre-existing features of a system that determine its ability to adapt to weather aberrations.

Source: IPCC AR4, WGII[21]

Introduction of Climate Risk

Drawing from the learnings of disaster management, the fifth assessment report of the IPCC (AR5) introduced the concept of 'climate risk', placing it at the intersection of exposure, vulnerability, and hazard. This framework focuses on identifying and managing climate risk and places vulnerability as a determinant of risk.[22] Risk is defined as the "potential for consequences where something of value is at stake and where the outcome is uncertain, recognizing the diversity of values. It is often represented as the probability of occurrence of hazardous events or trends multiplied by the impacts if these events or trends occur".[23] Climate risk is essentially a function of hazard, exposure and vulnerability, with vulnerability further defined as a function of sensitivity and adaptive capacity. The IPCC AR5 report defines 'exposure' as the presence of individuals, communities, systems, resources, and assets in places and settings that can be adversely impacted by climate change.[24] This definition includes the impact of the hazard beyond the inherent system to a spatial concept.[25] 'Hazard' is a new term in the AR5 and refers to climate-induced trends and their physical impacts.[26]

Figure 1
Contributing Factors of Climate Risk



Source: Adapted from IPCC AR5[27]

The Evolution of Climate Vulnerability Assessments

In recent years, this framework has been adopted in several climate vulnerability and risk assessments (VRA) that have been conducted for various sectors at the district and regional levels across India (e.g., the Department of Science and Technology's national-level vulnerability assessment using a common framework[28] and Central Research Institute for Dryland Agriculture's (CRIDA) vulnerability and risk assessment for the agriculture sector[29]). This framework is also being applied in the updated State Action Plans on Climate Change to assess vulnerability and risks in sectors of concern and develop adaptation strategies.[30] The framework is more suitable from a policy perspective, as it allows for the risk assessment of a natural or a socio-economic system at multiple scales for current climate variability as well as future climate change.

> "Climate risk is a function of hazard, exposure and vulnerability, with vulnerability further defined as a function of sensitivity and adaptive capacity."

Current Approaches for Conducting Assessments

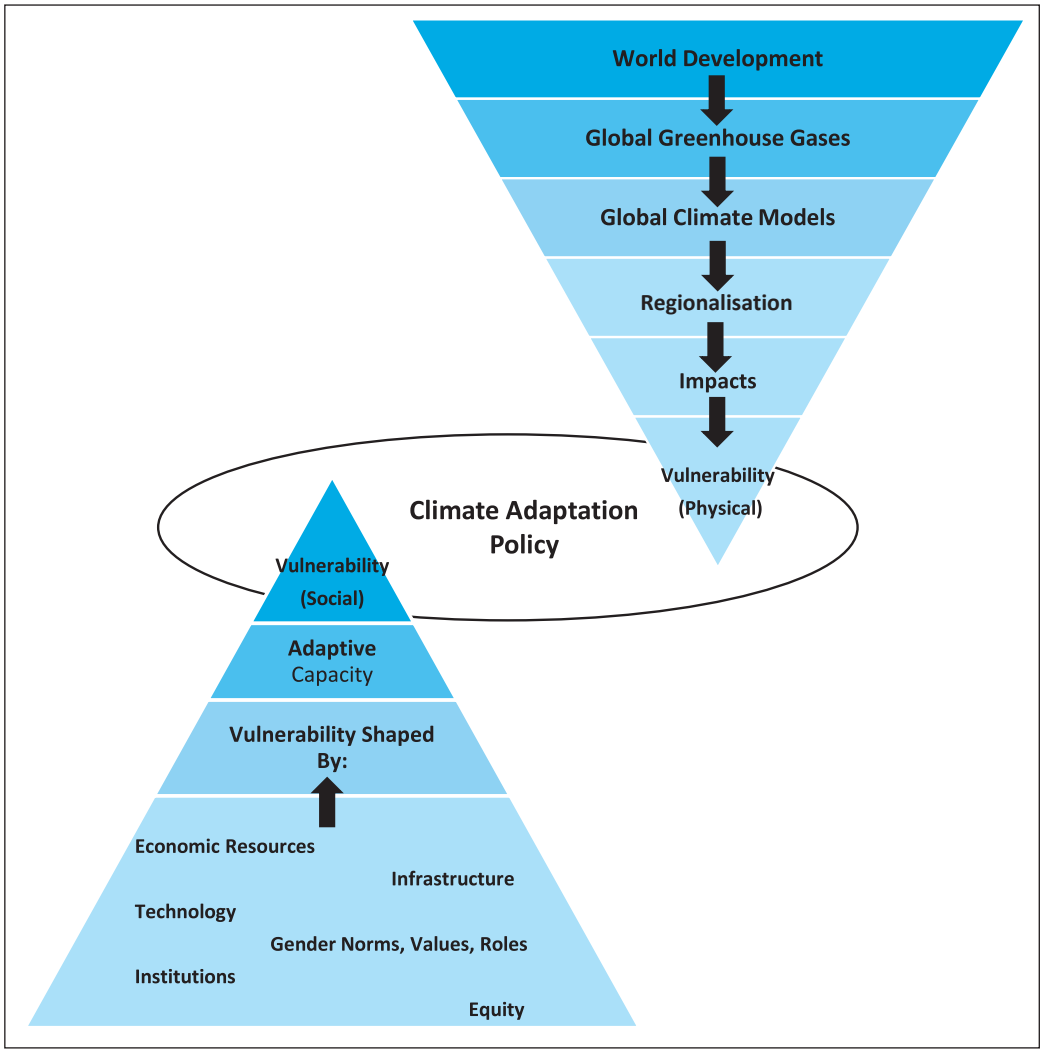
The choice of approach is essential to determine the resources required to conduct the vulnerability assessment. These assessments are commonly distinguished as top-down or bottom-up approaches. The top-down approach, also known as 'end-point analysis', is future-explicit and makes use of simulation models to project future climate impacts. The analysis is primarily focused on the biophysical effects of climate change that are quantifiable. This approach can present the direct cause-and-effect relationship of a climate stressor and its biophysical impacts backed by sound scientific analysis.[31]

Meanwhile, the bottom-up approach, also called the 'start point' approach, draws from approaches in disaster-risk reduction, humanitarian aid, and community development. This approach is more suitable for local-level assessments and focuses on the stakeholders or people affected by climate change.[32] This approach does not require any model-generated climate data though it calls for data collection from a specific location. It mostly relies on tools like participatory rural appraisal, focus group discussions, brainstorming, cognitive mapping, and community mapping to collect data. The strength of the bottom-up approach lies in its targeted approach. Its localised approach is also helpful for the local-level legislation and execution of climate adaptation policies, which a top-down simulation approach lacks in its large spatial scale.[33]

> "Vulnerability assessments are commonly distinguished as top-down or bottom-up approaches."

Figure 2

Top-Down and Bottom-Up Approaches to Understanding Vulnerability



Source: Adapted from Dessai and Hulme (2004)

Available Methodologies and Tools

Conducting a vulnerability and risk assessment is a multi-step exercise and requires the identification of a clear set of goals and objectives that will determine the type of vulnerability assessment, scale, sector, tier, indicators, and methods to be adopted. A majority of assessments in India follow an indicator-based methodology; for example, the DST's common framework and CRIDA's risk and vulnerability assessment follow an indicator-based approach to calculate climate vulnerability and risk, respectively. This method essentially involves quantifying the level of vulnerability using indices that can include both biophysical and socio-economic indicators.

Biophysical indicators such as temperature and precipitation measure the physical impacts of climate change, while socio-economic indicators such as poverty and access to education measure the social and economic impacts of climate change. The data for these indicators is collected through various means such as surveys, questionnaires, and remote sensing, depending on the availability and accessibility of data. Once the data is collected, the indicators are scored to determine the level of vulnerability of a community or sector. The scores can be based on a predefined scale, such as low, medium, or high, or on a numerical scale. Indicators can be a useful policy tool because they enable clear visual mapping of priority areas, also known as vulnerability hotspots.[34] However, this method of comparing indicators across various spatial and temporal scales is impeded by inconsistencies in the units of analysis.[35]

Climate risks and vulnerabilities are also assessed by bottom-up tools like CoDriVE and CRiSTAL, which integrate information from multiple sources, including active participation of various stakeholders. The most commonly used tools and guidance documents developed and applied in India—DST's common framework,[36] CRIDA's risk and vulnerability assessment,[37] the Vulnerability Sourcebook and Climate Impact Chains by GIZ,[38] the Risk Supplement to the Vulnerability Sourcebook by GIZ[39]—use a top-down indicator-based methodology and other are computer-based bottom-up automated tools like CoDriVE[40] and CRiSTAL.[41]

Selecting an appropriate methodology and tool for VRA assessment is informed by a number of factors, including but not limited to the purpose of the assessment, required outputs and spatial extension of the assessment, and practical considerations such as available time, budget, data, and expertise to conduct the assessment. Tables 2, 3, and 4 assess the functionality of the already existing frameworks and other commonly used tools and methodologies in the Indian context.

Table 2

Factors Determining the Assessment and Tools

Criteria/Indicator	Top-Down Indicator-Based Approach		Bottom-Up Automated Tools
	IPCC AR4 Vulnerability Framework	IPCC AR5 Vulnerability and Risk Framework	
Policy Support			
Identification of vulnerable communities, regions, sectors, etc.	✓✓	✓✓	✓✓
Analysis of the risk of a vulnerable system		✓✓	✓
Sectoral assessments to provide more details and targets for strategic development plans	✓✓	✓✓	✓✓
Prioritising allocation of funds	✓	✓	✓✓
Identification of adaptation strategies that reduce climate vulnerability	✓✓	✓✓	✓✓
Identification of adaptation strategies that reduce climate risk		✓✓	✓✓
Planning			
Adaptation planning of developmental programs and projects	✓✓	✓✓	✓✓
Assess potential consequences of climate change scenarios on livelihood sectors	✓✓	✓	✓✓
Monitor and evaluation	✓	✓	✓

Criteria/Indicator	Top-Down Indicator-Based Approach		Bottom-Up Automated Tools
	IPCC AR4 Vulnerability Framework	IPCC AR5 Vulnerability and Risk Framework	
Funding and Investment			
Attract investment from certain multilateral, bilateral, and private or other organisations concerned with climate change	✓✓	✓✓	✓
Knowledge Generation			
Informed research on climate change risk and vulnerability by sectors locally, regionally, nationally, or globally	✓✓	✓✓	✓✓
Considering traditional and empirical knowledge of local communities in responding to climate change	✓	✓	✓✓

Note: ✓ = can potentially be used; ✓✓ = can potentially be used and there are case studies available

Source: Author's own

Table 3
Types of Outputs Produced by the Tools

Criteria/Indicator	Top-Down Indicator-Based Approach		Bottom-Up Automated Tools
	IPCC AR4 Vulnerability Framework	IPCC AR5 Vulnerability & Risk Framework	
Type of outputs that can be produced			
Qualitative			
Maps	✓✓	✓✓	✓
Impact Chains			
Narrative Profiles	✓	✓	✓✓
Quantitative			
Index, Scores	✓✓	✓✓	✓✓
Scale of application			
Single Sector	✓✓	✓✓	✓✓
Multiple Sectors	✓✓	✓✓	✓✓
Spatial Scale			
Community, watershed, household level	✓✓		✓✓
Block level	✓✓		✓✓
District level	✓✓	✓✓	✓
State level	✓✓	✓✓	
National level	✓✓	✓✓	

Note: ✓ = can potentially produce; ✓✓ = can potentially produce and there are case studies available

Source: Author's own

Table 4
Practical Considerations for Each Tool

Criteria/Indicator	Top-Down Indicator-Based Approach		Bottom-Up Automated Tools
	IPCC AR4 Vulnerability Framework	IPCC AR5 Vulnerability & Risk Framework	
Resources and skills required			
Additional paid software licences			✓
Use of Geographic information system (GIS) software	✓	✓	
Modelling skills	✓	✓	
Expertise in PRA techniques (surveys, focus group, discussions, expert interviews)	✓	✓	✓
User support	✓	✓	✓
Sector-specific knowledge	✓	✓	✓
Stakeholder engagement			
Stakeholder consultation, participatory workshops, surveys	✓	✓	✓
Data/input requirements/demand			
Current variability		✓	
Long-term future projections		✓	
Socio Economic data	✓	✓	✓
Past disaster occurrences, including magnitude, frequency, location, returning period, and duration	✓	✓	✓
Biophysical data	✓		✓
Primary data collection (e.g., surveys, soil or water sampling, stakeholder consultation, social surveys)	✓	✓	✓

Criteria/Indicator	Top-Down Indicator-Based Approach		Bottom-Up Automated Tools
	IPCC AR4 Vulnerability Framework	IPCC AR5 Vulnerability & Risk Framework	
Data/input requirements/demand			
Ability to get results without any user-provided data (e.g., desk-based research, population data, or other inputs)	✓	✓	
Ability for users to adapt the tool, provide their own data, or customise inputs	✓	✓	✓
Cost/availability			
Cost	✓	✓	✓
Paid/licensed			✓
Other requirements			
Time	✓	✓	✓
Additional capacity building (financial/technical)	✓	✓	✓
Any additional specific frameworks to ease adoption	✓	✓	✓
Institutional mechanisms adopted to integrate VR assessments	✓	✓	✓

Note: ✓ = required for the assessment

Source: Author's own

Bottlenecks to the Adoption of VRA

There has been considerable progress in the adoption of vulnerability and risk frameworks and tools. However, these are yet to be scaled-up and implemented widely. While there might be a diversity of available approaches, the harmonisation of these frameworks is lacking. The following paragraphs describe the key challenges for scaling-up these assessments.

Unavailability of data

The credibility of climate vulnerability assessments depends on the technical quality and advocacy of the presented results. Using high-quality data is the primary step towards building credibility. Findings with high technical quality are likely to have quicker uptake by decision-makers. These assessments require a range of data, and non-availability of data at the granular level is a massive challenge. Data is usually not available for certain demographics as well as climate-related indicators at lower levels of government or newer districts. Additionally, there is the lack of a dynamic system that automatically updates datasets and keeps track of adaptation efforts and newer schemes undertaken by departments. There is also a need to enhance the quality and resolution of future climate projections and scenarios.

Time-consuming and resource-intensive processes

The investment required in terms of time and personnel depends on the availability of relevant data and technical resources. Assessments that use secondary data may require less time than those that require primary data to be collected. Some bottom-up tools, frameworks, and methodologies may also require trained field staff and a specific understanding of the baseline data, which may lead to slower uptake of these assessments by decision-makers. This may make the assessment time-consuming and cumbersome.

Lack of assessments at the sectoral level

There have been several recent national-level climate risk and vulnerability assessments, including the Climate Vulnerability Assessment for Adaptation Planning in India Using a Common Framework by Department of Science and Technology. However, there is a need to understand climate vulnerability and risk at a micro scale for each sector considered in the Climate Action Plan of India. Additionally, integrating climate change considerations into sectoral planning is still not a priority for most sectoral departments and line ministries;

they continue to rely on historical baselines and do not consider future climate risks as a result of the changing climate regime. Furthermore, there is a lack of inter-sectoral and inter-departmental coordination in collating relevant information to conduct assessments.[42] CRIDA has developed an India-wide, district-by-district vulnerability and risk assessment for the agriculture sector based on the IPCC AR5 framework.[43] Similar assessments need to be made available for other economic and development sectors such as urban habitats, forests, water resources, energy, coastal zones, and human health.

Lack of training and capacity

Climate vulnerability and risk assessments range from straightforward indicator-based studies to comprehensive qualitative narrative scenarios that may require technical and sectoral expertise. Technical understanding of climate risk and vulnerability is limited, and these inadequacies have a significant impact on adaptation decision-making in the long run. State line departments rarely have in-house expertise to analyse climate-related data and information. There is also a lack of capacity, as budgets are typically overstretched.

> “The credibility of climate VRA depends on the technical quality and advocacy of the presented results.”

Recommendations

Climate change has the potential to affect economies across the globe by impacting ecosystems, water resources, agriculture, energy generation, transportation, and dependent livelihoods. It is usually the poor and vulnerable who are most affected by climate change. Affordable, scalable solutions are possible and can enable developing countries to build climate resilience. Climate change VRA is an essential and prerequisite step to understand the changing nature of the climate, climate hazards, exposure, sensitivity, and prevailing adaptive capacities of humans, their habitats, and natural ecosystems. The VRAs can be used by governments as well as the private sector and communities to design and implement focused strategies that ensure adaptation to climate change. This forms the basis of the following recommendations, which are based on an extensive review of literature showcasing tools that can be applied across sectors for assessing climate vulnerability and risk at the national and local levels.

Simplifying the assessment process

Designing forward-looking assessments on climate vulnerability requires a detailed evaluation of current and future climate risks. This process demands significant time and personnel. Therefore, there is a need to simplify the process by developing an application or software to analyse a wide range of previously downscaled climate data at virtually any scale (local to global). This automation can further help rapidly develop various climate scenarios. While there exist automated tools to conduct the assessments, most of them are licensed and paid. An open-access automated tool is required to address the specific information needs of different users through an intuitive and user-friendly interface.

At a basic level, a user must be able to select the climate and economic scenarios, choose from a set of indicators, run the model, and analyse the results. Additionally, the interface should allow advanced interactions for more professional users. Users should also be able to edit the data, use their own indicators, and possibly even alter the model's algorithms. The application should also allow the user to choose an appropriate methodology by providing a well-thought-out path to decide upon the data and tools to be used for the assessment at a given jurisdictional scale for a sector.

Box 1: Automated Tools for Climate Risk and Vulnerability Assessments[44,45]

Several automated tools and software are being developed and piloted to help development practitioners and decision-makers facilitate the assessment of climate vulnerability and risk. Tools like CoDriVE and CRiSTAL can identify specific groups of people and communities that are vulnerable to climate change. These tools allow assessment at small spatial scales and are useful to anyone involved in the design and implementation of projects, such as NGOs, district-level authorities, facilitators working closely with government line departments, Panchayati Raj Institutions (PRIs), and the community itself.

Improving availability, accessibility, and quality of climate data

These assessments use a variety of data, from ecological baselines to social vulnerability, economic livelihoods, and climate and weather projections. While most of the data is available with state departments and government-funded research institutions, there is still a need to make data available at a more granular level, such as at the block or agro-ecological zone level. Providing open access to tools and input data is essential to further ease the process of assessment and ensure robust and acceptable results. A repository of existing climate data and information is already available in previously conducted national level assessments and other relevant climate studies. However, the data might not be available at the required temporal or spatial scale. Therefore, there is a need to develop data and information management systems for the transparent reporting of climate-related data. There is also the need for a common platform to disseminate climate-related data and future projections. The data also needs to be updated regularly, specifically at the gram panchayat, city, district, and state level. One existing platform, GIZ's Climate Information Portal, provides historical climate trends and future projections. More such portals are required to disseminate other relevant data on ecological, social and economic indicators. Additionally, a compendium of quantitative case studies and qualitative narrative scenarios at different spatial scales need to be provided. There is also a need to invest in infrastructure for enhanced weather monitoring to enable the availability of climate-related data.

Incorporating climate risk considerations into developmental planning

Climate change is a pervasive issue affecting all development sectors. Climate vulnerability and risk assessments can be useful in applying a climate lens in the formulation of development polices, plans, and programmes. It is imperative to mainstream these assessments into development plans rather than addressing climate change concerns in isolation through sectoral programmes and policies. Climate vulnerability and risk assessments should be given space in the sub-sections of detailed project reports and 'smart city' proposals to build resilience against climate hazards. They can be integrated into the criteria used to screen project proposals. This can further provide an opportunity to steer clear of excessively risky projects, develop climate-proofing measures, and mobilise finance for vulnerable projects.

These assessments also need to be included in insurance or alternative policy instruments to provide incentives for investments in climate risk prevention. A study conducted by Climate Risk Horizons noted that a majority of the banks in India have not undertaken any climate-related scenario analysis or risk assessment to gauge the climate resilience of their investments. This is at a nascent stage globally; however, the Indian financial sector needs to build capacity to undertake these assessments and build resilience against various physical and transitional climate risks.[46]

Box 2: Mainstreaming Climate Adaptation in Germany[47]

Climate change vulnerability and adaptation has been included in the National Frameworks and Environmental Impact Assessments. Key land use, spatial planning, urban planning, and maritime spatial planning policies account for the impacts of climate change. In addition, adaptation is mainstreamed in insurance and alternative policy instruments to provide incentives for investments in climate risk prevention.

Climate-proofing national and state budgets

Fiscal policy is an essential part of governments' strategies to combat climate change. There is a need to further enhance the effectiveness of these policies by integrating climate change concerns within India's public finance management system, especially in national and state budgets.[48] These assessments can assist in preparing budgetary papers reflecting additional funding requirements for climate adaptation under each sectoral program. They can also aid in the development of new spending proposals for each program for additional climate change action.

Training and capacity building to enable innovation and knowledge generation

The capacity and expertise to integrate climate vulnerability into development practice is lacking across sectors, and state officials rarely have in-house expertise or training to conduct these assessments. Compounding the challenge is the heterogeneity in the definitions of terms; technical terminology such as 'exposure' and 'sensitivity' can also overwhelm local actors and decision-makers. Periodic trainings and capacity-building workshops can be conducted in association with state climate change cell officials to raise awareness on the conceptualisation and use of these assessments for departmental planning at the block, district, and state levels. There is also a need to sensitise local actors such as counsellors and state legislators through training workshops that provide robust scientific information on climate-change trends and projections, impacts, vulnerabilities, and risk.

This situation calls for certain intermediaries to work iteratively with decision-makers to identify, analyse, and communicate information. These intermediaries can be universities and think tanks that promote research and capacity building on tools and methods for assessment and translate technical jargon and other information into simpler language. Intermediaries can also be NGOs that conduct trainings and workshops to communicate with a diverse group of stakeholders, from gram panchayats and youth organisations to local women's Self-Help Groups and government officials. Additionally, for the private sector, capacity building related to climate risks and vulnerability has become progressively crucial for improved investment decision-making and to mobilise private capital towards adaptation financing. Therefore, there is a need to build capacities in this sector on prioritising and operationalising the use of these assessments as well as sensitising stakeholders on the role of assessments in the better allocation of finance for adaptation.

Box 3: Capacity Building Initiatives in Kenya[49]

To make information and advisory services available for strong adaptation decision-making, Kenya introduced a consultative forum for climate change in the agriculture sector. The forum consists of academic institutions, intergovernmental research organisations, and other government institutions. This significantly aided the government in decision-making by providing a diversity of information on climate-change vulnerability and adaptation.

Enhancing communication, dissemination, and outreach

Climate vulnerability and risk assessments have the potential to be a transformational tool if deemed credible and legitimate by decision-makers. This includes making the process of assessing climate vulnerability transparent and inclusive. Therefore, it is essential that the climate vulnerability and risk assessment process involves stakeholder representatives from various sections of society. There is also a need to build dialogue between the developers, practitioners, and end-users of these assessments by adopting multiple channels of communication to reach a wide range of local actors and decision-makers. Periodic workshops can be conducted in association with state climate change cell officials at the inception of the study. This can be followed by capacity-building and dissemination workshops. This can facilitate deliberation on the selection of appropriate indicators and data points, the structure of the assessment, the method of execution, and the type of output that will be produced as an outcome of the assessment. Furthermore, the results of these assessments can be summarised or tailored to cater to specific audiences to make the information more decision-relevant over time.

Conclusion

Climate vulnerability and risk assessments are essential for climate adaptation planning, as they help identify areas, populations, and systems that are most at-risk from the impacts of climate change. They can also be used as a tool to develop adaptation projects and mobilise multilateral finance. These assessments also contribute to reporting under Article 9 of the Paris Agreement by assessing climate impacts, vulnerabilities, and risk, and aid in the formulation of national adaptation plans. They can be much more than evidence-based studies, as they can include tailor-made adaptation interventions for a region.

However, in India, there are hardly any development programs or projects that are being implemented on the basis of climate VRA. Additionally, climate resilience is still struggling to find space in the sub-sections of investment proposals in India. There has also been slower uptake of these assessments by line departments at the sub-national level.

This paper set out to analyse the impediments to VRA adoption by reviewing the most practised top-down and bottom-up frameworks, methodologies, and tools in India. Climate vulnerability and risk assessments can be resource-intensive and require expertise to analyse the data and produce actionable information. These assessments are data-intensive and rely on accurate and up-to-date data which is not available at lower levels of governance. Additionally, there is a lack of awareness and technical capacity amongst decision-makers.

There is an urgent need for training and capacity building to sensitise local actors such as counsellors and state legislators through periodic workshops that provide robust scientific information on climate trends and projections. There is also a need to mainstream these assessments into development planning by making them a mandatory part of climate budgeting, detailed project reports, and investment proposals. These assessments can help identify areas, populations, and systems that are most at-risk from the impacts of climate change as well as inform policy and investment decisions and guide the development of adaptation and mitigation strategies. They can also aid in enhancing accountability and transparency, which can help build trust and increase public engagement.

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