



Climate, community, cooperation: An Indian approach to adaptation in the Global South

March 2023



Foreword

The several climate-related disasters witnessed in 2022 are a strong warning that the world is on the verge of a climate-induced breakdown. Devastating floods in Pakistan and across the Indian subcontinent, the worst drought on record in the Horn of Africa, heatwaves across Asia, unprecedented weather fluctuations in Europe, wildfires in the USA, and devastating earthquakes in Afghanistan, Fiji, Indonesia, Syria and Turkey – all serve as a reminder that the world is very close to reaching climate tipping points. The heartbreaking images from the Syria and Turkey earthquake drive home to us the reality that the world is experiencing some of the century's deadliest catastrophic events with little to no time left for global climate action. The urgent need for action is reiterated by the UNDRR Global Assessment Report 2022 which indicates that the world will face 560 disasters annually by 2030.¹ The report also highlights that India has witnessed over 400 disaster events which resulted in over 2 lakh deaths and losses worth over USD 200 billion in the last 20 years. The 18th edition of the Global Risks Report,² released at the World Economic Forum 2023, highlighted that climate change, natural disasters and extreme weather events are inextricably linked, with cascading economic consequences that climate-vulnerable economies cannot afford.

While these crises will challenge every economy across the globe, what is becoming increasingly evident is that the developing world will possibly experience the most pronounced impact. Estimates suggest that the gap in economic output between the world's richest and poorest countries is 25% higher than what it would have been without climate change³ – presenting a huge challenge for developing economies to achieve their SDG agenda. These economies have to develop new models of economic growth which can balance climate action with their development goals. Advanced and developed nations must also take greater ownership for the problems created by their fossil-heavy growth trajectories and provide greater support to the Global South in its adaptation efforts.

As one of the largest emerging economies, India is uniquely placed to aid in these efforts. Already, India has shown great ambition and leadership on the mitigation front: enhancing its Nationally Determined Contributions (NDCs), committing to net zero by 2070, and pioneering the concept of sustainable consumption through the Lifestyle for Environment (LiFE) movement. India has also implemented a myriad of policies and initiatives to mainstream adaptation efforts into the development process, financed largely through domestic resources. India's size, scale and wide range of climatic conditions imply that solutions which work for India could also provide an effective template for the rest of the world.

Moreover, continuing economic growth and an increasing geopolitical footprint have put India in a good position to catalyse resources for adaptation efforts. Union Budget 2023–24, which aims for 7% real GDP growth in the current year, includes an INR 10 lakh crore capex package for 2023–24 to enhance growth potential, job creation and boost private sector financing. This provides a vital nudge to India's economic prosperity by making sectors such as agriculture and public infrastructure more attractive to private investors.

At this critical juncture, India must prioritise advocating for increased international consensus, leveraging new technology solutions, financing mechanisms, increasing private sector involvement, and most importantly emphasising people-centric approaches through improved state climate governance. Initiatives such as the International Solar Alliance (ISA) and the Coalition for Disaster Resilient Infrastructure (CDRI), launched by Prime Minister Modi in 2019, have been envisaged with the goal of promoting resilience in new and existing infrastructure and energy security through strong partnerships with other developing economies. India's G20 presidency in 2023 also presents a unique opportunity to build momentum towards centring the needs of developing economies on the global stage. With India at the helm, ideas around refuelling growth through green transitions and the creation of climate-conscious pathways have already emerged as important elements of the G20's agenda for research and action.

In this context, this report, jointly produced by PricewaterhouseCoopers (PwC) and Observer Research Foundation (ORF), seeks to document and aid India's attempts to synergise adaptation efforts with its broader development trajectory. Combining on-ground research with secondary analysis, this study aims to bring out the best practices in climate hazard management across diverse states in India, and to identify opportunities for improving existing mechanisms and catalysing stronger partnerships across stakeholder groups. The report also aims to address the challenges associated with financing adaptation efforts, specifically focusing on a greater role for private, philanthropic and international finance. The authors also aim to provide a template for disseminating some of India's best practices to other nations in the developing world and utilising existing international platforms which could aid these countries in further accessing resources for their adaptation efforts.

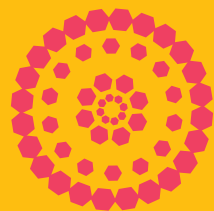
The decade ahead presents a unique opportunity for India to emerge as a self-reliant as well as climate- and disaster-resilient nation balancing economic growth and climate goals with prudence and integrity. We hope that the insights and findings shared in these pages offer valuable inputs to policymakers, practitioners and the public to understand the complex climate challenge and the catalytic impact its strategic responses could have on adaptation efforts in the Global South.

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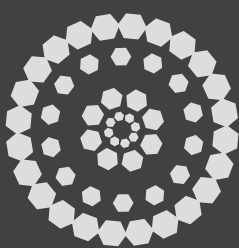


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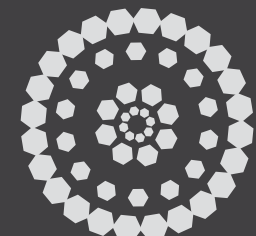
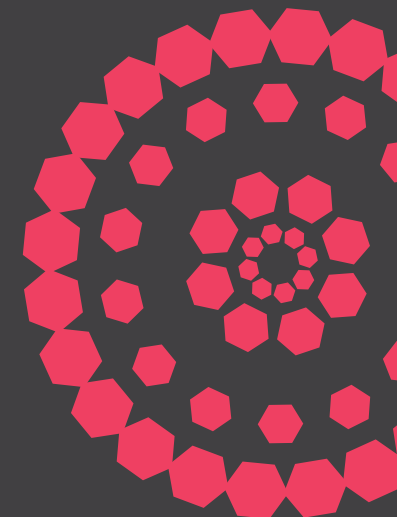
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Executive summary

The need to adapt to the now inevitable impacts of climate change is becoming increasingly urgent. However, there is still a long way to go in terms of strengthening resilience, reducing vulnerabilities and sensitivities, and unlocking the adaptive capacities of global interconnected systems. According to the IPCC, global average temperatures have risen drastically since pre-industrial levels.⁴ If not controlled immediately, achieving the 1.5 °C limit for global temperature rise will be extremely difficult. Climate change is no longer a debate for the future, but a lived reality for several millions of people across the world. We are in the midst of a climate emergency, and it is our moment to take action. Globally, the decade from 2012 to 2021 was the warmest on record.⁵ Over the previous four decades, average worldwide sea surface temperatures have risen by around 0.6 °C. Rainfall has become less frequent and the number of drought events has increased in the past few decades. In 2022, India experienced extreme weather events on 314 out of 365 days. Thunderstorms and lightning claimed the highest number of lives (1,285; 58% of total such deaths), followed by floods and heavy rains (835 deaths), snowfall (37 deaths), heat waves (30 deaths) and dust storms (22 deaths).⁶ The serious threats caused by these changes to human life, property and well-being are more pronounced for the developing world.

As per CCPI 2023¹ published by Germanwatch, the New Climate Institute and Climate Action Network International based in Germany, India earned a high rating in the GHG Emissions and Energy Use categories and a medium rating for Climate Policy and Renewable Energy. Not only the government but also the private sector is taking steps to mitigate the changes.

Private sectors businesses, medium and small-scale industries and global supply chains are also now altering their priorities to align

with climate mitigation efforts through net zero targets. PwC's 26th Annual Global CEO Survey, which polled 4,410 CEOs in 105 countries, including 68 CEOs from India, found that around 24% of Indian CEOs (14% of global CEOs) felt that climate change poses a major threat to their top line and is driving the development and integration of corporate climate strategies. India's top five business conglomerates are planning multi-billion dollar investments in hydrogen, renewable energy generation and innovative climate-friendly products to rank among the world's top climate-neutral companies. With its financial strength and strategic thinking, the private sector can play a critical role in accelerating the urgent transformational changes for green growth.

In this context, this study intends to assess India's present approaches to disaster and climate risk management, adaptation and resilience building, to record best practices and analyse how these approaches can be scaled up globally as well as domestically by driving more investments. The study was carried out across four states – Odisha, Maharashtra, Assam and Meghalaya – with the objective of tackling the major climatic disasters confronting India today and their impacts on vulnerable landscapes. The states chosen for the study are dealing with the main disasters that affect India, and they also have a long history of disaster management and adaptation initiatives. Odisha has a lengthy history of cyclones, and its zero-causality policy has attracted attention globally. Droughts are common in Maharashtra and its drought-proofing strategies have reduced the plight of farmers significantly. Assam and Meghalaya are seeing greater unpredictability in annual and seasonal rainfall, as well as frequent landslides. However, a rich legacy of community adaptation initiatives, nature-based approaches in economic revival and the use of multiple stakeholders, including military forces, are helping the states fight extreme weather events. The study highlights the lessons learnt in dealing with multiple disasters and provides a blueprint for scaling up these practices in similar geographies and socioeconomic contexts.

India jumps 2 spots higher and now **ranks 8th** as per Climate Change Performance Index, 2023; on track to meet its 2030 emissions targets.¹

- **Germanwatch**

Key takeaways from the study

A sociocultural response framework

The state of Odisha has effectively kept mortality rates due to cyclones low, earning itself a global reputation in disaster management. The United Nations has lauded Odisha as a 'global success story' and a model for other states and cities. Since the severe cyclones in 1971 and 1999, Odisha has been pushing for 'zero casualty' or minimum deaths. The

OSDMA believes in capacity building of local communities as 'first responders' to extreme weather events and has constructed public infrastructure such as multipurpose cyclone shelters which can be used by the community even beyond cyclone protection. Odisha has also made positive strides in EWS, with DMR centres installed in each of the six coastal blocks. Vulnerable communities are taught search and rescue, first aid, and community shelter management as part of the Aapada Mitra Scheme. This training has aided in the development of self-sufficient communities. These trained 'disaster warriors' have contributed to making Odisha a champion in cyclone and tsunami management. On similar lines, in Assam, communities come together to rebuild damaged houses under a traditional system called hariya. Built on the traditional philosophies of mutual trust, cooperation and collaboration, indigenous practices observed in both Odisha and the Northeast help in achieving community-level adaptation and resilience. Both Odisha and Assam, with their extensive expertise in disaster management believe in CBDP, which has led to the development of decentralised risk mapping, localised action plans and local institutional strengthening. With climate change increasing the frequency of natural hazards in the nation, these approaches provide an optimistically detailed framework where environment protection, sustainable development, economic growth and social equity are woven together in a single matrix to strengthen the resilience of our common future.

In **April 2018**, **Odisha** became the **first Indian state** to have a fool-proof **EWDS communication system**. At present, **1,205 villages** from **22 coastal blocks** in the coastal districts, with the villages of Noliasahi and Venkatraipur getting India's first **UNESCO-IOC 'Tsunami Ready'** recognition.

- **OSDMA**

¹ India now ranks amongst the top five countries and the best among G20 countries since the first, second and third ranks were not awarded to any country.

Technology for climate adaptation and resilience

Maharashtra has been afflicted by droughts for decades. Maharashtra's water train to supply drinking water in drought-affected villages attracted considerable media attention in 2016. Subsequently, the state launched Jalyukt Shivar Abhiyan (a water conservation scheme) to make the state drought free by 2019. The state's efforts to connect the private sector

An **Agriculture Accelerator Fund** to be set up to promote agri start-ups among young entrepreneurs, increase adoption of **cutting-edge technologies**, and offer innovative and economical farm with such **climate smart tech initiatives**.

Union Budget 2023–24

and farmers in order to enable direct procurement and provide farmers with access to the latest technology are key highlights which could be scaled up going forward. Several drought-afflicted districts of Maharashtra that saw a high number of farmer suicides are employing climate-proof farming. In many places, greenhouse farming is being introduced to cultivate high-yield varieties of crops.

Farmers are also involved in artificial cross-breeding of desired crop types, which is largely employed for the manufacturing of hybrid seeds. The region's groundwater level has risen because of the watershed programme, and soil erosion has

been prevented through the construction of artificial barriers such as check dams, which also assist in keeping water stagnant during floods. Farmers in this region have altered their cropping pattern by transitioning to less water-intensive crops. They are also gradually shifting to organic farming to boost the carbon content of the soil. As part of the programme, farmers are taught how to make natural fertilisers. The private sector, which supplies the necessary crop types and obtains the harvested seeds, has been involved in these efforts. This has limited community migration in the region and instead made these farmers employers. The Maharashtra example demonstrates how technology can address society's most difficult challenges.

India's technological advancements have been quite commendable, and the country can emerge as a pioneer in enhancing forecasting and EWS. The IMD intends to create 660 DAMUs by 2025, increasing coverage from 3,100 blocks in 2023 to 7,000 blocks in 2025. The Doppler Weather Radar Network is expected to cover all of India by 2025. This will aid in more precise forecasting of extreme weather occurrences. The Maharashtra government is attempting to map land parcels using satellite imagery for monitoring degraded farms and identifying loss and damage in the event of droughts and floods. The adoption of artificial intelligence (AI) to assess and analyse loss and damage will help in compensating farmers. Insurance firms can use these technologies to design climate risk insurance packages.

Going green

Assam has allocated 3% of the annual budget of all line departments of the state's R&DM Department for disaster reduction. Climate budgeting, which was first introduced in 2012, has lately caught the attention of governments for state budget planning and revision. The Assam government is also using green budget tagging in many departments to address climate change challenges in line with its SDGs and development plans. This idea could be scaled up going forward. It is crucial to highlight that green budget tagging is only one part of green budgeting, which also includes a solid strategic framework and a supportive enabling environment. The indigenous housing methods of Odisha and Assam that are cyclone and flood resilient can be scaled up in other similar geographies. However, in our efforts to develop sustainable infrastructure, we must also employ sustainably sourced nature-based building materials.

Additionally, zero-budget natural farming should be given impetus by unlocking increased flow of investments in scientific agricultural research, climate-smart agricultural practices and agricultural extension. This will help in eliminating the negative impacts of climate change on food production as well as protect the livelihood of vulnerable communities.

Women first

The issues that various segments of vulnerable populations face are not the same. Disasters have a disproportionate impact on the lives of women. Therefore, district and village-level plans should include the implications on various sections of vulnerable groups. As men relocate for jobs, women are often the first responders in rural communities. During storms, many women volunteers are deployed for search, rescue and first aid. The revenue generated by the community-managed shelters might be utilised to compensate community volunteers and keep them involved in disaster relief activities. Many women with children in Maharashtra have been widowed because of the high rate of farmer suicides. As a result, they have to work hard to make ends meet. Gender inclusion should be considered while choosing beneficiaries for farmer relief and assistance grants. It is important to frame solutions that bolster inclusivity and women's empowerment.

India's NDRF Warriors

The NDRF is now the world's greatest rapid response force for disaster response.⁷ The BSF, CISF, CRPF, ITBP, SSB and Assam Rifles comprise over 15 battalions of the NDRF. Each battalion has a total strength of 1,149 soldiers. The IAF and NDRF activities in Assam and Meghalaya during the 2022 floods might be used as a model for flood relief operations in similar landscapes with difficult physical accessibility in emergencies. As part of the state's humanitarian aid and disaster relief (HADR) operation, the IAF flew 74 sorties, rescued 253 people caught in floods in Assam and Meghalaya, and dropped over 200 tonnes of relief goods. Along with the Indian Army, IAF and a medical team, 101 NDRF personnel are also assisting relief efforts following the earthquake in Turkey, thus transforming India into a 'provider of assistance in international disasters'. India is also a donor, having recently contributed significant international disaster relief and foreign development aid to other nations, notably its neighbours like Bangladesh, Nepal, Myanmar and Sri Lanka. India has held DM exercises, which allow the NDRF to showcase disaster response tactics to their peers in other countries. When Nepal was devastated by a 7.8 magnitude earthquake in 2015, the NDRF stepped in.

The study elaborates on many good practices adopted by the four states and uses them as an integrated approach in India's battle against climate change and increasing disaster risks. These approaches could be replicated not just across the country but also in other similar geographies, notably the SIDS and LDCs.

The adaptive nature of India's democratic system provides tremendous scope to leverage cross-state and Centre-state exchange of institutional knowledge and technical capacities which can come handy in managing devastating natural hazards. The Inter-State and Zonal Councils introduced by the nation to support Centre-state and inter-state coordination and cooperation in India are excellent forums to bolster the exchange of institutional knowledge and capacities, continuous capacity building of states (through tailored need-based training, workshops, regional CoEs, etc.) as well as raising of funds for emergency response and relief operations. Specific resources, data and institutional knowledge of Regional Zonal Councils can be leveraged to conduct annual exercises and mock drills on disaster management and for long-term awareness dissemination activities of diverse stakeholders in different geographic contexts. In addition, a repository of location-specific best practices in DRR and climate risk mapping can be made available to the public as well as private agencies for cross-learning and scaling up in similar geographies in the larger Indo-Pacific region to foster international collaboration.

India has pioneered several ground-breaking initiatives – for example, the use of satellite remote sensing and geospatial technology for better climate information and decision support, the first domestic carbon market and investments in disaster-resilient infrastructure. In terms of creating financial resilience, the RBI, as a recent member of the NGFS, is actively looking at de-risking the Indian financial sector through robust identification, monitoring and management of climate risks.⁸ All of these measures demonstrate India's ability to increase resilience through the loss and damage financing agreed upon during the COP27 discussions. To fully realise the value of this funding, the country must prioritise better quantifying the costs and benefits of resilience, improved risk information and cross-decisional coordination. G20 provides a distinctive opportunity for India to spearhead a unified model of resilience adaptation building among developing nations. The G20 has constituted a separate working group on DRR for the first time to encourage dialogue between developed and developing nations on effective response, preparedness and resilience building to extreme climatic events. Being at the helm of affairs, India's key priority at this international platform would be to highlight the financing gap in fast-tracking DRR and CCA initiatives in a unified framework that looks at participatory approaches, increased women and youth participation, strengthened international collaboration, improved climate predictions and enhanced climate governance.

Assuming the G20 Presidency, India could position itself as a champion of climate action for the developing and emerging world. Finance delivery in accordance with earlier promises, increased private sector collaboration, access to a worldwide ESG finance pool, and the contribution of MDB must all be driven during this time and beyond.

Motivation and objectives

Background

India’s approach to adaptation and resilience is multidimensional and involves a very large set of stakeholders. The interactions and intersections across the wide range of policies at several levels of governance decide the ultimate direction of India’s climate action. While climate action plans and disaster management plans exist at both the national and state levels, several resilience-building efforts are also carried out as part of broader development programmes. Effective actions can be catalysed if there is a concerted effort to create synergies within this vast ecosystem of policies and stakeholders.

Objectives

In this context, this study aims to assess India’s present approach to disaster management and adaptation and resilience building, document best practices, identify key gaps, and provide some ideas for a future roadmap. The study aims to address the following broad questions:

- What has been the success of the present policy framework for adaptation and resilience building?
- What are some of the best practices at a state level which India could recommend as a template to other developing nations?
- How has India financed its efforts and how can adaptation finance be mobilised at scale as the impacts of climate change worsen?
- What are the key challenges and key considerations for creating a unified adaptation and resilience policy framework?

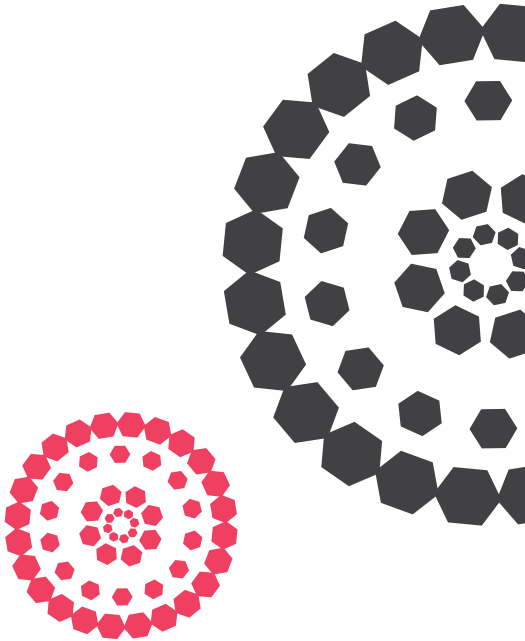


Selection and delineation of the study geography

Given the diverse nature of climate risks and the strong role of state and local actors, the study has been conducted across four states – Odisha, Maharashtra, Assam and Meghalaya – to cover the key climate hazards facing India today. The study regions were selected as they are vulnerable to the major hazards the country faces and have a long history of disaster management and adaptation efforts.

State/Region	Natural disasters	Rationale
Odisha	Floods and cyclones	<ul style="list-style-type: none">• Odisha is often referred to as the ‘disaster capital’ of the country, due to its high vulnerability to natural hazards, particularly tropical cyclones and storms• The coastal area is densely populated with agriculture, fishing, tourism and port management being the primary sources of livelihood which further increases the disaster risk for the inhabitants.
Northeast region	Floods, landslides and soil erosion	<ul style="list-style-type: none">• As per CEEW Climate Vulnerability Index 2021, Assam is India’s most climate vulnerable state.• According to ‘Climate Vulnerability Assessment for Adaptation Planning in India’ report, Meghalaya has been ranked as the twelfth most vulnerable state to climate change• It is facing increasing volatility of annual and seasonal rainfall and rise in annual mean temperatures.• Due to its geographic location, it is highly susceptible to natural disasters.
Maharashtra	Droughts and floods	<ul style="list-style-type: none">• Maharashtra is one of the most multi-hazard prone states in the country.• The livelihood of around 65% rural population of the state is heavily dependent on agriculture and allied activities which makes droughts and floods a major concern.• Over 15,000 farmers have committed suicide in Maharashtra between 2013-18 (6 years)

The selection of the states for this study is purposive. Based on different vulnerability and exposure profiles derived from a secondary literature review, the study geographies, which are representative of the cumulative climatic and disaster risks faced in the Indian context, were delineated. Each state’s niche demography was purposefully chosen to capture diverse qualitative information centred on traditional best practices that have been acclaimed in academic research, media publications and local government initiatives. Another motivation for selecting the study geographies was the authors’ previous association with state authorities as well as local communities, which made it easier to access data and conduct fieldwork.



Approach

The study includes an assessment of the vulnerabilities, adaptation and mitigation initiatives at the ground level (village level). It also includes wider stakeholder participation with inputs gathered from key stakeholders spanning local communities, government, CSOs, private sector organisations and research institutes. The team selected a list of parameters such as community-level action, institutional structures, government interventions and the landscape of climate and disaster financing to arrive at best practices from the study regions. Stakeholder consultations and field visits were conducted in selected high-risk districts in each of the study regions to get first-hand accounts of the problems faced with respect to DRR and CCA. Field visits were conducted at both rural and urban locations to understand the differences and similarities in the ground-level practices adopted as well as the local institutional structures. Semi-structured KIs and FGDs were used during the stakeholder consultations with a focus on social interaction, field observations and ethnographic accounts of the stakeholders to get rich qualitative insights for the study.

Further, extensive desk reviews of existing secondary literature were undertaken to validate ground research with existing frameworks, theories and approaches. Disaster data was downloaded from the International Disaster Database EM-DAT which provides core data on the occurrence and effects of over 22,000 mass disasters in the world from 1900 to the present day. Location-specific data was also collected from SDMAs and DDMAs. Some data was also collected from newspaper articles, print media, etc., to fill data gaps and triangulated using quantitative research methods.

Output and outcomes

The study aims to provide insights into the disproportionate impacts of climate and disaster risks on vulnerable communities in India, laying the foundation for replication and scale-up in the Indo-Pacific region. The publication also aims to raise awareness among diverse stakeholders such as corporates, decision makers, NGOs and INGOs, multilateral agencies, practitioners and local authorities about climate change, evolving hazard and risk profiles, and the first-response mechanisms that have evolved over the years. Insights from this publication can also be used for enhanced decision making and better integration of CCA and DRR into broader development policy debates. By highlighting the lessons learnt from each state and providing recommendations, the study aids in the development of the evaluation, learning and innovation required to drive participatory governance.

This publication is the first step for the authors. PwC and ORF will continue to work together to share and advocate for community-led transformations and initiatives in CCA and DRR. Emerging ideas, problems and solutions will continue to guide PwCIF's and ORF's work in this domain, as well as help define future projects and interventions in similar geographies and social contexts.



Introduction

The last three decades have seen India achieve continued high rates of economic growth and sustained progress toward the 2030 SDG agenda. However, at the same time, the world has also witnessed a rapid and unprecedented rise in GHG emissions and global warming. The IPCC has estimated that average temperatures across the world have already increased beyond 1 °C compared to pre-industrial levels and are well on track to exceed the 1.5 °C target in the next two decades.⁹ The impacts of climate change are no longer a thing of the future but a lived reality for millions of people, with the developing world bearing the worst consequences. India now faces an additional hurdle of having to manage the consequences of increased climate risks on its development agenda.

Since the middle of the twentieth century, India has witnessed a substantial rise in average temperatures; a more volatile monsoon season, a rise in extreme temperature and rainfall events such as drought, floods and cyclones; and an increased rate of sea level rise (Table 1). The rate of change of these climate-induced variables has been much more rapid than in previous periods. There is now substantial compelling evidence to suggest that human activities are a key contributing factor to changes in regional climate.

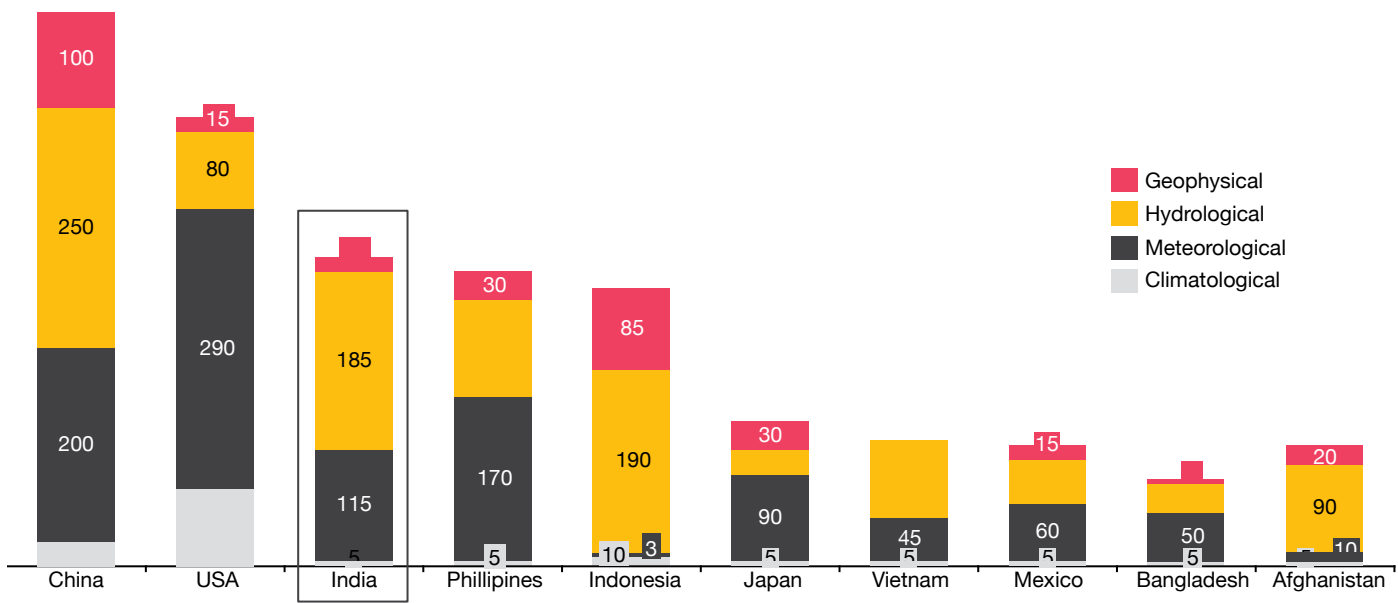
Table 1: Changing climatic variables across India

Climatic factors	Global changes	Changes in India
Temperature rise	Global average surface temperatures have risen by approximately 1 °C since 1900. Worldwide, 2016 was the warmest year and 2012–2021 was the warmest decade on record.	Average temperature rises of 0.7 °C during 1901–2018. Accelerated warming since 1985, with annual mean temperature increasing by 0.15 °C per decade between 1986–2015
Sea surface temperatures	Average global sea surface temperatures have seen an around 0.6 °C increase over the last four decades	Sea surface temperature in the Indian Ocean has risen by 1 °C on average during 1951–2015.
Rainfall	Since 1901, rainfall events have become less frequent and more intense. Global precipitation has increased at an average rate of 0.04 inches per decade since 1900.	Summer monsoon precipitation has declined by around 6% during 1951–2015. More frequent dry spells since 1981, 27% higher during 1981–2011 relative to 1951–1980. Intense wet spells also more frequent
Droughts	Drought frequency and intensity has increased by nearly a third since 2000.	Intensification of droughts due to changes in rainfall patterns, more than 2 droughts per decade during 1951–2016 Area affected by droughts has also increased by 1.3% per decade in the same period.
Tropical cyclones (TCs)	It is likely that the proportion of TCs of major intensity and the frequency of rapid intensification events have both increased globally over the past 40 years (IPCC 6 AR, 2021).	Frequency of very severe cyclonic storms has increased significantly (at least one event per decade) in the last two decades (2000–2018).

Source: National Oceanic and Atmospheric Administration’s National Centers for Environmental Information; Ministry of Earth Science, Government of India, 2022¹⁰

These changes have had impacts across several dimensions. The most obvious consequence has been the increase in climate-related disasters that have affected human life, property and well-being. India is one of the ten-most disaster-prone countries in the world owing to its unique geo-climatic and socioeconomic conditions. As per a UNDRR report, India has been ranked third (after China and the USA) based on the number of natural disasters affecting the country between the years 2000–2019.¹¹

Figure 1: Top 10 countries by occurrence of disasters (2000–2019)

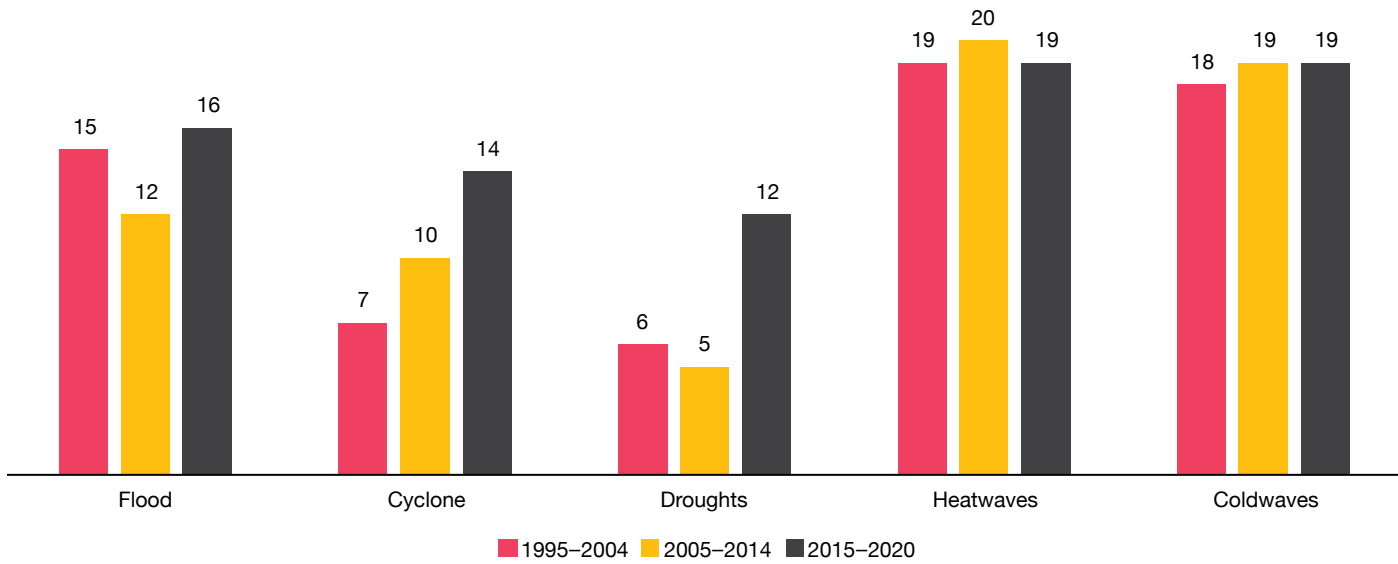


Source: UNDRR, 2022⁴

Around 85% of Indian states are prone to recurring natural hazards such as floods, earthquakes, landslides, cyclones and drought. Almost 58.6% of the land is earthquake prone (moderate to very high intensity), 12% is susceptible to floods and river erosion, 75.8% (5,700 km) of the total 7,516-km long coastline is prone to cyclones and tsunamis, and 68% is prone to drought. Landslides and avalanches are common in the country’s hilly regions.¹²

An increase in the frequency of extreme weather events has been reported in the country (Figure 2). Within a period of 35 years (1970–2005), 250 extreme events were recorded as against 310 events in 15 years (2005–2020).¹³ As per the State of Climate in Asia Report 2021, storms and floods resulted in estimated economic losses of USD 3.2 billion and USD 4.4 billion in the nation respectively.¹⁴

Figure 2: Average annual incidence of climate-related disasters in the last three decades

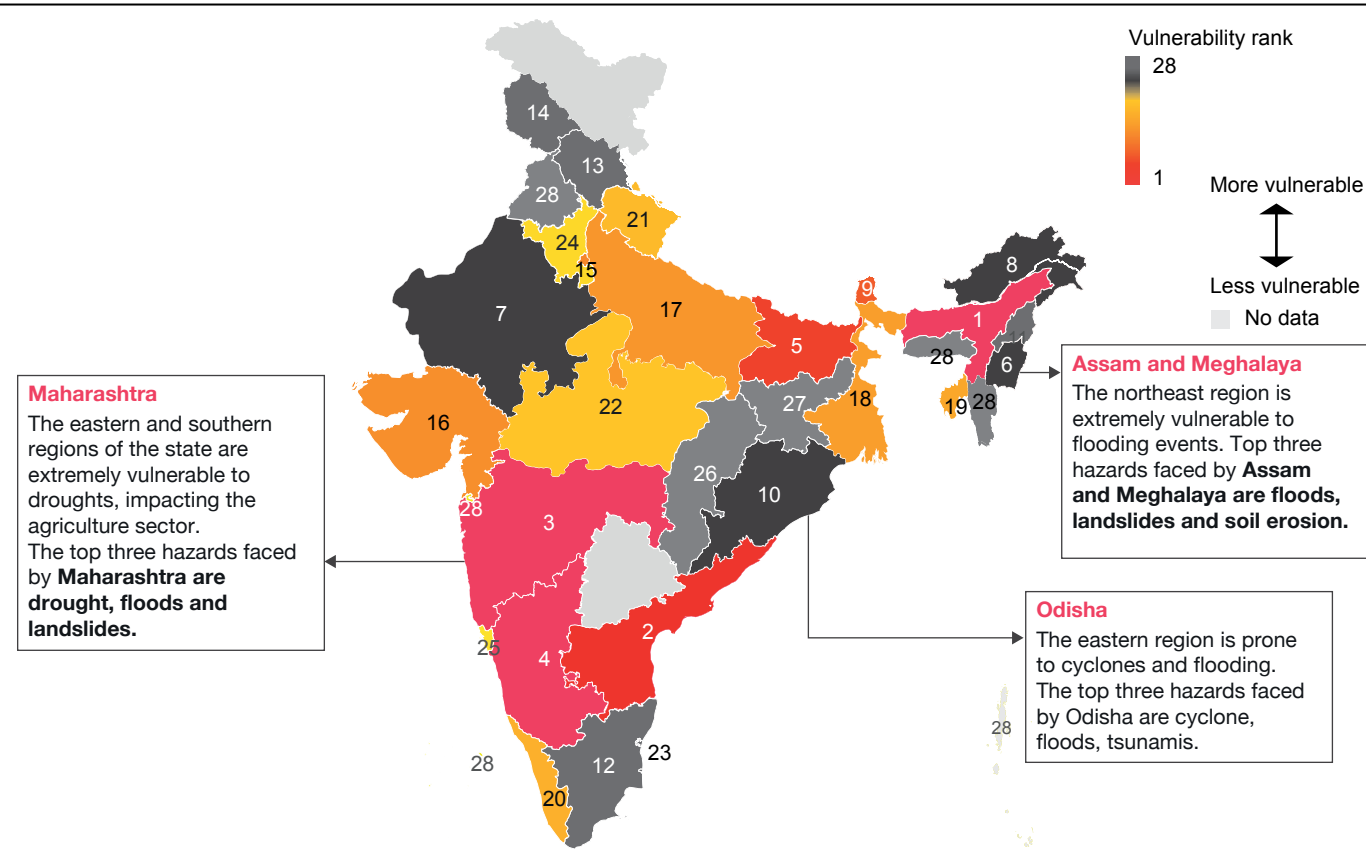


Source: GIZ India, 2021

Thus, climate change has already led to a substantial increase in a plethora of extreme events, leading to major economic losses. In fact, a cross-country index of loss and damages found India to be the seventh most affected country by climate change. In 2019 alone, economic losses from extreme weather events were worth USD 68,812 million or 0.72% of the GDP, a massive burden for a developing economy.¹⁵

Climate change is also causing systemic changes in natural and social systems, leading to cascading effects on many of India’s development goals. The temperature rises and increased incidence of heating increasingly affect labour productivity. A study estimated that India lost approximately 259 million labour hours annually between 2001 and 2020 due to the impact of humid heat, resulting in cumulative economic losses to the tune of USD 624 billion.¹⁶ Labour losses in India were the highest among all the countries assessed and accounted for half of the total global losses.

Map 1: Diverse climatic hazard vulnerability profile of India



Source: Climate Vulnerability Index - Council for Energy, Environment and Water, CEEW, 2021
(Recreated for the purpose of our study)

According to a study conducted by CEEW in 2021, Assam, Andhra Pradesh and Maharashtra are the top three states on the climate vulnerability index (refer to Map 1). This study considered the cumulative vulnerability to various hazards based on three parameters – exposure, sensitivity and adaptive capacity – to calculate the index. The index indicates that the Eastern and Northeastern zones have extreme exposure to flooding.

Certain models suggest that India could experience an additional two heatwaves a year or 12–18 days of extra high temperatures by 2064,¹⁷ further impacting the lives and livelihoods of several communities in lower-income groups. Shortages of water, both for direct consumption and irrigation, are also going to become increasingly common. A recent NITI Aayog report found that 600 million Indians already face extreme water stress.¹⁸ Changes in average rainfall patterns and increasing dry monsoon days have been key drivers of the water crisis along with generally poor water governance practices in India. This is likely to get exacerbated further, particularly in Northern India, where the changing dynamics of water resources in the Tibetan Plateau, often referred to as the ‘Water Tower of Asia’, could lead to an irreversible freshwater scarcity by 2060.¹⁹

A changing climate will also negatively impact health and well-being. Aside from the deaths from extreme events highlighted earlier, the incidence of certain water-borne diseases such as diarrhoea and vector-borne diseases such as dengue and chikungunya are also likely to increase. Droughts and longer dry spells will also impact human health by increasing exposure to dust and smoke. Freshwater scarcity will exacerbate existing challenges associated with sanitation and hygiene. Thus, India’s already stretched healthcare systems will have to increasingly adapt to the changing nature of diseases brought on by climate change.²⁰ The impact will also fall disproportionately on socio-economic groups which have the least adaptative capacity.

Diverse circumstances requiring diverse solutions

The climate change threat in India is not only substantial but also unevenly distributed across the country due to the diverse climate zones, ecosystems and topography.

The southern and western regions are most vulnerable to extreme droughts, predominantly affecting the agricultural sector. The Climate Hazards and Vulnerability Atlas of India highlights that drought has been a serious climate risk in India, with almost 87% of the districts being moderate to very highly vulnerable. Madhya Pradesh, Uttar Pradesh, Gujarat and Karnataka, followed by Maharashtra and Rajasthan, have been the most vulnerable states to droughts. While global warming has made the Indian monsoon more erratic, overall precipitation has reduced substantially to around 6% since 1951. Considering that over 56% of the country’s agricultural land is rainfed and depends heavily on regular monsoons, these droughts have placed great strain on agrarian communities.²¹ While droughts aren’t directly responsible for deaths, the UNDRR estimated that India lost anywhere between 2–5% of its GDP due to droughts between 1988–2017.²²

Floods have been among the most devastating climate-related disasters, increasing in both frequency and intensity. Almost the whole of the Northeast region is highly vulnerable to flooding events. Several other states also have districts that have recorded a very high incidence of flooding events, including West Bengal, Uttar Pradesh, Kerala, Maharashtra and Gujarat. The mountainous states in Northern India are also prone to flash floods, brought about by extreme rainfall as well as melting glaciers. In 2019, the Union Minister for State informed the Rajya Sabha that India suffered losses to the tune of INR 95,736 crore in 2018 from floods alone, 2.6 times more than the losses in 2017.²³ This increasing trend has been observed across most of the extremely flood-prone states. In Assam, around two million people on average were affected each year by floods before the 1990s. In 2020, this number was as high as six million and has been on the rise every year.²⁴

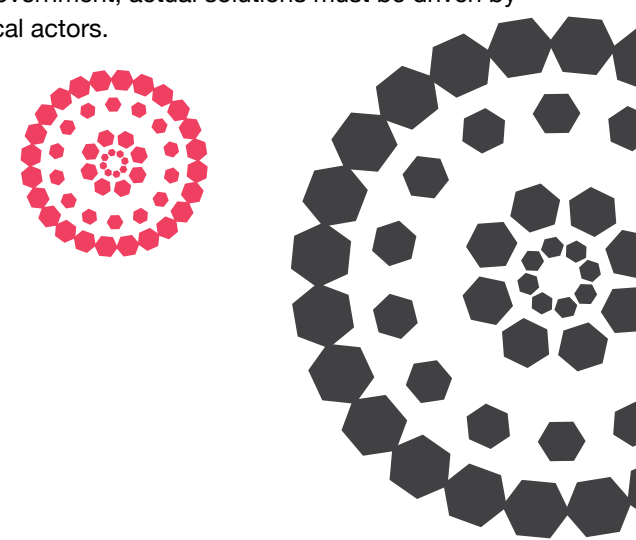
The states along the eastern and western coastline have the highest incidence of cyclonic events, with Odisha and Andhra Pradesh experiencing the highest number of cyclonic events as per the IMD’s Hazard Atlas. These cyclones are a direct consequence of increased ocean surface temperatures. Between 1970–2019, India was hit by 117 cyclones, leading to the loss of around 40,000 lives.²⁵ Studies have shown that the incidence and severity of cyclones have been on the rise In the Northern Indian Ocean covering the Arabian Sea and the Bay of Bengal.


A 2022 study found that the sea surface temperatures had increased by 1.2–1.4 °C in the Arabian Sea in recent decades compared to the last four decades.²⁶ This has led to a 52% increase in the number of cyclones and a whopping 150% increase in very severe cyclonic storms in the Arabian Sea.²⁷ While the incidence of cyclones has increased, the number of deaths from cyclones has seen a steady decline, a clear consequence of better cyclone warning systems and disaster response. However, economic damages are still extremely high. The 2020 super cyclone Amphan, originating in the Bay of Bengal, is estimated to have caused damage worth USD 13.5 billion in West Bengal alone, affecting a staggering 70% of the state’s population.²⁸

Aside from this, severe cold waves across the western states of Uttar Pradesh, Rajasthan and Punjab cause transient disturbances in the micro-climates of the region. According to a bulletin by Down to Earth in 2021, the year 2020 saw 76 times more deaths due to cold waves than heatwaves.²⁹ Triggered by the La Niña phenomenon, cold waves in the Indian subcontinent, with prolonged periods of low temperatures, have affected the productivity of rabi crops and high-value cash crops apart from claiming lives among several marginalised populations.

The Himalayan states also invariably experience several landslides in a year triggered not by earthquakes alone but a multiplicity of other hydrometeorological climate risks. Several such subsequent incidents result in severe losses of life and livelihoods, impacting the local economy and leading to lack of access to safe drinking water and other essential resources in the high-altitude regions. As a result, there is a mass exodus to the neighbouring low-lying areas.

Thus, the diversity of risks across India directly impacts disaster response mechanisms and resilience-building and adaptation strategies for each region. It is fairly evident that a one-size-fits-all solution will not be effective in India. In essence, the adaptation challenge is not a single challenge, but a mosaic of different challenges requiring unique and tailored solutions. Thus, while the impetus and financing for adaptation and resilience-building efforts must come from the Union Government, actual solutions must be driven by state and local actors.





Policy scenario in India

The policy scenario around disaster management and adaptation also reflects the diverse nature of the challenge. In fact, the political economy and policies around adaptation cut across sectors, administrative bodies and levels of governance.

In terms of disaster management, the National Policy on Disaster Management (2009) and the National Disaster Management Plan (2016) emphasise disaster resilience and incorporation of the Sendai Framework for Disaster Risk Reduction. Based on the local context, the State and District Disaster Management Plans lay out the guidelines for prevention, mitigation and response mechanisms. Following a series of disastrous events in India, the Disaster Management Act of 2005 established the NDRF to provide specialised response to natural and man-made disasters. With over 16 battalions spread across India, the NDRF first responses have brought about a shift in paradigm from prevention and preparedness to rapid response and mitigation. In many cases, community responses are the first level of response to disasters. These responses are a consequence of learning and experience from past events. Local communities are also responsible for some of the small-scale adaptation measures which are devised based on lived experiences and traditional wisdom passed down through generations. At the district level, the DDMA is the key nodal body responsible for disaster management, including developing disaster management and prevention plans and coordinating post-disaster relief operations. In the event of a drought, the relief department at the state level is in charge of drought response. The Relief Commissioner

coordinates and monitors the prevention, preparedness and response measures related to emergency situations, and appraises the local disaster management centres, district collectors and relevant departments and agencies of the next steps. The commissioner is also tasked with overseeing the SDMRF and issues orders directing its distribution to districts and relevant departments. The R&DM Department is also an important state stakeholder, particularly in terms of providing relief and implementing rehabilitation measures for those affected by natural disasters.

On the adaptation and resilience-building front, the policy mechanisms are far more complex and intersectional. The NAPCC provides guidance at a national level on India's adaptation priorities. The National Adaptation Fund was launched in 2015 to support adaptation activities in the most vulnerable regions. The fund has so far supported around 30 projects across various sectors, including climate-smart agriculture, water management, livestock management, forestry and among others. However, allocation to the fund has been declining steadily, coming down from INR 115.36 crore in 2017–18 to INR 42.94 crore in 2020–21. At the subnational level, State Climate Action Plans also have a specific focus on adaptation efforts, although this is often secondary to mitigation measures. Aside from this, there have also been substantial efforts to mainstream climate adaptation into disaster risk reduction programmes through various initiatives outlined in DM action plans administrated by different concerned state departments.



Odisha: Protecting coastlines from changing seas

Hazard mapping and the risk of disasters

Located on the northern part of India’s east coast, the state of Odisha is often referred to as the ‘disaster capital’ of the country, owing to its high vulnerability to natural hazards, which frequently wreak havoc on the lives of its populace. With 41.97 million people (21.21 million males and 20.76 females), the state ranks eleventh amongst India’s 28 states in terms of population and makes up for 3.4% of the country’s entire head count, according to the census data of 2011. Given this high population density, it is therefore not surprising that the state has a high disaster risk, especially as almost the entire state is exposed to a variety of climatic threats.

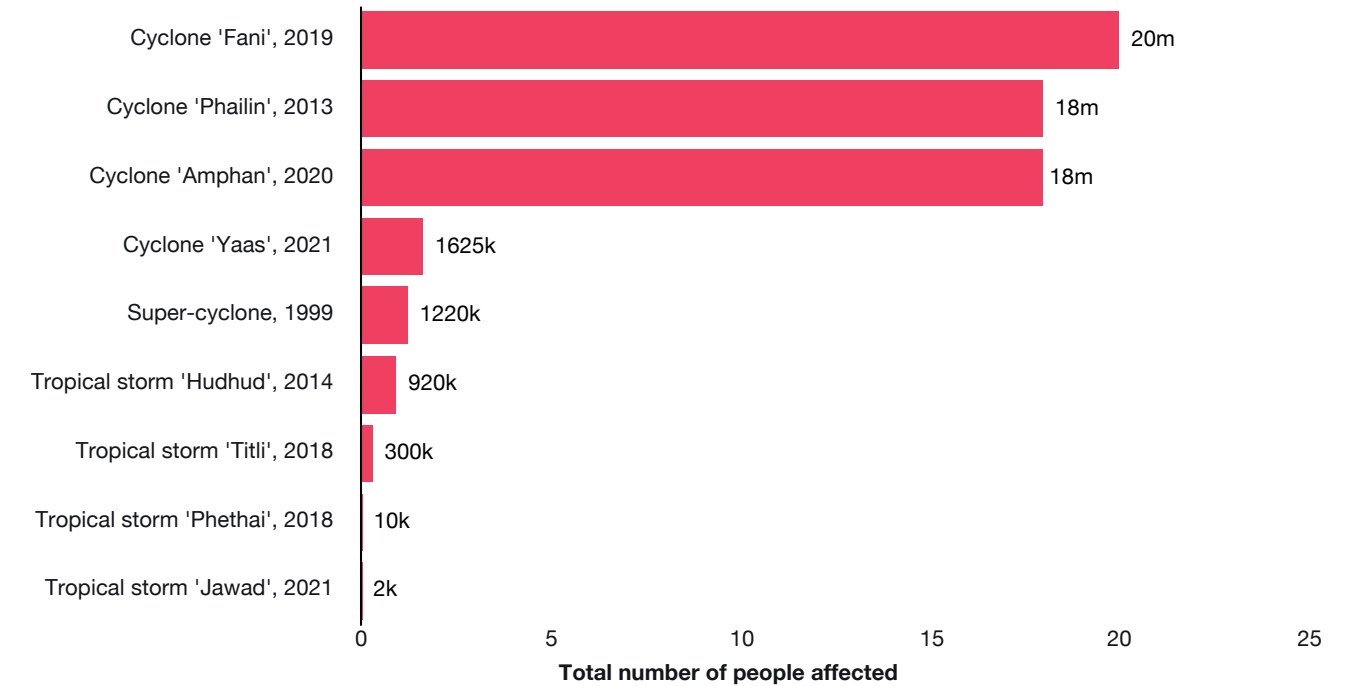
The state has five major morphological regions: the coastal plains, the middle mountainous and highlands region, the central plateaus, the western rolling uplands, and the major flood plains. The disaster vulnerability varies across these

morphological regions, not only in terms of intensity but also in terms of disaster type. For example, while coastal Odisha is prone to cyclones and floods, some parts of western Odisha have been identified as chronic drought-prone zones.

For more than two decades now, Odisha has been reeling under contrasting extreme weather conditions – from heatwaves to cyclones and from droughts to floods. While this contrast is striking, the regularity and intensity of weather events are alarming. According to a study, ‘Out of the last 100 years, the state has been disaster affected for 90 years: floods have occurred for 49 years, droughts for 30 and cyclones have hit the state for 11 years.’¹⁷ Since 1965, calamities are not only becoming more frequent but also affecting areas that were earlier deemed to be outside the vulnerability zone.¹⁷

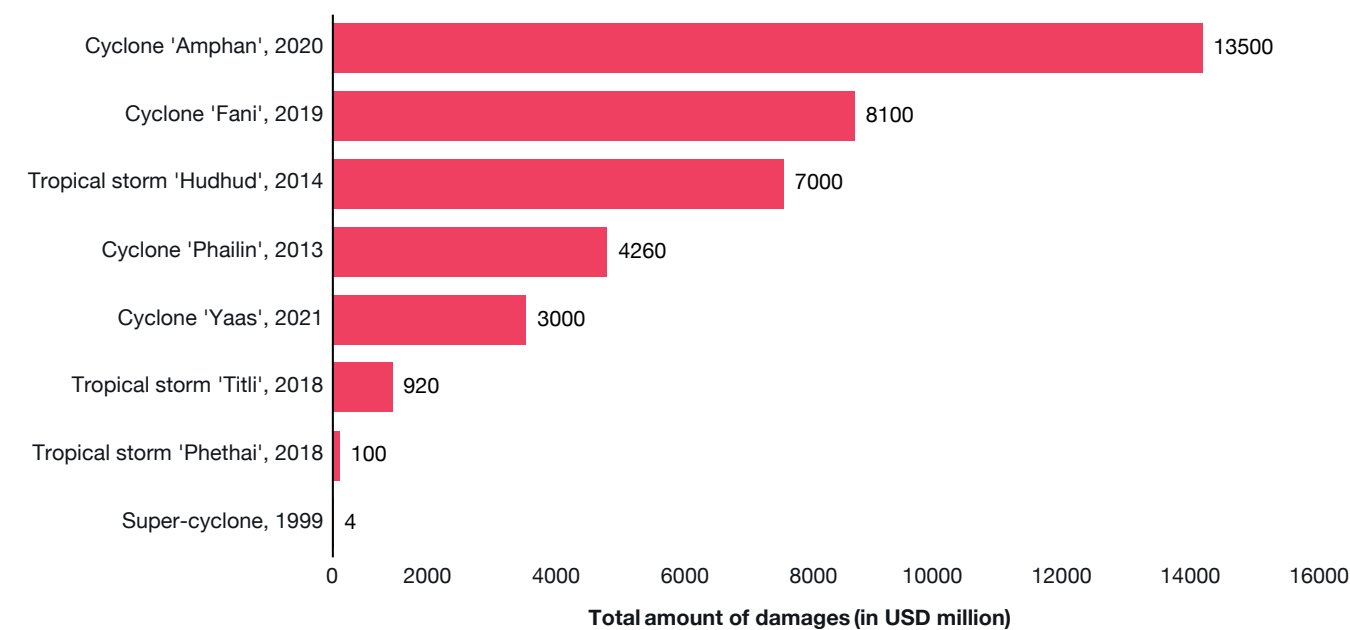
Key hazards in coastal Odisha

The intense disaster risk of Odisha takes a toll on the lives and livelihoods of its people. Of the state’s entire population, 83% lives in rural areas³¹ and their livelihoods are mainly climate sensitive, such as farming and fisheries. Apart from this, the state relies largely on the tourism industry for its sustenance. The frequently occurring extreme weather events impair these livelihoods.³² The disaster risk is highest in coastal Odisha, which forms about 17% of India’s entire eastern shoreline. Traversed by six rivers (Subarnarekha, Budhabalanga, Baitarani, Brahmani, Mahanadi, and Rushikulya), the coast is deltaic in nature. Its fertility and the many livelihood opportunities that the sea offers, such as fishing and tourism, have led to a high population count, with four of the seven coastal districts ranking amongst the top ten most populated districts of the state. These are Ganjam (the most populated district), Baleswar, Khorda and Puri. The other three districts are Jagatsinghpur, Bhadrak and Kendrapara. Naturally, the disaster risk is profound as the communities living here are continually exposed to climatic hazards originating from the Bay of Bengal.



Source: Climate Vulnerability Index - Council for Energy, Environment and Water, CEEW, 2021 (Recreated for the purpose of our study)

Figure 4: Total amount of damage caused due to various cyclones and storms in Odisha (1999–2021)



Source: Compiled from EM-DAT, CRED; retrieved on 13 December 2022, The Odisha Super Cyclone 1999: ADRC, Cyclone Fani: Damage, Loss and Needs Assessment, ILO and ADB, May 2019ⁱⁱ

As may be observed, cyclones are frequent in Odisha. The figures give an overview of the cyclones that the state has witnessed in the past two decades and their disastrous impact.

Located within the ‘World Hazard Belt’, as the Indian Ocean is often referred to, the Bay of Bengal owes its volatility to its triangular shape, the low flat coastal terrain, shallow depth and ‘easterly waves’.³³ These physical attributes create cyclones in the bay, while stormy winds are also drawn from the Pacific Ocean in the absence of any large landmass at the intersection of these two seas. Tsunamis are also a recurring hazard in the bay, triggered by the seismic activity of the mutually jostling European and Indo-Australian tectonic plates in the Andaman-Sumatra Subduction Zone.³⁴ The entire Indian east coast, which frames the bay entirely in the west, frequently experiences these natural disasters, as is seen in the case of coastal Odisha (see Table 2).

Table 2: Hazard profiling of coastal disasters in Odisha (1999–2022)

Cyclones and severe storms	Of all the severe cyclones that have occurred globally, 20% have struck Odisha, and India’s east coast is among the world’s six most cyclone-prone areas. The state experiences cyclones every year from April to May and from September to November and a severe cyclone once every 2–3 decades. Severe storms are even more frequent, wreaking havoc on life and property. Their impact is worsened by poor socioeconomic conditions, weak housing and roads, depleting mangroves and tree shelterbelts, and highly hazardous industries.
Floods	Floods are secondary disasters and happen in Odisha due to cyclones and storms. Moreover, 80% of the state’s annual rainfall is concentrated over a short monsoon of three months. The steep slopes of the inland cause the rainwater to run off and accumulate in the flat coastal plains. This leads to heavy siltation and flash floods. Sea level rise is also causing coastal erosion and inundation in several parts of the state.
Tsunamis	The Bay of Bengal is home to the Andaman-Sumatra Subduction Zone, an area of intense seismic activity along the mutually jostling tectonic plates. This confirms that Odisha may experience a tsunami within few hours if seismic activity occurs at the nearest point in the Indo-Burma plate. As such, undersea earthquakes can also cause tsunamis, and it is to be noted that five of the six coastal districts fall within the Earthquake Moderate Damage Risk Zone. Accordingly, 328 villages within 1.5 km of the coastline have been identified as tsunami prone, although no tsunami has occurred in the recent past.

Source: State Disaster Management Plan³⁵

ⁱⁱ Note: Conversion rate of 1 USD = 82.5 INR as on 13 December 2022; total damages and total affected implies the overall sum of damages across all affected districts

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A fishing boat costs around INR 3–4 lakh, and depending on the extent of the damage, even more money is required to rebuild our houses. In most cases, compensation from NGOs and the government is not enough to cope with a cyclone’s massive devastation. We have taken personal loans and used our savings to build our houses again.’

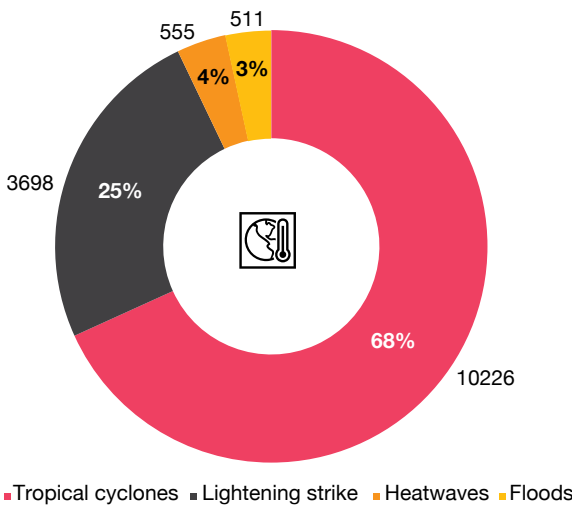
Members of fishing communities, Pentakota Urban Slum, Puri

Image 1: Women’s fishing community of Pentakota, Puri



Source: Spandan Plan

Figure 5: Total amount of damage caused due to various natural disasters in Odisha (1990–2021)



Source: Compiled from EM-DAT, CRED; retrieved on 13 December 2022

Image 2: A woman in Arola, Puri, re-enacting how she latched into a coconut tree to save her life during Cyclone Fani



Source: PwC

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After the cyclone warning came, we shifted to nearby schools the night before and when things calmed down after the cyclone, a few of us started returning to our village in the morning and then it started again. We saved our lives by hiding in the pond next to coconut trees. The cyclone didn’t even give us enough time to get home. Our village did not have electricity for upto two months’

Shanti Devi, Akola, Puri

Multidimensional analysis of DRR and CCA practices

Odisha's disaster management system has earned it international acclaim as well as created challenges. It is important to mention here that although Odisha has a separate Climate Change Adaptation Plan, its realisation is intertwined with disaster management.

Decentralised risk mapping and planning

Odisha is the first state to have a second phase climate action plan which is approved by the NSCCC under the MoEFCC. SAPCC-II outlines an investment of INR 2.45 lakh crore over a period of 10 years between 2021 and 2030 for climate adaptation and mitigation activities in key sectors.³⁶ The OSDMA believes in disaster management as a continuous process requiring prolonged support and intervention in resilience building and reducing vulnerabilities and exposure to disasters. It thus requires the preparation of detailed DMPs by all departments of the government. The plans deal with risk assessment and vulnerability analysis, identification of disaster-prone areas, response structures, inventory of resource SoPs, directory of key institutions, and training of key responders to remain alert in emergency situations and act as first responders. A DMTC has also been set up at the district level for building capacities of different stakeholders in disaster management. Each of the district disaster management plans provides detailed village-level risk mapping. The implementation strategies of the DMPs have been laid out for the district officials in the State Disaster Management Plan. However, there is still potential to involve local communities and other ground-level stakeholders in regular updating and testing of the VDMPs.

Strengthening community awareness and knowledge on natural hazards and climate change

The Aapada Mitra Scheme undertaken by the NDMA has trained around 6,000 men and women from local communities in disaster response, preparedness and recovery measures.³⁷ Every year 75 volunteers are trained by the OSDMA: 25 for shelter management, 25 for search and rescue operations, and 25 for first aid.³⁸ Communities are encouraged to have local ownership, address local needs, and promote a culture of mutual help to prevent and minimise damage. These training programmes are conducted by the government with the coordination of a local NGO. Volunteers for this training are chosen by a village committee. Information about the community awareness programmes on natural hazards are listed under key activities for each of the sectors, such as coastal disaster risk, energy and waste management.

Detailed directions are provided on how to undertake early warning programmes. A trained list of volunteers is also provided, identifying their target groups. DDMPs highlight the awareness initiatives that need to be undertaken by the local authorities and identify lack of awareness about specific disasters. These also provide for the creation of awareness programmes for separate sectors, like schools and civil society.

Community networks have also been deemed necessary for the timely dissemination of alerts and mobilisation of resources. Two coastal villages, Venkatraipur in Ganjam district and Noliasahi in Jagatsinghpur district, have been recognised for being 'Tsunami Ready' by the Inter-Governmental Oceanographic Commission of the UNESCO.³⁹ This made India the first country in the IOR to establish such high levels of disaster preparedness at the community level. The award recognises the effective preparedness measures of the communities in terms of developing community tsunami risk reduction plans, comprehensible evacuation maps, annual tsunami community exercises, and a reliable means of receiving prompt tsunami alerts.⁴⁰ In an effort to further increase disaster risk resilience in Odisha, the state government is intent on creating Disaster Yodhas by introducing disaster and pandemic management in the educational curricula of students from class four to graduation.⁴¹

Keeping in mind the heavy death toll of the severe cyclones in 1971 and 1999, the state has consistently strived for 'zero casualty' or minimum deaths, in its efforts to manage each disaster. The idea behind Mission Zero Casualty is that every household should have a disaster warrior. Drawing from this, every member of the community, elected officials and higher administrative officials receive disaster management training. This has in effect helped to keep death rates low and has become the hallmark of Odisha's credibility in disaster management. The state has been hailed as a 'global success story' and a model for other cities by the United Nations.

However, it has also been reported that in many districts, community volunteer groups need to become more functional through training at regular intervals throughout the year. Cultivating effective community-based disaster preparedness is also a time-consuming and expensive process. It takes more than a month to implement a community-based disaster management programme. That kind of effort is yet to be invested.

Role of the private sector in adaptation and resilience financing

Provision for private sector investments is in place for all sectors identified in the plan for achieving climate resilience. Strategies on how to avail the funds are however not clear. The SDMP highlights the need to attract private sector involvement, especially CSR, but does not provide strategies. The DDMPs also have the provision of requesting funds from the private sector for recovery efforts but no strategies have been suggested. In the Odisha SAPCC, CSR funding has been mentioned for realising adaptation strategies. However, no linkage has been mentioned explicitly. The SDMPs do not mention corporate funding, although CSR is listed as a partner for the OSDMA which provides scope for corporate and private participation to finance DRR and post-disaster recovery and relief activities.

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Communities should be at the centre of disaster management planning and implementation. In the present system of disaster governance, the protocol is set from the top. There is a need to develop a bottom-up approach to ensure effective local governance in long-term resilience and adaptation building.’

Liby T. Johnson,
Executive Director, Gram Vikas

Case study

From community resilience to early warning – the role of the private sector in Odisha

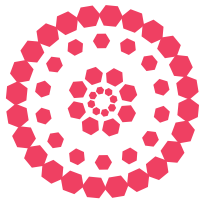
In May 2019 and May 2020, Odisha's coast was battered by two deadly supercyclones, Cyclone Fani which recorded windspeeds of 175–180 kmph and gusted to 205 kmph during its landfall. Gauging the massive damage to livelihoods and especially infrastructure, the government reached out to the Centre, private investors as well as banks for support in emergency response, rehabilitation and restoration activities.

The Tata Group implemented a number of emergency response measures, with Tata Steel, JUSCO, Tata Power Delhi Distribution Limited, and Tata Trusts assisting the government's power restoration efforts by providing over 100 skilled workers post Cyclone Fani in 2019.

PwCIF, in association with Gram Vikas, provided water storage systems and refurbished sanitation facilities to close to 300 families of Daruthenga Gram Panchayat in Odisha, which was severely impacted by Cyclone Fani. As part of the intervention, apart from providing safe drinking water, masonry training camps were also organised to help participants (60% of whom were women) find sustainable livelihood opportunities and build community resilience.

During Cyclone Amphan in 2020, Reliance Foundation issued cyclone forewarnings and preventive measures were sent by the foundation as mobile-based audio/text messages to agricultural farmers, livestock farmers, and inland fish farmers in the coastal areas of Odisha and West Bengal. These aimed at preventing livelihood damage and were sent between 15–19 May. Twelve pre-cyclone and twelve post-cyclone livelihood advisories were successfully delivered to 2,23,206 farmers. Detailed advisories were also sent to all stakeholders. Information on ten different topics was sent to agriculture farmers, including topics related to livestock and inland fisheries. Support was also provided through a 24/7 toll-free helpline. In addition, 18 livestock treatment camps and 22 virtual programmes were held for agricultural, inland fishery and livestock farmers to support the local government.

The Odisha Government has also partnered with L&T to establish its EWS. The facilities established under this project at the state and district levels during Cyclone Fani were outfitted with dispatcher terminals and GIS software, allowing radio dispatchers to effectively monitor and participate in the activities for quick and efficient response.



Roadmap for financing from government budgets

Odisha's prowess in disaster management is also backed by the Odisha government's strong commitment. All schemes (by budgetary allocations) presented by the government have been realigned to deliver on climate action points and safeguard people and property from natural disasters. This was also acknowledged by the Special Representative of the Secretary-General for Disaster Risk Reduction, UNDRR, post cyclone Yaas.⁴² This commitment is duly complemented with steady budget allocations. In the state budget for 2022–23, INR 3,210 crore has been approved towards the SDRF and NDRF. In the state budget for 2022–23, INR 3,210 crore has been approved towards the SDRF and NDRF. In addition, the state conducted a thorough cross-sectoral analysis to develop a Climate Budget for 2020-2021, opening up opportunities for adaptation and mitigation financing in the state. It is also the first Indian state to receive Green Climate Funding worth USD 34.4 million with the National Bank for Agriculture and Rural Development and aims to enhance groundwater recharge in community ponds through these funds.⁴³

Damage and loss assessment methodologies

The SDMP provides due procedures for damage assessment at the local level and provides for training programmes to undertake these. DDMPs provide tables for loss assessment at the village level and endorse the need to create assessment teams at the community level. However, the Odisha Action Plan on Climate Change does not provide any such methods to deduce the damages and losses from long-term climatic events like heat-stress, droughts and water salination. Under the revised provisions of the SDRF and the NDRF, provisions have been made for the payment of agriculture input subsidy where the crop loss is 33% and above against the earlier provision of 50% and above. Modes of crop loss assessment for individual farmers have also been mentioned. In addition, a proposal for assessment of social inclusion was presented to the SRC and the OSDMA jointly by the NDW-NCDHR, Sphere India and ALVM post Cyclone Yaas in 2021 for inclusion in the assessment of damages and losses in the state.

However, there still is scope for more initiatives and guidance for the affected communities, even if the affected are compensated for damages and losses financially. Often, the affected are paid in instalments, only after a phase of reconstruction of the damaged houses has been completed. Very often, in view of limited funds, communities, particularly those engaged in fishing, must also decide whether to repair their damaged boats or rebuild their homes. It thus becomes a choice between survival and livelihood. This creates potential for leveraging both public and private investments in disaster recovery projects.

Linkages to other government schemes

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Odisha is the first Indian state to amend the Panchayati Raj Laws. At present, the OSDMA consists of 1,000 specially trained people. Our idea behind Mission Zero Casualty is that every household should have a disaster warrior.’

**Dr Gyana Das, IAS,
Executive Director, OSDMA**

The focus of the state in recent years has been on the 3Ps – planning, preparedness and prevention – which an assessment of the SDMP and the DDMPs reveals. This is a result of the influence of the Sendai Framework for Disaster Risk Reduction 2015-2030. Accordingly, the state is trying to bring about a cultural shift in disaster management from a reactive to a proactive approach. The OSDMA is thus focusing on preparedness, capacity building and inculcating risk-informed programming strategies in key departments to increase the resilience of state, departments and communities. It is also collaborating with other departments, including Health, Forests, and Women and Child Development to develop a more inclusive and participatory disaster management model. The government is also keen to achieve risk reduction through critical tools like risk assessments, education, coordination, supporting policies, laws, good governance, risk-informed programming, early warning systems, contingency plans, information sharing, sustainable development.⁴⁴ It is also interesting to note that responsibilities for the various stages of disaster management are split between the OSDMA and the Special Relief Organisation, with the former in charge of the 3Ps and the latter responsible for 3Rs, namely relief, restoration and rehabilitation. This gives better autonomy to the OSDMA as a mitigation agency; however, cross-departmental learning and exchange still have a long way to go to ensure a multi-stakeholder response, prevention and preparedness approach.



Lessons from Odisha

Effective early warning and common alerting protocols

True to its principle of zero casualty', the various phases of pre-disaster management have been developed by the Odisha government. For the prevention of cyclones, the state government has taken measures like installation of modern communication systems for improved early warnings and improved infrastructure such as pucca houses for the poor in cyclone-prone areas. It has created 900 community-managed multipurpose cyclone shelters (with a budget of approximately INR 2 crore per shelter, managed by a 'Shelter Management Committee' comprising women, anganwadi workers, ASHA workers and the local community). The shelters are equipped with community kitchens and life-saving

equipment, and offer several services that are required during emergencies, such as allotted announcement vehicles. There is also an efficient early warning system through sirens at vulnerable locations, with controls at Bhubaneswar. However, there is a need to continuously generate alerts throughout the duration of a disaster to warn the communities.

Nonetheless, Odisha also has a good community outreach system by which alerts can be disseminated quickly and evacuation operations can be undertaken on a war footing. The state contains 1,000 specially trained people from OSDMA, Aapada Mitra volunteers, police, fire services and the military who are pre-deployed 48 hours before the expected landfall of a cyclone and trained by the OSDMA as first responders. Members of Panchayati Raj Institutions such as the Gram Sarpanch and the Secretary are obligated to participate in this process. Additionally, the NSF volunteers and paramilitary are also trained by the OSDMA for emergencies.

The mobile application 'Satark' has been launched to alert people of natural calamities. The application is designed to make different sounds to alert people for different types of disasters. The Odisha government has also been quite active across social media platforms (both electronic and print media). It also follows mass messaging systems where every resident of the state is made alert through push notifications from their service providers in the incident of any natural calamity approaching, including cyclones, lightening and floods. Apart from that, the government has also put in place public announcement systems for information to infiltrate in the remotest parts of the state.

Self-reliant communities

Training and capacity building have been successful in several villages as whenever a disaster strikes, the community doesn't wait for an assisted evacuation or help to reach the village, but rather, it manages the evacuation on its own. Communities have also developed indigenous methods to rebuild their homes. For example, to cope with floods along the coast, as the general level of the land is low, villages have been established at higher levels along the embankments for safety.⁴⁵ For thousands of years, the dwellers of the Mahanadi delta have learned to adapt to floods. Villagers often pile up earth dug from their backyards to artificially raise the foundation of their mud houses and these survive even the worst of floods. The water drains out in 3–4 days, leaving behind enriched soil.⁴⁶

As soon as cyclone alerts are issued, the people start preparing their safety kits to carry along to the nearby cyclone shelters. They stock basic ration for 3–4 days to manage their day-to-day needs until the grocery shops reopen owing to disruption to connectivity and accessibility after the occurrence of a disaster.

Image 3: Aapada Mitra volunteers demonstrating how to rescue a woman with an injured leg



Source: PwC

Multipurpose cyclone shelters

Cyclone shelters are viewed not just as physical infrastructure but also as social infrastructure. They are governed by communities and used by officers, volunteers, PRI members as well as NGOs for different purposes throughout the year.

Cyclone-resilient housing

After Cyclone Phailin, disaster-resilient housing on raised platforms was built for pucca houses and tubewells under the Odisha Disaster Recovery Project. During this project, Gram Vikas partnered with the Government of Odisha to reconstruct 17,000 disaster-resilient houses and adopting the ODCH approach, they provided constant support to the community through transfer of technical knowledge for disaster-resilient construction, community mobilisation, conflict resolution and skill development in masonry.

Case study

Indigenous cyclone-resilient housing practices

The case of Pentakota, an urban slum of fishing communities in the Puri Sadar block of Puri district, is interesting. Located 500 m away from the sea, their primary occupation is fishing and fishing-related activities. Being traditional fishing communities, it is sometimes difficult to persuade them to relocate to safe shelters during cyclones, leaving behind their boats, fishing equipment and houses.

To deal with the frequent high-speed winds, the roofs of their houses are lowered up to 3–4 feet from the base level on all four sides. The lowered roofs with tapering tops ensure that minimum air enters through the doors/openings to lift up the roofs of the houses. Thatched roofs with air pockets within the straw thatches act as natural insulators for the room during extreme weather conditions. The thatched roofs are secured with nylon fishing nets which provide resistance to high-speed winds. The spacing of the ropes on the leeward side holds the thatch together when wind blows from the coast. The face of the thatches is oriented in such a way that it provides maximum resistance to high-speed winds and the thatches are secured with PVC sheets to protect them from rains and tidal surges. Fishing communities in Pentakota have been rebuilding cost-effective, nature-based and indigenous disaster- and climate-resilient houses in this manner. They also transport and anchor their boats to a safe location before cyclones to minimise damage.

Integrating climate change adaptation with disaster risk reduction

In 2020–21, Odisha became the first Indian state to present a climate budget. The SDMP devotes an entire section on how CCA and DRR can be mainstreamed in developmental planning. This is essential as the emphasis of DRR is on prevention, mitigation, preparedness and recovery, while CCA aims at reducing vulnerability due to climate change or variability risk through adaptation to gradual changes in climate over a long period.

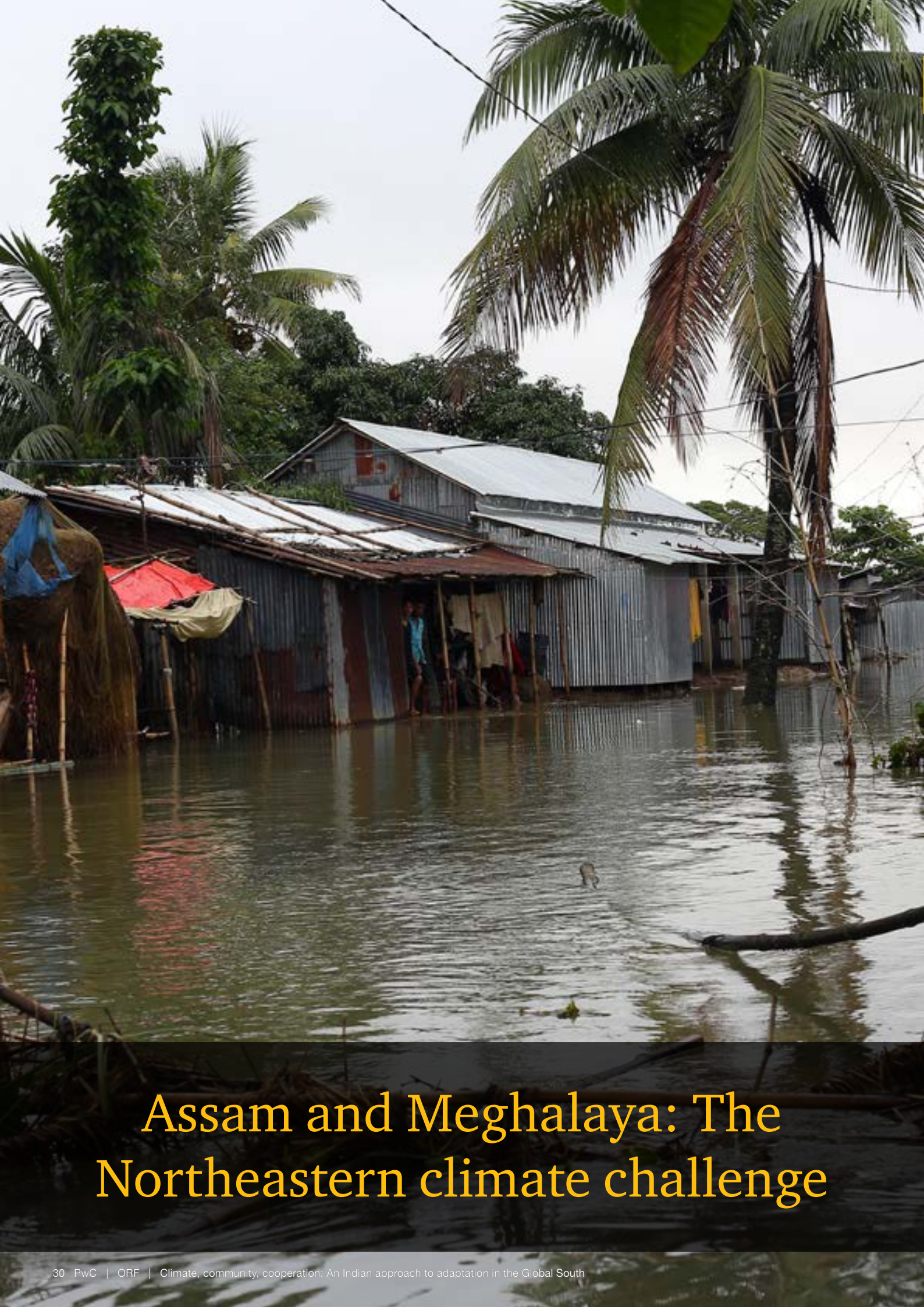
At the community level too, although CCA measures are found in the DDMPs, climate change is understood by the impact it has on their livelihoods. For example, for a fisherman, climate change assumes meaning when it takes a toll on fish stock availability. However, a community action plan for coastal climate resilience was recently adopted. This project has been sanctioned for investment of INR 261.50 crore, and it will contribute to addressing the impacts of climatic hazards and disasters on vulnerable coastal communities by popularising climate-adaptive livelihood activities. CBOs, NGOs, eco-clubs, women’s self-help groups and local village communities would be involved in the intervention’s planning, execution and implementation.⁴⁷

Image 4: Houses of the fishing community (left to right) (a) Roofs are bound together using fishing nets: (b) Roofs being lowered up to 4 ft from the ground



Source: PwC





Assam and Meghalaya: The Northeastern climate challenge

Introduction: Mapping hazards in India's Northeast

The Northeastern region of India consists of eight states with a combined population of over 45 million, which comprises 3.76% of the country's population. The population distribution across the Northeast shows great variation, reflecting patterns of sequent occupation, the agricultural potential of states, and the accessibility of the terrain. While the average population density of the region is 159 persons/km², it rises to 398 persons/km² in Assam and drops to a low of 17 persons/km² in Arunachal Pradesh at the Himalayan foothills. The most densely populated parts of the region are the plains of the Brahmaputra and Barak rivers, the Imphal plain in the state of Manipur and the western section of Tripura.⁴⁸

The proximity of the Northeast to the eastern Himalayas, the region's geo-ecological fragility, the presence of large river basins and the rapidly depleting green cover make it especially vulnerable to a broad spectrum of climate risks. Among the primary manifestations of climate change in the region are the increasing volatility of annual and seasonal rainfall, and the rise in annual mean temperatures.⁴⁹

Annual rainfall: The annual rainfall across the Northeast has seen a pattern of cyclical change between 1901 and 2015. Significantly higher rainfall was experienced in 1901–30 and 1961–90, with a marked reversal of trends in 1931–60 and 1991–2015. Although annual rainfall has tended to hover between 1500–1600 mm, the range of rainfall has expanded radically from 1,255–2,855 mm (1901–30) to 1,226–5,162 mm (1991–2015). Moreover, the doubling of the coefficient of variation of annual rainfall from 14.7% (1901–30) to 27.8% (1991–2015) is a further indicator of the uncertainty and volatility of rainfall patterns.⁵⁰

Seasonal rainfall: Patterns of seasonal rainfall in the Northeastern states too have witnessed major shifts. There is a pronounced reduction in rainfall across seasons, but it is the monsoon rainfall that has seen the most drastic reduction – decreasing by 8.1% from 996.9 mm (1901–30) to 916.5 mm (1991–2015).³⁷

Rising mean temperatures: The Northeast is experiencing rising temperatures as well. From 1951–2015, annual mean maximum temperatures have shown an increasing trend. The annual rate of temperature increases during 1951–90 was 0.01 °C, and this rose to 0.04 °C in 1991–2015. Annual mean minimum temperatures, on the other hand, initially showed a decrease of 0.04 °C per annum from 1951–90 and have since begun to increase at an average rate of 0.01 °C per annum.³⁷

These changing elements are increasingly leading to extreme precipitation events such as heavy rainstorms

and cloudbursts, which could cause devastating floods, extensive landslides and soil erosion, ultimately impacting the geomorphology of the Himalayan sections of the Brahmaputra basin. Since 2009, there have been a series of anomalous climate-induced hazards and natural disasters in the Northeast. These include high-intensity floods, severe droughts and drought-like situations, the warmest years recorded in over 117 years (in 2015/16), the delayed arrival of monsoons and rainfall deficits, and large-scale destructive hailstorms.³⁷

Urban and rural populations and agricultural communities are proving to be the primary victims of these climate disasters. Both urban and rural populations are routinely impacted by extreme floods, unseasonal rain, landslides and droughts.⁵¹ While agricultural communities experience similar locational vulnerabilities and risks of displacement, they are faced with the additional – and in some respects central – challenge of the weakening resilience of agricultural production systems themselves. The damage to crops by frequent floods, droughts and hailstorms is taking a toll on the security and livelihoods of agricultural workers; unfavourable weather conditions are causing more frequent outbreaks of crop and livestock diseases; the reduction in seasonal rainfall is creating unprecedented water stresses that impact agricultural productivity; and the rise in average temperatures could lead to poorer yields stemming from heat stresses upon crops.⁵²

Direct, sustained human interventions are contributing to climate change in the Northeast as well. The region has traditionally been known as India's 'green belt' and accounts for one-fourth of the country's forest cover.⁵³ But over the last two decades, the Northeast has witnessed rampant deforestation. This continues to have devastating implications for the region's biodiversity, releases large volumes of stored carbon dioxide back into the atmosphere,⁵⁴ and undermines India's climate action commitments such as its pledge to create an additional carbon sink equivalent to 2.5 to 3 billion tonnes of CO₂ through additional forest and tree cover.⁵⁵ Data shows that the state of Assam, for instance, has experienced the most severe rates of deforestation in the Northeast between 2001 and 2018, losing tree cover of an area considerably larger than the island of Mauritius in the Indian Ocean. And between 2001 and 2020, Meghalaya, the wettest region in the world, lost over 195,000 hectares of forest, representing 12% of its forest cover. Other Northeastern states where high deforestation has occurred during the same period include Mizoram, Manipur, Nagaland and Tripura, leading to a cumulative loss of over 70% of the region's tree cover.⁵⁶

Key hazards: Assam and Meghalaya

The neighbouring Northeastern states of Assam and Meghalaya form the focus of this chapter. Both states are part of the Indian Himalayan Region and lie squarely within the Brahmaputra and Barak River basins. Notwithstanding the difference in their sizes and the numbers and density of their populations, both states share similar climate and disaster risk profiles, and are equally at threat from externalities such as deforestation.

Table 3: Socioeconomic and geographic overview of Assam and Meghalaya

	Area (km²)	Population Size	Population density (person/km²)	Brahmaputra basin drainage area	Barak basin drainage area
Assam	78,438	312,05,576	398	70,634	7,224
Meghalaya	22,430	29,66,809	132	11,667	10,650

Sources: Compiled from ‘Brahmaputra River System’ and ‘Barak River System’, Water Resources, Government of Assam (<https://waterresources.assam.gov.in/>)

According to the report ‘Climate vulnerability assessment for adaptation planning in India’, Assam and Meghalaya have been ranked as the fifth and twelfth most vulnerable state to climate change.⁵⁷ The report shows that Assam’s very low coverage of crop insurance schemes, availability of trained healthcare professionals and low green coverage per 1,000 population, coupled with Meghalaya’s high incidence of waterborne diseases and lack of healthcare infrastructure, make the region highly vulnerable to the impacts of climate change and natural hazards. The three principal climate hazards common to Assam and Meghalaya, as identified through our analysis, are floods, landslides and soil erosion. Each of these is discussed in greater detail below.

Floods: With its vast network of rivers – more than 50 tributaries feed the Brahmaputra and Barak – the state of Assam is especially prone to floods and erosion. In terms of extent, duration and intensity, these hazards in Assam are arguably the most acute in India. Nearly 40% of the state’s area, including urban and rural areas, is flood prone. By comparison, as a proportion, only 10.2% of the whole of India is flood prone. In the post-independence period, the average annual losses due to floods in Assam have been approximately INR 200 crore, but since the early 2000s the yearly losses have begun to exceed this figure greatly.⁵⁸ Scientists agree that climate change is a major factor in the increased frequency and severity of the state’s catastrophic floods – the monsoons have become increasingly erratic and variable, meaning that much of the rain expected to fall over the course of a year arrives in a matter of weeks.⁵⁹ Recently in June 2022, Assam received twice its average June rainfall in just the first three weeks of the month.

In Meghalaya, too, June 2022 saw the state receive three times its average June rainfall during the same period.⁶⁰ Much like Assam, both urban and rural Meghalaya have increasingly experienced extreme damage to infrastructure, crops and livestock along with the loss of life due to flash

floods on account of the high variability in rainfall. This may be seen as part of a larger state-wise trend. An analysis of extreme precipitation events in Meghalaya over the last 100 years shows that there has been an increase in such events, including floods, in nearly every district of the state.⁶¹

Landslides: Assam’s excessive rainfall directly and routinely results in violent landslides. Besides excessive precipitation caused by climate change, other factors that have a destabilising effect on hill slopes and contribute to landslides are the state’s location in a geologically unstable and seismically active zone of the eastern Himalayas, large-scale deforestation, and the ways in which urban land use and infrastructure development continue to be planned.⁶² The Assam State Disaster Management Plan 2015-20 has identified ‘heavy concentrated rainfall’ and ‘torrential rains’ as the chief causes of the state’s major landslide events;⁶³ and in the period 2016–22 there have been nearly 1,000 landslides triggered by rain that have claimed over 100 lives.⁶⁴ Experts have observed that catastrophes in Assam related to rain and floods – such as landslides – are increasing, and this could worsen in the coming years in the state and in the Northeastern region as a whole.⁶⁵

Extreme precipitation events cause devastating landslides in Meghalaya every year, and as in Assam, the risks of landslides in the state is compounded by the geological instability of the region. Mining activities, especially in the Garo Hills districts and Jaintia Hills, have resulted in the loss of forest cover over large swathes of land; and unregulated shifting cultivation is further fragmenting and degrading forests.⁶⁶ The interplay of natural and man-made factors has begun to cause more frequent and damaging landslides in Meghalaya. A report points out that: ‘The landslide vulnerability [in Meghalaya] has increased in the recent past due to ‘unplanned and unscientific’ development, deforestation, choking and blocking of natural drains, poor road construction, encroachments on steep hill slopes and unstable slopes.’⁶⁷ Urban areas such as the city of Shillong



have become increasingly susceptible to landslides.⁶⁸ Shillong is now divided into three zones depending on the intensity of rainfall it receives, but the basis of ranking each rainfall zone is its susceptibility to landslides.⁶⁹

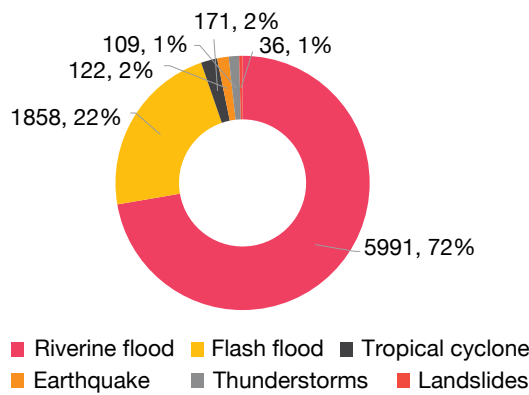
Soil erosion: The acuteness and magnitude of soil erosion in Assam are greater than in any other state. The erosion of riverbanks by the Brahmaputra, Barak and their tributaries is occurring at an alarming rate, with the width of the Brahmaputra having increased up to 15 km in places due to bank erosion. Damage caused by erosion runs into several hundred crores every year, and breaches of embankments caused by erosion have become a regular phenomenon.⁷⁰ Erosion is also causing Assam’s riverine fertile agricultural lands to dwindle, severely impacting the state’s rural economy. According to state figures, the Brahmaputra has washed away 427,000 hectares of land in the last 70 years, and the area of river islands like Majuli has been more than halved by erosion.⁷¹

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Northeast India is a hotspot of climate risks in the entire South Asia region. Its sociocultural landscape is distinct from that of the rest of India. Building local leadership and locally led solutions can provide more space for local communities to participate in development planning in affected areas.’

Tirtha Prasad Saikia,
Joint Director, NEADS, Assam

Figure 6: Mortality due to various natural calamities in Assam and Meghalaya (2000–2022)



Hazard type	Occurrences (2000–2022)
Drought	2
Earthquakes	3
Flashfloods	6
Landslides	3
Riverine floods	26
Thunderstorms	3
Tropical cyclones	3
Total	46

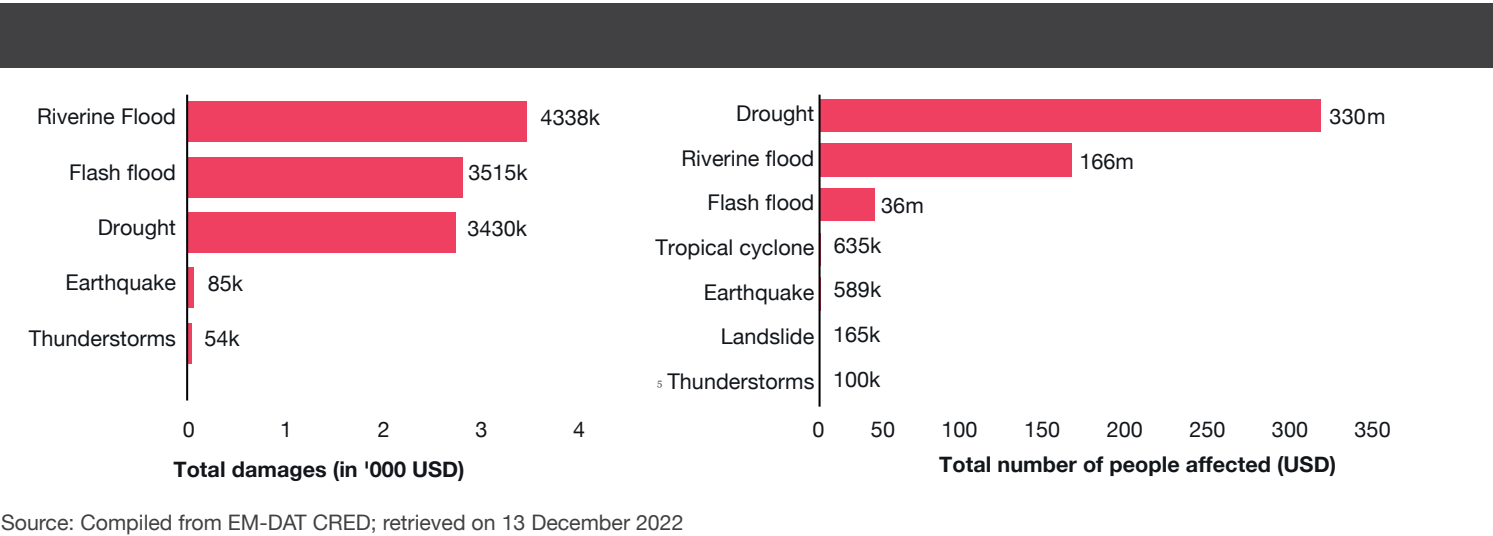
Source: Compiled from EM-DAT CRED; retrieved on 13 December 2022

Meghalaya too is prone to severe soil erosion. Well over 8,150 sq km has been impacted – and this has an acute adverse effect on the state’s agricultural sector. Extreme precipitation events such as rainstorms and cloudbursts in the Brahmaputra basin continue to cause widespread landslides and soil erosion.⁷² In Meghalaya’s urban areas, including Shillong, the challenges of landslides and erosion are aggravated by the absence of stormwater drainage, which results in waterlogging and flooding. Indiscriminate development activities also contribute to the menace of erosion by obstructing drains and encroaching upon rainwater flow paths.⁷³ Finally, large-scale deforestation on hill slopes and the resultant destabilisation of the slopes and soil have led to further erosion in ‘the state.

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In one of India’s first-of-its-kind rescue operations, 26 NDRF teams, the Indian Army and the SDRF rescued more than 12,000 people in the June 2022 Assam floods. A special plane of the Indian Air Force was used to transport diesel and petrol to the affected areas. At present, the ASDMA has 70,000 volunteers who are tasked with pushing early warning flood messages from the control room.’

ASDMA



Multidimensional analysis of DRR and CCA practices

Summarised below are the key features of Assam and Meghalaya’s disaster management system:

Decentralise risk mapping exercises and related planning and action

Assam: Climate action and disaster management processes have been decentralised in Assam. In addition to the ASDMA, each district has a DDMA to prepare district-level plans and build local capacities. Sectoral proposals for building climate resilience include strategies/recommendations for capacity building of local authorities and personnel. Capacity building functions have been further decentralised, with local authorities such as Panchayati Raj Institutions and municipal bodies playing a key role. The state could go further to encourage panchayats to draw up and execute climate action plans. This could support effective community-enabled actions at a hyper-local level and delegate responsibilities to the communities who experience climate-induced risks most directly.

Meghalaya: Localising risk mapping exercises is a priority for Meghalaya too. The SAPCC identifies a range of ‘climate vulnerabilities’ across sectors but does not outline risk mapping plans. It, however, mentions that the state is keen to create a special research group to conduct climate risk assessments, among other functions. Both the SAPCC and MSDMP appear to recognise this need and include provisions for specialised locally-rooted groups to assess risks. The SAPCC, for instance, articulates the aim of creating a special research group for the purpose; and the MSDMP authorises the DDMAs to prepare localised risk-based plans. Additionally, feasibility studies for public sector infrastructure projects usually involve context-specific climate risk assessments, and 2022 saw the launch of a state-of-the-art GIS and UAV to mainstream geospatial mapping techniques and drone operations into efforts to study risks. A study of climate risks has been done for Meghalaya Power Distribution Sector Improvement Project.⁷⁴ Unfortunately, panchayat-level climate action planning is yet to be formally introduced and existing policies and programmes fall short of decentralising risk mapping processes to non-governmental stakeholders. Local self-governing bodies, community-based and philanthropic organisations, and private research institutions could all contribute to risk mapping and their support must be enlisted.

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Earthquake risk in Shillong, Meghalaya is the highest among all districts as most of the households have not adhered to the Meghalaya building bylaws. The SDMA is therefore majorly working on limiting building hazards by promoting increased use of hazard-resilient building technologies and standards.’

Senior Consultant, State Disaster Management Authority, Meghalaya

Transboundary dialogue for climate diplomacy in South Asia

The Brahmaputra is a transboundary river that originates from the Himalayas and flows through Tibet, Northeast India, and Bangladesh and is regarded as one of the largest river systems in South Asia. Entering the Indian state of Assam, the river flows through some of the state’s biodiverse regions – the Majuli river islands and Kaziranga National Park. There is no internationally agreed multilateral diplomacy in collaboratively governing the Brahmaputra among India, China, Bhutan and Bangladesh. Water governance over the Brahmaputra is a state subject under Indian laws. The Brahmaputra is a massive source of hydroelectricity as power generated from the Brahmaputra is used to provide electricity to most of the remotest villages in Northeast India. However, in recent years, several under-construction hydro-power projects beyond

the Indian borders have prioritised the economic benefits from power generation more than considering flood protection for the downstream local communities. This has created significant negative ripple effects on downstream communities such as frequent flash floods in summer in Assam, shifting of the river course, riverbank erosion and heavy siltation as well as lack of high-value fish species for fishing purposes. Coupled with the incessant rainfall patterns caused by the southwest monsoons, the majorly rainfed tributaries of the Brahmaputra and the Barak River basin overflow causing annual floods, landslides and soil erosion in the low-lying parts of Assam.

Image 5: Majuli – the world’s largest river island situated on the Brahmaputra



Source: PwC

Meghalaya shares its geo-environmental settings with the bordering nation of Bangladesh. Incessant downpours and the inability of Meghalaya and Bangladesh to manage the unprecedented natural disasters caused by annual flash floods have severely impacted the fragile landscape of the region causing extreme soil instability and landslides. There is an urgent need for transboundary dialogue in integrated water resource management across multiple interconnected river basins that dominate the landscape. Both the state’s SAPCCs and SDMPs do not explicitly highlight the importance of cross-border water and climate governance in managing its climate risks and adopting an integrated approach to dealing with them. However, it does talk about the prevention and spread of diseases and epidemics across borders by the installation of healthcare centres and check posts at the borders.

How transboundary water governance and diplomacy can help Assam cope with its flood crisis

Assam has been in the headlines for the recurrent summer floods and the massive devastation to crops, lives and properties. Incessant rains brought by the Indian monsoon coupled with glaciers melting and an evolving geo-climatic region of the Himalayas has triggered severe floods, landslides, earthquakes and riverbank erosion, affecting the livelihoods of downstream riverine communities. Coupled with this is the issue of construction of multiple hydroelectricity projects to meet the growing energy demands of the region. Multipurpose projects of Arunachal Pradesh such as the Ranganadi Hydro Electric Project and the Subansiri Lower Hydroelectric Project have been causing untimely floods and inundation due to excessive release of water from the dams in the Dhemaji, Biswanath, and Lakhimpur districts of Assam, which share the border with Arunachal Pradesh. Lying on a tectonically fragile zone, the construction of several other hydropower projects in the neighbouring nations including the gigantic Mutou hydropower project proposed to be constructed by China at the Great Bend on the Yarlung-Zangbo river could cause significant changes in geology of the region greatly impacting the seismic sensitivity of the region. Experts opine that hydropower projects of such magnitude could also lead to frequent landslides and ground movement making India’s Arunachal Pradesh and Assam more vulnerable to losses from earthquakes.

The other cause of concern is massive floods in downstream Assam. Arunachal’s long resented dam construction has taught how unregulated release of water from the reservoirs could cause significant alternations to the flow of the Brahmaputra. Besides causing flash floods in downstream Assam, it could also cause drought like situations when there is a flow deficit impacting the cultivation of boro paddy in the region which is a staple crop. Dwindling flow could also change the river course and cause excessive siltation thus changing the navigation, agriculture, fisheries, wetlands, water supply, irrigation, floral and faunal diversity and food security.

There is a need for an integrated basin approach in governing the Brahmaputra which is shared between India, China, Bhutan and Bangladesh. At present, several cross border riverine initiatives are being conducted over the Brahmaputra but a majority of them are initiated by non-state actors. The Brahmaputra dialogue is one such dialogue between China, Bangladesh and India that facilitates transboundary dialogue on water resources governance among competing and complimentary stakeholders to arrive at a joint management model. Formalising these institutions and fostering regional cooperation between nations by involving key water users from each nation can go a long way in helping Assam fight its tryst with annual floods. There is also a need to initiate interstate dialogue between different riparian states within India.

Strengthening community awareness and knowledge of natural hazards and climate change

The SAPCCs and SDMPs of Assam and Meghalaya recognise that ground-up approaches for climate adaptation and disaster preparedness and response will be crucial. Interviews with experts in both states indicate that local communities often play a major role in reconstructing damaged bunds and embankments after floods and in assisting the government in their efforts to fortify small dams. There has been an increase of community-led tree-planting initiatives in recent years to support carbon sequestration and offset the losses caused by deforestation. Other community activities include the creation of water channels to improve drainage, especially in cities like Guwahati and Shillong and in flood-prone rural districts.

Assam: Assam’s SAPCC SDMP focuses chiefly on the capacity building of government personnel, though, in some cases training is also extended to community members, volunteers and other frontline workers.⁷⁵ Local authorities such as PRIs and municipalities ensure that their officers are trained in DM and relief/rehabilitation activities. Funds are allocated from the centre for capacity building of state administration. The government also conducted a UNICEF-supported training programmes for block-level frontline workers during the 2022 Assam floods.

Image 6: Bridge made of bamboo for fishing by local communities



Source: PwC

Meghalaya: Meghalaya’s SDMP includes key points for building the capacity of CBOs and community members, systematically mapping certain types of capacity development exercises against the government institutions that could conduct them. The MSDMP recommends several types of capacity development/training programmes targeting different groups of officials involved in DM, as well as training programmes for non-governmental stakeholders including educational institutions, youth organisations and others. In each case, the nodal government department that is expected to conduct the training has been identified. At present, the SDMA has been working on the ‘Upscaling Aapada Mitra’ scheme launched by the DDMA for the East Khasi Hills District in May 2022 to train the community volunteers in disaster response.⁷⁶

Stakeholders have observed, however, that the gap between these plans and their implementation, could be bridged more effectively. There is an urgent need to design and conduct more training-of-trainers workshops, for example, so that community-level capacity-building can become a self-perpetuating exercise. State institutions would do well to engage with the *dorbar shnongs*^{III} and secure their cooperation for community training and planning initiatives. In Meghalaya and Assam, there is a tendency to treat community sensitisation efforts as seasonal events which are operationalised post-monsoon in the aftermath of floods and landslides. As such, they often become exercises chiefly in disaster response. What is required is a year-round cycle of capacity-building efforts that can educate communities about the relation of climate change to natural disasters, adaptation measures as well as disaster preparedness and response.

The role of the private sector in adaptation and resilience financing

Assam: The SDMP acknowledges that it recognises a need for coordination and partnership support from business and industry organisations. However, neither the SAPCC nor the SDMP 2014–22, presently outline a strategy for availing of funds from the private sector. The new Draft Assam SDMP 2022–30 marks a significant departure in this regard. The section titled ‘Alternate sources of funding’ outlines several possibilities for the government to receive private sector funding. It highlights that the 15th Finance Commission believes that there is a strong case for introducing insurance and risk pooling in niche areas, where essential conditions for market-based risk management instruments exist. It enables state governments to issue reconstruction bonds in post-disaster situations with the approval of the union government. The draft ASDMP also recognises crowdfunding as a key potential platform for supporting disaster relief and recovery and observes that ‘CSR investments^{IV} may also be explored for increasing state level resilience’.⁷⁷ All these additions constitute a landmark shift from the earlier plan documents, which focused exclusively on funding from government sources. Each of these options ought to be retained as the draft is finalised.

Within local communities, an interesting practice called *hariya*, which is a system of rebuilding damaged houses wherein every member of the village pitch in and collaborate in the reconstruction work, is observed. The capacity building of communities must be mainstreamed further to support a more bottom-up approach to climate action. This would also help realise the SAPCC’s recommended strategies for raising awareness among communities and other non-government stakeholders.

Image 7: Houses constructed on bamboo slits and raised platforms along a stream in Meghalaya; highly susceptible to landslides



Source: PwC

^{III} *Dorbar shnong is a traditional, powerful local institution in Meghalaya. Their buy-in and direct involvement with local development initiatives are essential.*

^{IV} *The Assam CSR Policy 2019 could further facilitate this. While the policy does not currently list climate action or disaster relief and reconstruction among its suggested priority areas, an amendment might be considered in this regard, especially in light of the upcoming new Assam SDMP 2022–30.*

Meghalaya: The SAPCC recognises the need to build public-private partnerships ‘to interface with the private sector’⁷⁸ to fund adaptation, and that a nodal government entity tasked with addressing climate issues should forge partnerships with private sectors. Meghalaya’s SAPCC and SDMP have the scope to include a strategy for sourcing climate finance from the private sector or leveraging CSR funds for adaptation efforts. The latter function could be taken up by the Meghalaya State Council on Climate Change and Sustainable Development. Innovative funding options, like the ones proposed in Assam, also need to be explored.

While the quantum of CSR funding and initiatives in the Northeastern region has increased over the last decade, it is still considerably lower than other parts of India. Moreover, as the following chart shows, ‘environment sustainability’ continues to be a surprisingly low priority area for CSR investments in the region. Disaster relief activities tend to draw some CSR support, but longer-term climate adaptation measures have almost always been neglected, possibly because of the longer timeframes required to demonstrate its impact. Businesses in Assam and Meghalaya need to be sensitised about how their contributions could benefit climate actions. Industry associations and chambers of commerce could play a critical role in this regard. More initiatives like the awareness-raising drives undertaken for the private sector in Meghalaya by Promotion and Incubation of Market-driven Enterprises Meghalaya and Invest India need to be rolled out. Finally, an instrument such as a Northeastern CSR Corpus Fund might be explored for the purpose of drawing together, on a single platform, the combined resources of all the companies in the region, a portion of which could then be utilised for climate action.⁷⁹



Roadmap for financing from government budgets

Assam: Neither the SAPCC nor the ASDMP presently include a formal built-in roadmap for financing from government budgets. The SAPCC estimates its total and yearly fund requirements but cautions that while the amount could be availed of from various sources, if adaptation is not systematically undertaken, this cost would continue to increase and become a significant part of the state’s GSDP. Therefore, it is important that adaptation costs are factored in every year within the department’s planning processes. For DRR, on the other hand, a new strategy has recently been approved under the Assam Disaster Risk Reduction Roadmap 2030, whereby 3% of the annual budget of all line departments of the state’s R&DM department shall now be allocated for disaster reduction.⁸⁰ The Government of Assam is also starting the green budget tagging^v of various departments to address climate change-related issues mapped to their SDGs and developmental planning. The allocation of these resources must be monitored and the interventions for which they are utilised closely evaluated. The Assam State Budget 2022–23 does not have an explicit allocation for relief measures. There is also a need to integrate a dedicated budget for mainstreaming flood resilient agriculture and fishing practices to enhance the capacity of local indigenous communities who avert migration and adapt their lifestyles to suit the evolving climatic patterns.

^v Green budget tagging involves assessing each individual’s budget measure and giving it a ‘tag’ according to whether it is helpful or harmful to green objectives. Green objectives could be related to climate or to other areas of the environment, such as biodiversity, and air and water challenges (quantity and quality).

Case study

Private sector and CSR initiatives transforming climate-resilient growth in a disaster-prone Northeast India

Assam is highly prone to natural disasters, particularly flash floods and earthquakes. Flooding can further trigger disasters such as landslides or epidemics like malaria due to stagnant water. By combining maps of flood inundation, potential flood shelters and vulnerable households, Reliance Foundation’s GIS-backed initiatives are helping in planning evacuation paths as a part of flood response. PRI members or community planners are able to identify existing gaps and make a development plan to add facilities for building their community-level preparedness and crisis management. Digital elevation models are combined with elevation of the water surface and finally overlaid to create a flood inundation map. This helps flood-affected districts like Cachar identify ‘very high’ and ‘high-risk’ areas to drive focused interventions for the foundation.

Floods impact vulnerable communities such as tribal communities by causing loss of life, livelihood, resources and displacement. PwCIF, in collaboration with the NGO SEEDS, supported the establishment of Nikori Miri Vikas Kendra – a flood-resilient shelter in Nikori village, Desoi Gram Panchayat, Golaghat, Assam – where the Mishing tribe faces the brunt of floods. The shelter was made with the participation of the local community, using local resources such as structural bamboo.

A Shelter Management Committee has been formed to manage and oversee the operations of the shelter, with the BDO as Chairperson. The PwC India Social Sector team has been involved as part of a pro bono intervention, working closely with the partner NGO, local community, and authorities to develop and strengthen the governance framework, and build relations with various government departments for community development and connections to livelihood schemes. This intervention seeks to improve the quality of life of the community and build their resilience to disasters through the holistic involvement of stakeholders across the board, bringing in various skills and resources.

Walmart and Flipkart Foundation mobilised employee contributions amounting to more than (USD 250,000) towards community volunteer mobilisation and distribution of medicines and first-aid kits in flood-affected districts of Assam during the 2022 floods.

In Meghalaya, the absence of a vibrant manufacturing sector and proper healthcare and transportation facilities, heavy reliance on agriculture, years of insurgency, and natural disasters like floods and landslides have made the region vulnerable to economic backwardness. As a part of **HDFC Bank’s Sustainable Livelihood Initiative, Parivartan**, capacity-building sessions have been organised with women and youth from remote villages of Meghalaya to support organic farming and provide continuous access to safe water to rural communities. This initiative has been able to create sustainable communities in over 72 villages across two districts in Meghalaya, reaching over 5,497 households.

Funded by the JICA, L&T Construction, in collaboration with NHIDCL, is constructing India’s longest river bridge, connecting Dhubri in Assam to Phulbari in Meghalaya across the Brahmaputra. This bridge will reduce the distance between the two states by 250 km and improve connectivity between the Northeastern states and the rest of the country. Increased connectivity and disaster-resilient transport infrastructure will help in timely recovery and response in the difficult terrain of Meghalaya.

Meghalaya: Meghalaya’s SAPCC and SDMP currently do not have a detailed roadmap for financing climate action and disaster reduction. They do, however, outline the conventional institutional arrangements for procuring finance. For instance, the SAPCC stipulates that a project management unit set up under the SDMP will support the Meghalaya Basin Development Authority by sourcing funding from government institutions or external funding agencies. The SDMP, on the other hand, states that all relevant state government departments and other bodies must prepare disaster management plans along with financial projections and necessary allocations will be made as a part of their annual budgetary allocations. A capacity building grant for state functionaries and other stakeholders could also be utilised.

Damage and loss assessments

Assam: Clear methods for estimating damages and losses from disasters, particularly from frequent floods, are not explicitly outlined in the SAPCC or the SDMP. The ASDMP simply mentions that all information about economic value of loss and damage must be compiled into a single consolidated report for PDNA. According to consultations with experts in ASDMA, the NDMA facilitated training of ASDMA personnel is underway and Assam will soon have its first PDNA. The government also provides a rehabilitation grant to the affected families whose house and household properties are burnt/ damaged due to natural calamities. This includes INR 95,100 per house in plain areas, INR 1,01,900 per house in hilly areas for fully destroyed houses and INR 5,200 per house and INR 3,200 per house for partially damaged pucca and kutcha houses.



“About 5–7 years back, we used to get big fishes in our catch (such as chital, rohu, mrigal and boralì) which used to sell at INR 700–800/kg. In recent years, only small fishes (such as naro and boriala) are available in the river that sell for not more than INR 200/kg. The quantity of fish available has also declined over the years. We only practice subsistence fishing now. Every fishing household is seeing more than 50% loss in fishing. Those who can are turning to alternative sources of livelihood.”

Fisherman, Majuli, Assam

In the first four months of 2022–23, massive floods in Assam destroyed about 340,000 hectares of crops.⁸¹ Considering the massive economic repercussions on the food and livelihood security after the floods and landslides, several advancements can be noticed in terms of livelihood enhancement and protection. Indian Council of Agricultural Research had developed and released 41 waterlogging tolerant varieties/hybrids of different crops for commercial cultivation during 2014–21. National Innovations in Climate Resilient Agriculture has conducted village-level demonstrations in four villages of Assam on the use of flood tolerant varieties of crop. Similar advancements could also be explored to make other critical sectors of livelihood such as fishing and animal husbandry resilient.

Meghalaya: The Meghalaya’s SDMP notes that in the immediate aftermath of a disaster a ‘need and loss assessment’ ought to be done within 24 hours based on spot visits, aerial surveys and information from primary and secondary sources. The district administration will then mobilise resources for relief accordingly. Stakeholder consultations indicate that there is limited awareness around the newer methods of conducting more holistic loss and damage assessments.

Blueprint of needs assessment in the context of floods and landslides

Floods and landslides cause considerable damage to lives, health, properties, livelihoods as well as a significant disruption of services in both rural and urban areas. A review of the existing methodologies to conduct a needs assessment in the context of floods and landslides reveal that recovery needs assessments should be focused on three key areas:

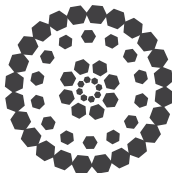
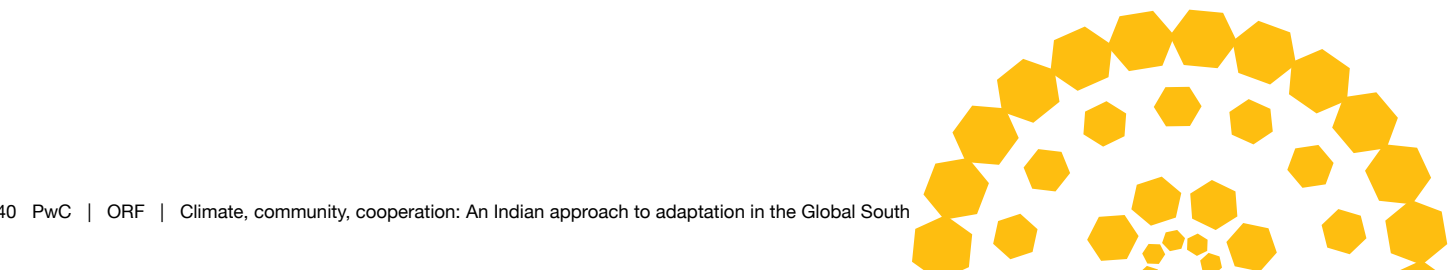
- i) assessment of damages and disruptions to critical assets
- ii) external assistance needs for early recovery
- iii) ongoing emergency response and assistance needs.

According to the Myanmar PDNA, there is a need to emphasise the specific needs of states, townships and villages because different regions may be affected disproportionately by one specific climate risk depending on their vulnerabilities and exposures. It also emphasises the significance of livelihood restoration programmes such as direct cash transfers, expanding microcredit and restructuring loans in order to provide debt relief for small and medium-sized businesses and farmers. Bangladesh’s PDNA methodologies highlight the need to capitalise the knowledge of on the ground actors and their capacities and underline why local knowledge should be built in identifying the immediate recovery needs. Local communities could be used as providers of baseline information. It is therefore valuable to understand how traditional best practices can be best incorporated into a recovery and resilience-building framework while undertaking a PDNA. The Kerala PDNA has taken a first-of-its-kind gender and socially inclusive approach to identify the recovery needs as impacts of frequent floods can have longstanding implications on society and particularly on the health of women and children. The Nepal PDNA focuses on the need to closely monitor the macroeconomic vulnerabilities and public expectations in new constructions that will need to be monitored closely. In the context of earthquakes and associated landslides, it would be useful not to confuse post-earthquake resilient reconstruction and revival of old infrastructure in the very early stages of recovery to encourage prioritisation and economic use of scarce resources.

Association with other government schemes

Assam: The Assam SAPCC highlights linkages with the Assam’s water policy, agriculture policy, forest policy and state-level execution of the eight national missions under the NAPCC. Documents like the SDMP typically link interventions to larger development initiatives like irrigation schemes and aim to provide low-intensity flood mitigation measures, such as the National School Safety Policy 2016, which has been adapted by ASDMA and state education department. Similarly, health services during flood and post-flood phases are mentioned in the National Health Mission. However, the SDMP does not adequately explain their relation to the larger processes of climate change. This may have produced an inadequate understanding of climate change at the administrative levels in Assam and could also be symptomatic of a tendency to focus on ‘incidents’ rather than their underlying causes or long-term effects. In this context, initiatives such as Assam’s recent creation of ACCMS, a special vehicle to coordinate the implementation of the Assam SAPCC and other climate change related activities, is laudable. It could go a long way towards building an understanding of climate issues, helping in aligning the development agendas of different ministries and promoting integrated planning.⁸²

Meghalaya: Meghalaya’s SAPCC establishes connections with the state water policy, Meghalaya Vision 2030, and state-level execution of the eight national missions under the NAPCC. Meghalaya’s SDMP too highlights the link with the Meghalaya Forest Mission, Meghalaya Water Harvesting Mission, Accelerated Irrigation Benefit Programme and National Health Mission (constructing climate-resilient health centers). Meghalaya’s SDMP, however, focuses only on specific hazards without explaining the underlying causes or their connection with climate change. Consequently, disasters are often perceived as mere functions of uncertain weather, but not as outcomes of larger systemic climate processes. This is a shortcoming that the state is trying to rectify. Meghalaya’s SAPCC, for instance, foregrounds the impact of climate change vis-à-vis affected sectors and identifies clear ‘adaptation pathways’ for most of them. In another move that aims to sharpen the administrative response to climate change, the state has established dedicated management and overseeing bodies such as the State Council on Climate Change and Sustainable Development and the Meghalaya Climate Change Centre to address climate-related matters in a holistic manner, coordinate with stakeholder groups with respect to cross-cutting issues, and oversee the implementation of climate actions.⁸³ Revisions to foundational plans and the establishment of climate-change-specific institutions are both necessary initiatives and could be undertaken in other states as well.



Lessons from Assam and Meghalaya

Early-warning systems

Assam: Tried out for the first time in the country, FLEWS Assam which began in 2009, integrates risk knowledge, monitoring and warning services, dissemination and communication and response capability in a combined system. FLEWS is a fully automated system with a response time of 72 hours and uses advanced hydrometeorological modelling to predict the probability of floods in urban and rural areas. The system uses hyperlocal modelling to give location-specific warnings and can be a great tool in flood-resilient roadmaps for the cities. However, there is tremendous potential to use advanced climate technologies, scientific data and nature-based cost-effective approaches in making the best use of FLEWS to generate local-level action plans. There is also a strong need to innovate model-based flash flood warnings.

Meghalaya: Even as Meghalaya continues to explore ways to strengthen its formal early warning systems for landslide prevention, a best practice already in place is the presence of strong traditional institutions headed by the village headman that alerts the communities about extreme weather conditions such as heavy rainfall, mudflows, etc. which are possible triggers for landslides. Traditional knowledges of these institutions must be capitalised to have in place a proper early warning dissemination system for landslides, particularly in remote villages.

Setting up decentralised disaster information and response centres

Assam: Decentralised disaster information and response centre at the revenue circle level has been helpful in forming the early response and providing immediate and timely access to all the emergency services in the event of floods, earthquakes or crisis situations. The Integrated 108 Mrityunjoy Emergency Response Service also has seven boat ambulances equipped with emergency medicines to respond to medical emergencies in riverine areas and during floods, making it one of the region’s most unique approaches to improving response efficiency. The 108-Mrityujoy and 102-IFT ambulance services are now integrated through a single toll-free number ‘108,’ which ensures prompt communication and activation of a response. A preparedness and emergency management exercise called GEMEx was conducted to harness the strengths and capabilities of the state emergency responders, educational institutions, hospitals and humanitarian agencies, etc. in their effort to meet any possible disaster in the city. More recently, flood mock drills were conducted in Guwahati airport to strengthen and validate the efficiency and efficacy of airport operators in times of natural disasters and accidents. The ASDMA also conducts table-top mock drills and simulations at the city level training various stakeholders (engineers, architects, doctors, PRIs, NGOs, volunteers in first aid, search and rescue) to respond to different types of disasters through painted/artificial simulation of disaster-related scenario.

Meghalaya: Meghalaya had initiated the preparation of school disaster management plans under the National School Safety Programme to ensure the safety of school staff and students and limited damage to school infrastructure. The programme began in 2006 and suggested the initiation of disaster awareness groups, response groups and a school disaster management committee as schools are regarded as community nodes which have responsibilities towards the immediate locality. There is an urgent need to activate, operationalise and revive such programmes and strengthen local communities in remote areas by regularising teacher training techniques and by mainstreaming DRR initiatives in the region.



Multistakeholder approach

Assam: Stakeholder consultations indicated that man-animal conflict has reportedly added to the flood woes in the river island of Majuli and the adjoining areas. Due to the floods in Kaziranga National Park, every year, elephants and rhinos are forced to migrate to higher ground and frequently seek refuge by migrating to nearby villages in search of food and protection from flooding. ASDMA takes a multistakeholder approach based on participatory planning to manage the threat to Assam’s biodiversity due to the floods. Every meeting of ASDMA sees participation from key stakeholders from all government departments, public utilities and services, private sector organisations, CBOs and NGOs, ex-servicemen in DM who safeguard the interests of communities and protect the wildlife at all stages of a disaster. The ASDMA conducts brainstorming sessions with key stakeholders from with the civil society and private sector and is chaired by the CEO of ASDMA.

Revisiting hazard and vulnerability profiles

Assam: The ADSMA regularly updates the state’s evolving vulnerability and hazard profile by mapping the risks, vulnerabilities, and capacities of the communities under the CBDP programme. Revisiting the danger levels of major rivers of Assam has aided the districts in better preparedness and planning for flood responses and flood-resilient livelihood interventions. Updated vulnerability and risk maps are used to install porcupine structures made of bamboo along the riverbanks to arrest riverbank erosion and limit the inundation of croplands from flood water.

Indigenous disaster-resilient practices

Assam: Flood resilient housing practises, such as building houses on raised platforms, as seen in the case study on Mishing tribes, and the use of banana rafts as transportation instead of boats, are examples of indigenous best practises that aid in survival during the long months of flooding. The introduction of floating agriculture on Majuli river island could be regarded as a flood-resilient farming practise as many farmers have started practicing it. However, sufficient evidence on the long-term sustainability of this practise is still lacking.



Meghalaya: The traditional farming systems of the Khasi community in Meghalaya provides a sustainable way of doing agriculture which is both resilient to frequent disasters as well as climate change. Diverse traditional food systems supported by jhum (shifting cultivation), home gardens, forest and water bodies, avoidance of synthetic chemicals in food production, and community-led landscape management support the resilience and sustainability of the indigenous food system. This practice supports as many as 63 different varieties of cereals, legumes, tubers, roots, fruits, seeds and spices. The ash that originates from burning biomass adds fertility to the jhum fields helping farmers grow a diverse variety of crops that can withstand the changing climatic regime.⁸⁴ Traditional agroforestry practices also helps in slope stabilisation, soil moisture conservation, improving soil fertility and arresting landslides. If managed properly, agroforestry also offers ecosystem services for the local communities and helps them in cultivating high value plantation crops such as eucalyptus, palm oil, acacia, etc.

Knowledge creation and dissemination

Assam: The ASDMA runs technical projects undertaken by knowledge institutions in the state. It also undertakes annual scientific collection of flood damage data, basin-wise preparations of flood risk maps and conducts floodplain zoning in cities like Guwahati. It has been a trailblazer in establishing the AIDM to include disaster risk reduction education, foster scientific knowledge and train disaster management professionals to spearhead mitigation and adaptation initiatives which is crucial for the sustainability of the region.

Case study

Indigenous climate resilience practices of the Mishing tribe

The Mishing tribe, which resides in the Brahmaputra plains of eastern Assam has engineered a way to adapt to the floods that affects the region every year.

They build their houses on bamboo stilts with mud foundations, bamboo flooring and thatch roofs, and the floor height can be adjusted according to the flood levels. Known as chang-ghar in Assamese, Mishing houses also include innovative features for protecting food grains, important documents, assets and livestock from floods. It also has a provision for a light raft to be secured underneath the house to allow mobility. They can easily dismantle the house in times of riverbank erosion and shifting river course and migrate to the upper reaches. They even install tube wells at a height to ensure that they do not get submerged during floods.

In Nongtraw, a village in Meghalaya’s East Khasi Hills district, a mix of traditional food systems supported by jhum (shifting cultivation), home gardens, local forests and water bodies coupled with community-led landscape management have helped evolve a secure and uniquely climate-resilient food system. States must promote and showcase these adaptation measures so that they can be replicated elsewhere. In this context, the grassroots ‘mini climate change conference’ held by the Government of Meghalaya with multiple villages in a climate-vulnerable province to collect successful cases of ‘traditional knowledge in action’, is itself a model that ought to be more widely deployed across India.

Image 13 (left to right): a) A traditional Mishing grain bank b) A PwC community shelter built in the style of indigenous traditional flood-resilient bamboo house called ‘chang-ghar’ in Assam



Source: PwC and SEEDS





Maharashtra: Protecting farmers from climate change

Hazard mapping: Physical risks and their impact on the communities of Maharashtra

Sprawled across a geographical area of 3.08 lakh sq. km. and a population of 11.24 crore (2011 consensus), Maharashtra is one of the biggest commercial and industrial centres located in the western and central part of India.⁸⁵ Despite its rich cultural diversity, Maharashtra is vulnerable to both natural (floods, cyclones, earthquakes, landslides, droughts, etc.) and manmade (fire, road accidents, building collapses, etc.) disasters. Experts opine that it is one of the most multi-hazard prone states in the country. Climate change poses a serious challenge for Maharashtra threatening communities, businesses, government and the environment. Experiencing erratic weather conditions, floods in some of the urban areas and droughts in the rural regions, Maharashtra’s economy, especially the agricultural sector, is severely affected. Most of the rural population comprising small and marginal farmers, including the economically vulnerable, rely on agriculture and allied activities for their livelihoods. According to Bhagwat and Nazareth (2021) the production of four major crops – soybean, cotton, wheat and gram – are likely to be impacted in the coming few years. In 2019, unseasonal rains wiped out crops in an area of 94.5 lakh hectares (9.4 million hectares) in the state.⁸⁶ It is also estimated that the total economic cost of the loss amounted to more than INR 5,000 crores in 30 of the 36 districts of the state.

Reeling under droughts: Impact of climate change

Traditionally a drought-prone state, almost 70% of the Maharashtra’s geographic area is semi-arid making it susceptible to acute water scarcity. About 148 talukas in the districts of Pune, Aurangabad and Nashik are a part of the DPAP. Vidarbha and Marathwada are also severely marred by droughts. Data reveals that almost 77% of Maharashtra’s cropped area is vulnerable to climate change. A joint study conducted by ICAR, NDRI and IIWBR revealed that the district of Nandurbar is most vulnerable to cyclones, droughts, floods, changing rainfall patterns and extreme weather temperatures affecting its crop production. Other highly vulnerable districts include Buldhana, Beed, Jalna, Aurangabad, Hingoli, Parbhani, Nanded, Akola, Amravati and Washim.

Climate change increasing the risk of floods

Maharashtra is severely prone to floods, most of which are flash floods caused by nallah overflows and poor drainage systems while some like the 1983 Konkan flood are caused by heavy rainfall in the region. A list of flood prone areas from Maharashtra Disaster Management Plan 2016 is shown in Table 4.

Table 4: Flood-prone areas in Maharashtra

Place	River	Nearest dam
Pandharpur	Bhima	Ujjaini
Nira-Narsingpur	Nira	Vir
Pune	Mutha	Khadakwasla
Daund	Bhima	Ghod
Sangli	Krushna	Warna
Karhad	Koyna	Koyna
Paithan	Godavari	Jayakwadi
Nanded	Godavari	Vishnupuri Barrage
Nashik	Godavari	Gangapur
Akola	Morna	Katepurna
Beed	Bindusara	Bindusara

Source: Maharashtra State Disaster Management Plan

As per the 2021 IPCC’s Sixth Assessment Report, Maharashtra is likely to be affected by the rise in temperatures in the coming years.⁴ The rapid change in climate is simultaneously triggering heat waves and extreme rainfall leading to floods. For instance, Chandrapur located in eastern Maharashtra experienced a record high temperature of 48°C in 2021 whereas parts of Vidarbha, Kolhapur, Pune, Sangli, and Mumbai suffered from serious floods since 2019.

Climate variability causing environmental hazards

With rapid urbanisation and deforestation, the degradation of the natural environment is occurring at a fast pace. Decreasing soil carbon is one of the main factors affecting agricultural productivity in Maharashtra. Environmental hazards also impact the health sector resulting in poor sanitation and hygiene, agricultural and industrial contamination of air, water, food and land. Rapid economic growth and increasing population of Maharashtra has resulted in a higher demand for food production.

Changing climate resulting in earthquakes

The west coast and the Western Ghats are the most seismically active areas in Maharashtra. Near Ratnagiri, along the western coast, the Koyna Nagar, Bhatsa, and Surya areas of Thane district, Nanded, Beed, Ujjani, and Solapur in eastern Maharashtra, and Uran, Kolhapur, and Sindhudurg in south-west Maharashtra are the principal locations where seismic activity has been noted over the past few years.

Climate change and landslides

Landslides, which can also cause massive loss of life, property and critical infrastructure, are another natural disaster that affects Maharashtra. They are frequently brought on by excessive rainfall coupled by human-induced development activities in the Western Ghats. The Konkan region, which includes Raigad, Ratnagiri, Sindhudurg, portions of Thane and Pune, and the foothills of the Sahyadri, are the most vulnerable areas in Maharashtra, according to the GSI, which estimates that around 30% of the state is prone to landslides. Below is a summary of a few notable landslide episodes (Table 5).

Table 5: Major landslides in Maharashtra

Place	Year	Casualty
Jui, Rohan, Dasgaon, Kondivate villages in Mahad taluka, Raigad	25 July 2005	Landslide caused by incessant rainfalls claimed the lives of more than 100 people resulting in severe damage to life and property
Sakinaka, Mumbai	26 July 2005	Landslide triggered by massive rainfall claimed the lives of more than 74 people, destroying large number of tin shelter houses
Malin in Ambegaon taluka, Pune	30 July 2014	Landslide caused by heavy rainfall claimed the lives of 150 people

Source: Maharashtra State Disaster Management Plan

Key hazards

The most prominent hazards impacting Maharashtra include:

- a) water scarcity resulting in droughts
- b) erratic and changing rainfall patterns leading to floods
- c) decreasing soil carbon impacting agriculture.

A review of secondary studies reveals that Maharashtra has the highest number of dams and waterbodies in India. However, the state is hit by droughts annually due to the depletion of surface and groundwater sources and scanty rainfall patterns. Coupled with this is the issue of excessive siltation of river channels and improper or poor water harvesting practices. Yavatmal is severely hit by the agrarian crisis lying in the extremely dry Vidarbha region.⁸⁷ The livelihood of around 65% of the rural population in Vidarbha is dependent on agriculture and allied activities, with cotton being the major cash crop in eight of the 11 districts and covering an estimated 12 lakh Ha area. It has also been observed that agriculture in this region is comparatively less productive than the state and national averages.⁸⁸

Multidimensional analysis of CCA and DRR initiatives

A summary of the key points covered in the Maharashtra SDMP and the Maharashtra SAAPC has been provided below:

Decentralised risk mapping and planning

Localising disaster preparedness and climate adaptation strategies is essential to protect the farmers and can also prove instrumental in increasing their labour productivity and enhancing their livelihood prospects. In 2003, Maharashtra SDMP institutionalised the program Disaster Risk Management Program with the support of UNDP. DDMOs⁸⁹ are employed in all districts on contractual basis under the DDMA in order to implement the MDRM programme at district level.⁹⁰ All DDMA are provided funds by state government for strengthening EOCs, organising capacity-building training and public awareness programmes in order to strengthen the institutional capacities. Maharashtra SAAPC also mentions involvement of block level departments and Panchayati Raj Institutions towards equipping the farmers, both technically and financially. It also focuses on empowering NGOs, CSOs and community-led organisations to ensure local-level action and timely response to drought affected families.

Strengthening community awareness and knowledge on natural hazards and climate change

Awareness on climate change is gradually increasing in Maharashtra, as observed during field visits and stakeholder consultations. Through improved access to climate services, risk management techniques, and safety nets against climate impacts, Maharashtra SAAPC mentions possible actions that could be taken to protect farmers from climate risks. Additionally, it emphasises improving the adaptability of farming systems through varied cropping patterns, soil preservation, and value addition. Potential steps are outlined to strengthen farmers in securing food supply chains. The Maharashtra SDMP outlines both structural as well as non-structural measures for both demand and supply side management of water resources in the state. Structural measures include soil management, crop management, adaptation of new technology, drought forecasting and warning, techno-legal regime to strengthen resilience and adaptive capacities to droughts. The local governments, irrigation department, revenue department and the panchayat are responsible for the development of techno-legal regime or regulations for:

- i) the prohibition of development in wetlands, flood zone and low-lying areas
- ii) encouraging flood proofing structures in flood-prone areas
- iii) building new water and sewage systems and utility lines
- iv) prescribing standards for different flood-prone zones on flood maps
- v) the enactment and enforcement of laws regulating developmental activities in flood plains
- vi) specific building bylaws for flood plains.

Both Maharashtra SAAPC and SDMP outline community mobilisation in their respective ways. The Maharashtra SDMP has compiled a list of initiatives to educate people about the effects of droughts and offers suggestions for water conservation, plants that can withstand dry conditions, cutting-edge technology and non-farming activities. Activities are included to educate farmers about government programmes and insurance policies for agriculture, fisheries, horticulture and animal husbandry. The agriculture department also arranges for farmers to go on exposure tours to learn about new technology and non-farming jobs. The Maharashtra SDMA places a strong emphasis on actively involving women SHGs and developing their capacities through the transmission of climate change information, technology demonstrations and communication materials.

“

When it comes to droughts, the agriculture department, water and irrigation department and all associated government bodies must come up with a mutually agreed mitigation strategy. Adequate alternative livelihood opportunities must be made available to farmers. In 2022, over 2000 farmers have taken their lives despite the state’s assistance.’

Dr Prasanna Patil,
Savitribai Phule Mahila
Ekatma Samaj Mandal



Table 6: Major interventions in Maharashtra (2000–2022)

Major drought years	Regions affected	Interventions taken
2007–2008	Nashik, Solapur, Marathwada, Western Vidarbha	Union Government introduces a whopping INR 60,000-crore package to provide relief to the indebted farming community by waiving loans of small and marginal farmers – Agricultural Debt Waiver and Debt Relief Scheme, 2008
2013	Solapur, Parbhani, Ahmednagar, Latur, Pune, Satara, Beed, and Nashik	The 2013 drought in Maharashtra was considered as the worst drought in the history of Maharashtra in the last 40 years. Between 2008–2013 Prime Minister introduced INR 3750 crore and INR 1075 crore in state packages for various subsidies and training programs for farmers in the region. The state government also began providing quality seeds for crops and drip irrigation sets at 50% subsidies. An assistance of INR 25,000 per family is also given towards the purchase of farm equipment. Greenhouses have been set up in the suicide-prone districts.
2016–2017	Beed, Osmanabad and Latur in the Marathwada region of Maharashtra, Vidarbha region	In 2017, Chhatrapati Shivaji Maharaj Shetkari Sanman Yojana, a farm loan waiver of INR 35,000 crore for 89 lakh farmers was introduced. In April 2016, Maharashtra also operated a water train to supply drinking water to the drought affected Latur region. In 2016 Jalyukt Shivar Abhiyan (water conservation scheme) was also launched to become drought free by 2019.
2019	Marathwada and Vidharbha regions	The Maharashtra government approved a blueprint of a phased water grid project to combat drought in Marathwada. The project envisions an integrated piped network connecting 11 dams in the region to ensure a year-long water supply for drinking, irrigation and industrial purposes.
2021	Amravati, Aurangabad, Nashik, Nagpur, Pune, Konkan	The water grid project is expected to begin in the first phase at the Jaikwadi dam in the Paithan taluka of Aurangabad. The project has received initial funding of INR 285 crore from the government. The second phase will focus on other talukas in Aurangabad, with the third phase focusing on dams in the Beed, Osmanabad.
2022	Amravati, Aurangabad, Nashik, Nagpur, Pune, Konkan	In October 2022, the state paid INR 1 lakh to the families of farmers who committed suicide.

Source: Data and information compiled from different media articles

Role of the private sector in adaptation and resilience financing

Both the Maharashtra SAAPC and the SDMP highlight the importance of private sector financing in adaptation and resilient building efforts, however, they do not explicitly provide a roadmap or strategy for availing these funds. In FY 2020–21, the state received INR 3306.72 crores in CSR funds from 4453 companies. Reliance Industries Limited (INR 383 crores), Nuclear Power Corporation of India Limited (INR 96.85 crores), and Reliance Jio Infocomm Limited are the top three companies in the state in terms of CSR funding (INR 86 crores). Education, health, and environment were the top three sectors of focus for CSR initiatives. Private sector initiatives around strengthening drought resilience have become increasingly common in drought-ridden parts of the state. A diverse low-carbon private energy provider has constructed and repaired 260 watershed structures in villages surrounding Khandke as part of its water security initiative. The six year-long project is being carried out in collaboration with WOTR, a Pune based organisation, and has brought much-needed relief to the 15 drought-affected villages by increasing water availability and storage in these villages. Several private companies have also been assisting farmers by conducting research and development on drought-resistant crop varieties and high-yield crop varieties to assist farmers with additional revenue and reduce wastage, thereby increasing their cash liquidity.

Roadmap for financing from government budgets

A review of the Maharashtra Budget 2021–22 reveals that the state had allocated 6.1% of its total expenditure towards agriculture and allied activities in 2022 which is marginally lower than the average allocation for agriculture by states (i.e. 6.3%). However, promising allocations

have been made for water supply and sanitation, particularly irrigation projects, including an allocation of INR 853.45 crores for Gosikhurd National Irrigation Project. The 2022 Budget also highlights the financing gap of INR 16,385 crores to fully implement more than 55 planned interventions in the drought-hit cotton belt of the Marathwada region that has seen maximum farmer suicides in the last decade. A special package has been approved on 18 July 2018 which provides central assistance to complete 83 surface minor irrigation projects and 8 major/ medium irrigation projects in drought-prone districts in Vidarbha and Marathwada and rest of Maharashtra phases up to 2023–24. According to the Maharashtra SAAPC, microcredit financing could be expanded to promote green jobs for rural women (an example would be entrepreneurship in solar home systems and charging stations). The Maharashtra SDMP highlights that farmers can trade their farm products directly online with APMC/ mandis through the e-NAM portal. The MahaDBT portal could also be useful for transferring subsidies and benefits directly into eligible farmers’ bank accounts. However, prioritising certain sector projects will help strike a balance between budget allocation and implementation of projects that are more important.



Case study

Private sector supporting disaster management in Maharashtra through drought early warning, response and relief

Since 1994, eastern part of the Vidarbha region in Maharashtra has experienced repeated flash floods. On 19 July 2022, one of the worst flash floods hit the region and inhabitants were left struggling when the intensity and extent of flooding exceeded their expectations.

Reliance Foundation adopted a focused and collaborative approach, working closely with government agencies for early warning, relief and evacuation. It provided rations as an immediate relief measure to 3,500 families in 11 villages in Wani and 7 villages in Ralegaon of Yavatmal district. It also set up seven livestock camps in seven villages of Yavatmal district that addressed the health concerns of 1,431 livestock units and helped 246 livestock owners. Using weather forecast information from the India Meteorological Department (IMD), the foundation supported the dissemination of early warning advisories.

PwCIF, in collaboration with the **SPMESM**, worked in the Shelgaon village in Aurangabad which was grappling with drought due to poor rains and defunct water bodies. The objective was to support and build the capacity of farmers battling drought. One of the key interventions involved restoration of the existing water-harvesting structures and soil and water conservation activities in watershed clusters in coordination with the community. Similar interventions were then undertaken in the Narla village with a population of over 1,500. The project helped in restoring defunct water structures, creating a capacity of 20.6 million litres of water for the purpose of irrigation and drinking for humans and livestock and provided ongoing support to the village community.

Axis Bank Foundation and Dilasa Sanstha are collaboratively working towards creating sustainable livelihoods for tribal people in ten districts of Maharashtra. The programme aims to bring water security for the inhabitants. The initiative is making use of community networks and knowledge to reintroduce phad, an indigenous irrigation practice, along with other low-cost watershed management techniques, allowing them to harvest their crops with a sufficient supply of water.

Standard Chartered Bank's CSR project for drought-proofing Maharashtra incorporates cutting-edge technology. WATSCAN is an integrated IT-driven, GIS and remote sensing-based information system developed by **CII and Triveni Water Institute**. It generates millions of digital pixels, connects satellites and on-ground databases, and uses cloud computing for analysing real-time water resources. The project has been working to adopt water management strategies for enabling social transformation at scale by engaging with villagers and integrating with ongoing government programmes such as Jalayukt Shivar Abhiyan and Village Social Transformation Mission.

Damage and loss assessment methodologies

In Maharashtra, damage and loss assessments from droughts are undertaken by the state's agriculture department. However, in order to have a standardised approach, it would be beneficial if Maharashtra SAAPC or SDMP could include a section to report on loss and damage assessment methodologies. According to the state government, the total area of crop damage (more than 33%) caused by unseasonal rainfall in October-November 2019 was estimated to be 94.53 lakh hectares. A total of 103.52 lakh farmers were reportedly affected. There is a need to integrate year-round damages and losses in these assessments to ensure that effective farmer compensation packages are devised and distributed on time.

Connections to other government schemes

As a part of mainstreaming disaster risk reduction, the state action plan lists state and national level schemes and how DRR activities have been undertaken within each of these schemes to reduce physical exposure to natural hazards. One of the priority areas of the state plan is to 'build back better' in recovery, rehabilitation and reconstruction and schemes like PMAY, PMGSY, MGNREGA, which focus on the construction of low-cost multi-hazard resistant housing designs, build back connecting roads and strengthening of drought proofing activities, respectively, lead to a strong foundation in incorporating risk reduction features. In villages suffering from water scarcity, Jal Jeevan Mission aims to improve water security by reducing the high cost of long distance bulk transfer of water for household water supply. With a 16% increase in the budget allocation in 2023–2024, the scheme is set to integrate rainwater harvesting and greywater management by sourcing drinking water from local surface water bodies.

Krishi Kanya: Empowering women farmers at the grassroots

Working extensively with women farmers for the past few decades, this programme is run by a non-profit organisation – Savitribai Phule Mahila Ekatma Samaj Mandal (SPMESM) – in Aurangabad to disseminate the basics of agro technology.

Urja project

Another SPMESM initiative focuses on providing solar dryers to rural women.

Prioritising gender inclusion

It is essential to understand that climate change has different impacts on men and women. Moreover, women's contribution towards economic productivity and labour production often remains undervalued and unrecognised. Extreme natural disasters affect women the most, further aggravated by lack of access to resources, knowledge, capacity, etc. In a typical rural set-up, women's voice and participation in decision-making is sparse and undermined. Therefore, gender inclusion plays a very important role to encourage and empower women farmers at the grassroots level. Both the Maharashtra SAAPC and SDMP mention gender as one of the essential cross-cutting issues in devising effective and inclusive policies.

Lessons from Maharashtra

Aquifer-based groundwater management

Maharashtra has started using aquifer-based groundwater management practices through participatory groundwater recharge and usage control techniques at a watershed level. Under the flagship Atal Bhujal Yojana (central scheme for groundwater management), the state has been adopting both demand side (water saving measures) and supply side (water conservation and groundwater recharge) management of ground water resources along with appropriate investment actions led by community through convergence of various ongoing /new central and state schemes. To strengthen the institutional capacity and develop a framework for effective groundwater management, the state has a total allocation of about INR 188.26 crores for institutional strengthening and capacity building and INR 737.51 crores for incentive-based actions.⁹¹ The later includes preparation of village-level water security plans, public disclosure of groundwater data and arresting the rate of decline in aquifer groundwater table. WOTR is also helping residents in drought prone areas to change their farming approach by redirecting more focus on soil moisture replenishment work supplemented by water budgeting and efficient crop planning. Farmers in drought-prone Jalna district have been building bandhara or CNB through support from the irrigation department, which involves creating a cement/concrete wall along the way of a stream to obstruct and store flowing water. This practice is proven to increase the water levels in wells and allow farmers to use the water all year round.

Maharashtra is set to adopt convergence of agricultural interventions to curb agrarian distress

In the backdrop of rising agrarian distress and associated farmer suicides, the Maharashtra government provides crop insurance, farm subsidies and INR 1 lakh relief packages to families of farmers who have committed suicide. It is also considering increasing the relief packages with due budget allocations made in the next state budget due for 2023. The government is also committed to providing assistance of INR 50,000 to farmers who pay their crop loans on time.

The Government of India and the state government of Maharashtra have also requested the IFAD to intervene in the region, where unpredictable agricultural output and farmers committing suicides are major concerns. The productivity and incomes of the farmers are low and they face food shortage due to inefficient water use, depleted soil fertility and an indiscriminate use of fertiliser and hybrid seeds.

To alleviate the suffering of the farmers in this region, the national and state governments will converge to provide emergency assistance to affected households and shift the focus of agricultural development towards low-input production systems. A sum of USD 41.11 million has been agreed for the project that caters to multifold objectives – increase household income by diversifying farming and off-farm activities, empower women by improving their access to microfinance and to activities as microentrepreneurs, ensure cross-departmental convergence and building capacities of farmer groups in climate smart agriculture practices.

The IGWDP, funded by NABARD and WOTR, has also assisted in the implementation of watershed projects and increase in ground water levels across Maharashtra through widening of existing drainage channels, lakes and other reservoirs. Farmers avoid using water from the watershed, allowing the water to soak into the soil. Dawargaon, a village in Maharashtra, is surrounded by tiny hills, which cause flooding during rainstorms. To counteract this, CCT were built over the slopes of the hills, which aid in the retention of runoff water. Farm bunds were built around the hills to preserve runoff water and the top fertile layer of soil which is eroded due to floods. These ongoing capacity-building activities have aided in restoring soil fertility and improving groundwater levels, thereby reviving the drought-affected areas of Maharashtra and minimising the migration of the people.



Farmer field schools

FFS is a participatory training approach that brings a group of small-scale farmers together to discuss their problems and brainstorm solutions to production problems through sustainable agriculture means. In a typical FFS, a group of 20–25 farmers meet once a week in a local field setting under the guidance of a trained facilitator. In the last 5 years, the state has been making laudable efforts in bridging the capacity and knowledge gaps in modern farming techniques by bringing together concepts and methods from agro ecology, experiential education and community development to assess the problems in agriculture technology adoption and suggest possible solutions.

In this approach, farmers investigate a wide range of topics in this field-based setting including soil fertility and water resource management, methods of local varietal selection and seed quality issues, risks associated with toxic pesticides and implementation of low-toxicity alternatives, marketing skill development and diversification of farming systems with new crops.



Measures taken by the government to drought-proof Maharashtra

The Union Government has aided water rejuvenation activities in Maharashtra by allocating funds through programmes such as the NHM), the MGNREGA, RKVY and PMKSY which provide subsidies for plastic linings in farm ponds, micro-irrigation practices, etc.

Technology infiltration

The government is effectively utilising information and communication technology to raise awareness, improve knowledge and increase the farmer’s efficiency. The MahaDBT portal is used to transfer subsidies and benefits directly into the eligible farmers’ bank accounts. Farmers are given access to the e-NAM portal for direct online trading of farm produce with APMC/mandis. Farmers can use the Krushik application to increase farm productivity by

accessing relevant information. To ensure minimal human interference and human errors in the valuation process, the state has established the e-governance system MAHA-MADAT for assessing the drought situation in the state. The MAHA-MADAT application and website has been created by the Relief and Rehabilitation Ministry with the help of the MRSAC.

Participation of civil society and NGOs

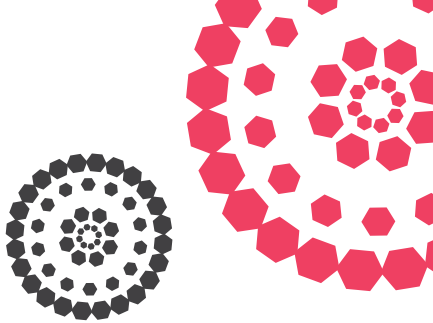
Maharashtra is home to Bollywood, the Indian film industry. In 2015, two Bollywood actors founded the Naam Foundation, which has distributed four tonnes of foodgrains to 340 drought-affected families in Ahmednagar. Some celebrities have also taken the initiative to assist drought-stricken families. Paani Foundation devised the novel concept of the ‘Satyamev Jayate water cup’, which is a water management competition between several village gram panchayats. Influential leaders, NGOs and voluntary organisations in the state are demonstrating the art of sustainable water utilisation and management.

Crop diversification and drought-resistant cropping systems

Several NGOs and the private sector are working hard to educate farmers about farming patterns in order to combat water scarcity. Farmlands have switched to multi-cropping patterns rather than single crops, with a focus on cash crops such as cotton, ginger and vegetables. Farmers are now growing tomatoes, onions, wheat, ginger, cotton and other crops in addition to cotton, bajra, maize and pigeon pea. The Marathwada area of Maharashtra, which was historically a cotton belt, is increasingly changing to maize and soybean farming which has resulted in an increasing demand for maize and soybean processing. Drip irrigation has enabled farmers to grow more crops with less water. Greenhouses are being developed in numerous communities in the Jalna area as part of the POCRA. Tomatoes and chilies are cultivated inside the greenhouses for their seeds. Farmers use artificial crossbreeding to create desired seed variations. Private firms, that had offered seeds for the cultivation process, commercialise these seeds. Farmers rely on crops such as cucumber and bitter gourd for the rest of the year, allowing them to maintain a consistent income all year round.



The financing challenge: Who will pay for India's climate adaptation and resilience?



Climate finance and global mechanisms

The United Nations Framework Convention on Climate Change (UNFCCC) defines climate finance as **‘local, national or transnational financing; drawn from public, private and alternative sources of financing; that seeks to support mitigation and adaptation actions that will support climate change’.**⁹²

The first agreed climate finance target to mobilise USD 100 billion a year by 2020 by developed countries for developing countries can be found in the Cancun Agreements in 2010 where the GCF was established to act as a key delivery mechanism. This target was further reinforced in the Paris Agreement in 2015 with a goal to raise the target after 2025 and that this funding would come from a ‘wide variety of sources, public and private, bilateral and multilateral, including alternative sources of finance’.⁹³ Climate finance is as important for adaptation initiatives as it has been for mitigation so far because reducing emissions and adapting to ‘new normal’ can only be achieved through extensive investments.

At present, there are broadly three sources of climate finance: bilateral and multilateral, public and private.⁹⁴ A significant fraction of these funds is managed by multilateral bodies like the GCF Adaptation Fund, the World Bank’s CIF and the GEF.⁹⁵ Developed countries can either provide financial support bilaterally or via an accredited institution.

In turn, these institutions invest the funds in programmes aiding climate action, disaster resilience and control. As per OXFAM⁹⁶ and OECD⁹⁷ data, almost 70% of total climate finance from 2016 to 2018 was received by middle-income countries. LDCs received only 14% of the aggregate funding while SIDS were able to obtain only 2%. Most interestingly, while 66% of the finance was targeted towards mitigation, only an estimated 25% of reported public climate finance was for adaptation.⁹⁸

Climate finance caters to programmes across myriad sectors like energy, infrastructure and agriculture. Larger projects at times have certain climate-sensitive objectives and features despite the project overall not being green or climate-compliant.⁹⁹ Large infrastructure and mining projects, for instance, with remote reductions in carbon emissions might inflate a country’s reported funding requirements. It, therefore, is important for all national governments and stakeholders to understand and assess their climate finance needs and to also assess how these funds are to be mobilised. The UNFCCC website includes a climate finance data portal with helpful explanations, graphics and figures for better understanding the climate finance process as well as a portal for information on climate action activities eligible for funding in developing countries, along with the financial mechanisms of the operating entities.



The Indian landscape: Climate finance requirement and methodology

What constitutes climate finance and the type of finance that is pledged, received and ultimately utilised by the developing countries has been a longstanding debate. Broadly, there is a lack of conceptual clarity on the definitional features of climate finance, especially the notion of additivity, which probably affects computations of financing requirements. There are also many calculations of India’s climate finance requirements which is problematic. Estimation methodologies often conducted in different contexts making them inconsistent. Lastly, there is a lack of adequate private sector involvement to close to multi-billion-dollar funding gap in the Indian context.

Lack of conceptual clarity on the definitional features of climate finance	<ul style="list-style-type: none">Though the definition of climate finance is crystal clear, it does not adequately agree on the principles of ‘equity and common but differentiated responsibility and respective capabilities’ (Paris Agreement 2015) which brings more consensus among the developed and developing countries.In India, the first expression of domestic needs for climate finance was in the Economic Survey 2012–13, which arrived at INR 2,30,000 crore (INR 2,300 billion) as the quantum of funding required to meet the mission goals under the NAPCC. However how much finance has been mobilised, provided and received, and the sectors it has been used in is yet to be assessed to better quantify sectoral needs.
Credibility, accuracy and transparency in estimation methodologies	<ul style="list-style-type: none">In addition to the lack of multi-nationally agreed climate finance, there is also missing synergies between measured flows of climate finance from developed countries, disbursed funds across borders and actual utilisation of funds.An independent review of India’s NAPCC alludes to the ambiguity regarding the way the financial estimates for some of the missions were arrived at (Byravan and Rajan 2012). Another study on SAPCCs found marked inconsistencies in the estimates quoted by different states, in addition to a dearth of objective yardsticks in identifying the prioritised list of actions (Mandal, Rathi and Venkataramani 2013:16).
Lack of private sector involvement in catalysing climate finance	<ul style="list-style-type: none">Besides multilateral climate financing (who are major providers of climate finance, especially debt/concessional loans), blending public and private sector finance is useful to de-risk climate investments (such as through first loss default guarantees or performance guarantees). Private sector finance mobilisation also needs to significantly replace public sector finance.State of climate finance in India Report 2022 highlights a USD 1.01 trillion pledge in climate finance by 2030, which is an increase from 2021 pledges due to increased focus and spend in energy and infrastructure sector. This calls for significant private action aligned with net-zero movements in global markets.

However, it is important to note that climate mitigation receives a larger share of the overall Indian climate finance due to the focus of international climate finance on mitigation. Despite the Global South’s scepticism towards embracing more ambitious climate targets, India is among the largest recipients of climate change assistance,¹⁰⁰ which is greater than any other nation. However, clear policy signals in consonance with the India’s NDCs and judicious fund allocation between mitigation and adaptation requirements will be important for the country.

In India, domestic sources continue to account for the vast majority of climate finance, accounting for 87% and 83% in fiscal years 2019 and 2020, respectively. The private sector contributed approximately 59% of these domestic sources amounting to USD 22 billion. At approximately 54% and 46%, respectively, public sector flows were evenly distributed between government budgetary spends (central and state) and PSUs. Majority of the finance flows have been towards mitigation initiatives, specifically clean energy, clean transport and energy efficiency. The total amount of green finance for the adaptation sectors was INR 37 thousand crores (USD 5 billion) per year over FY2019/ FY2020. Domestic funding was the primary source of adaptation funding (94%), and it was fully funded by Central and State government budgets.¹⁰¹

Odisha became the first Indian state to recognise the significance of identifying sectoral budgetary needs and incorporating climate change into the state budget in 2021. Odisha's climate budget 2020–2021 highlights the state's exceptional climate finance flows. The state has received a GCF financing of USD 34.35 million for the project 'Ground water recharge and solar micro irrigation to ensure food security and enhance resilience in vulnerable tribal areas of Odisha'. It has also received central allocations from the Ministry of Science and Technology to strengthen the state's existing 'climate change cell,' as well as from the MOEFCC to strengthen capacity under the NMSKCC. National Adaptation Fund on Climate Change is also an innovative project that will be addressing management of runoff in the Jonk river basin of Nuapada district to reduce vulnerability and enhance resilience for traditional livelihood. Recently, a fund known as the OEMF has been established for climate change activities.¹⁰² This fund will serve as a corpus fund for providing financial assistance to the formulation of some remarkable projects in the context of climate change. Apart from these, the Odisha government has raised increased capital investment in the drinking water initiative, rural housing, tribal welfare, millet mission as well as rail infrastructure in the Union Budget 2023–2024. However, there is a need to diversify Odisha's climate finance flows by reducing reliance on central allocations and aligning its actions more closely with corresponding national missions. In drought-riddled Maharashtra, ADB has been financing

for MAGNET project which aims to improve the networks of post-harvest facilities and marketing management for value chains. An 11% hike in agriculture credit target to INR 20 lakh crore in FY 2023–24 and investments for an agri digital infrastructure for FY 2023–24 are welcome steps towards incentivising private sector investments in upscaling and further innovating these initiatives in the context of the state.⁸⁸ In Assam and Meghalaya, ADB has been investing in major hydropower, transport and power infrastructure projects. ADB recently sanctioned USD 300 million for road sector development in Assam, with the goal of upgrading over 300 km of state highways and MDRs in the state.⁸⁸ Public and private service providers, as well as rural communities, are implementing modern climate change adaptation strategies in the Northeastern states of Meghalaya, Nagaland and Sikkim. This project is a bilateral collaboration agreement between India and Germany.¹⁰³

Although private funding of climate action is a critical constituent of nation's climate adaptation policy, there exist numerous hurdles in studying climate funding sourced from the private sector with most reviews indicating that such finance is highly biased toward renewable energy projects (such as more allocations for the mining sector and energy efficiency sector). This is because the country has undertaken noteworthy schemes and resolutions over the past decade to show seriousness in phasing out fossil fuels and these ventures have drawn significant private investment in renewables. There exists, however, a significant room for attracting additional private investment in non-renewables-based climate projects via inventive financial instruments like resilience bonds.

Green development can intertwine with programmes and finance initiatives addressing smart cities, NCAP and state action plans on climate change. Although states have various recourses pertaining to green development, there has existed underuse of climate finance for adaptation programmes. To mitigate this, the private sector must assist state governments in identifying best practices and developing use cases that demonstrate how blended finance can provide sustainable development solutions that are robust to climate change.

A few stakeholder-wise recommendations can be made based on the discussion above. There is a need to arrive at a conceptually consistent climate finance framework using standardised metrics for gauging the benefits from adaptation and resilience-building efforts since these have very different outcomes compared to most mitigation projects. Standardisation of climate financing methodologies would also ensure comparability between different official expenditure estimates. The framework must also clearly delineate the role of various financial stakeholders.

The L&D fund agreed at the COP27 is a key milestone in empowering countries that have been severely impacted by climate change in the past and strengthening resilience and adaptation to future climate shocks. The fund is expected to address both economic and non-economic losses caused by climate-related disasters, such as loss of life, destruction of cultural heritage, migration and displacement, and impact on health. Developing countries, SIDS and LDCs can access approximately USD 3 billion in UN investment in EWS, USD 50 million through CDRI's IRAF, and funds available through the Global Shield Financing facility. However, as extreme weather events become more destructive, loss and damage financing must not only provide disaster response and reconstruction, but also enable local stakeholders to better anticipate and prepare for the loss of development gains. Given this, the roadmap for how Indian states intend to receive and use L&D funds must be a key component of the SAPCCs. States must clearly outline broader strategies for financing larger adaptation programmes in addition to addressing disaster management funding. Importantly, states must clearly seek private capital sources rather than relying solely on allocations from state and central schemes. The six small-scale adaptation fund projects implemented by the NABARD must be extended to other vulnerable regions such as in the Northeast of India as these are pioneering diverse adaptation models and establishing the required networks and experiences for sharing knowledge critical for making broader changes across India.

Estimates of the damage in developing countries range from USD 290 billion to USD 580 billion by 2030.¹⁰⁴ In addition, only a small portion of natural hazards in emerging economics, SIDS and LDCs are insured. Transparent climate risk insurance programmes, improved public-private participation in the insurance industry and enabling regional risk insurance pools can help vulnerable countries come out of the vicious debt cycle of climate induced economic losses. Further, the insurance component of projects funded

by multilateral climate funds need to be carefully designed to support the most vulnerable and to minimise the potential for maladaptation. Projects with insurance components should further implement holistic, ex-ante climate and disaster risk management, effective incentivising or mobilisation of resources for risk reduction and pre-emptive action and readiness as part of broader adaptation and DRR programmes and policies. Where insurance premium subsidies are provided to render coverage more affordable, these should be designed to reduce rather than support vulnerabilities and exposure to climate risks, and should not disincentivise adaptation investments.

Finally, the private sector must assist state governments in identifying best practices and developing cases that demonstrate how blended finance can provide sustainable development solutions that are unaffected by climate change. Assisting states in setting up a pipeline of credit-worthy green infrastructure programmes can enhance the quality of climate bonds. CSR norms must be made flexible so that they can account for the benefits of adaptation and resilience projects, thus incentivising greater flow of funds in the future. There is a need to diversify the delivery mechanisms of L&D funds to attract more private sector involvement. Investments in social protection, devolved climate finance mechanisms for investing in public goods at the local level and municipality development funds used to build community resilience are examples of such mechanisms. Innovative financing streams can attract investors with varying risk profiles and help broaden the investor base by drawing in institutional participants like insurance companies, retirement funds, banks, etc. An overarching recommendation is to scale up blended finance where governments can work collaboratively with development banks and investors to identify financing constraints and further explore how they can scale up private financing. Resilience bonds have been incentivising municipalities in several regions, including India in funding climate resilience projects by converting anticipated losses from urban development projects into revenue streams. Experiences of successful case studies from within and outside the country can be shared including, but not limited to, bond issuance to help municipalities improve their credit worthiness. Centre-staging domestic finance will enable state governments to access and use such funds for targeted adaptation purposes. It is necessary to recognise the critical role of novel and non-traditional modes of climate funding in propelling self-sustaining sponsorship alternatives and reducing reliance on external as well as government finance.



India demonstrating adaptive leadership and future readiness

While incidence of climate-related hazards has increased substantially in India in the last few decades, improved disaster response mechanisms have led to a decline in the mortality associated with these disasters. However, the economic losses and damages from natural hazards continue to rise. Therefore, India's approach must shift from disaster response to adaptation and resilience building, with a clear focus on livelihoods and health. Effective management of climate risks will be a critical component of India's efforts to achieve its growth targets and SDG agenda.

India must now scale up the existing best practices in terms of disaster preparedness and response and make the necessary institutional changes needed to shift to a more holistic approach to resilience building. Furthermore, a large economy, high population density, diversity of climate hazards, and intersections between climate risks and SDGs mean that solutions that work for India can serve as a template for much of the Global South. A strong private sector and business environment, modern financial institutions, and strong community knowledge base will enable India to be a catalyst for building capacity and facilitating the financing of adaptation and resilience in many developing economies, LDCs and SIDSs. This has also been a key driver of the CDRI initiative launched by India in 2019. The CDRI can become a vehicle for greater south-south cooperation on climate action by leveraging the advantages of being the largest economy in the emerging world. The CDRI is also well placed to house regional platforms to foster improved regional cooperations and leverage private sector investments and capacities. Such platforms will help in facilitating regional dialogues, transboundary collaboration and cooperation, and exchange of knowledge and new technologies through active engagement of diverse thought leaders and practitioners for promoting resilience of existing and new infrastructure.

This section highlights some areas for India to become an enabler of the adaptation efforts for the Global South and some suggestions for mainstreaming resilience and adaptation into the existing domestic policy framework by using its existing experiences.

India leading enhancement of adaptation efforts in the Global South

Participation of civil society and NGOs

Assuming the G20 Presidency on 1 December 2022, India could position itself as a champion of climate action for the developing and emerging world. Incidentally, the G20 troika (present, last and incoming) will consist entirely of developing countries for the first time after December 2022.

Numerous countries have encountered the impacts of global climate change in 2022, significant examples being the heat waves across India and Europe, and floods in Pakistan and Puerto Rico. Climate change poses the greatest threat to developing countries in the Global South. Thus, India must utilise its G20 presidency to advance its climate goals and encourage the availability of technology and finance to allow nations to not only meet their mitigation targets, but also channel funds from multilateral financial institutions towards climate adaptation and resilience efforts.

The G20 provides a distinct intergovernmental platform for both developing and developed nations, with a rotating presidency which allows the presiding nation to establish a plan aimed at pushing the G20's aims while highlighting country-level matters. With green energy and climate finance having become significant areas of attention in recent years, it was not entirely unexpected when the MEA in India indicated that the country's presidency will focus on climate finance, energy security and green hydrogen in the energy sector. These themes are actively under discussion in the next G20 presidency and were also pivotal during the 2019, 2020 and 2021 presidencies of Japan, Saudi Arabia and Italy, respectively.¹⁰⁵

Encouragingly, the environment secretary of the Government of India has stated that adaptation must be prioritised in developmental interventions, while addressing a session on 'Long-term strategy on adaptation and adaptation readiness in India' organised by TERI at the India Pavilion at COP27 in Egypt. Emphasising the urgent requirement for adaptation financing, she identified the development of a global norm to increase transparency and investor trust as critical for increasing adaptation preparedness.

Moreover, the environment secretary has also stressed upon how the institutional set-up and the proposed strategy and fundraising must complement each other. The secretary has also underscored the need for information dissemination to strengthen communities for adaptation and resilience building.

Thus, finance delivery in accordance with earlier promises, increased private sector collaborations, access to a worldwide ESG finance pool and the contribution of MDBs must all be focused on during India's G20 presidency.

Disseminating best practices for disaster response

As highlighted earlier, some Indian states have done an exceptional job in improving disaster response mechanisms. These success stories can serve as a template for other countries in the Global South facing similar threats. This will especially be relevant for regions which may face newer hazards for which they may not have existing infrastructure or expertise to deal with. For example, the probability of intense tropical cyclones is expected to more than double in all regions except the Bay of Bengal and Gulf of Mexico.¹⁰⁶

In this context, states with experiences of dealing with such disasters may explore setting up CoEs which can document the best practices and institutionalise this knowledge to policymakers and planners from other geographies at risk. Officials and private sector stakeholders from well-performing states should also be sent for capacity-building programmes to countries in the Global South, which lack planning capabilities to deal with the evolving climate hazards, by utilising the existing network available through the CDRI.

Documenting and disseminating traditional, indigenous and local knowledge and practices

While climate change has hastened the pace of various hazards, many regions already have a long history of dealing with such disasters. Thus, in many cases, historically affected communities already have effective traditional and indigenous methods for dealing with

such disasters. Therefore, these regions could serve as an effective model for other geographies in the Global South with similar geographical and social characteristics. As many of these regions are also at various stages of development, practices that may be difficult to implement in India may be useful in other parts of the Global South. In this regard, a comprehensive documentation of such best practices for different types of hazards could be a useful exercise.

Leveraging private sector to provide solutions for the Global South

Private sectors actors across civil society, academia and corporates have played a crucial role in disaster response and adaptation efforts in India. Their contribution has been significant, both in terms of providing financial resources and knowledge. Many of the existing gaps in the policy framework are often filled by the private sector. For example, NGOs working in this space have developed local-level climate risk mapping tools and improved means of communicating these to communities. Some have also developed tools for better mapping of loss and damages, which directly involve the communities in the mapping process. The private sector's role is yet to be integrated into the official planning process. However, these solutions could be effective in other geographies with limited private sector interventions and technological innovations. Both planning capabilities and technological innovations available in the private sector could be shared with other countries. However, this will require a clear mapping of the existing solutions available in the private sector and creating of platforms where these solutions can be made accessible to those in other parts of the Global South.



Need for pre-emptive sector-wide government financing strategies for long-term resilience and adaptation action

Building resilience at all levels of governance calls for financial stability, access to adequate resources and institutional strengthening. The present system of resilience funding across the varied geography studies highlights a gap in the **potential sector-wide availability of funds for strengthening long-term resilience and adaptation initiatives.**

Central schemes and policies aimed at climate adaptation and ecological restoration

- A novel scheme MISHTI is said to make mangrove plantation easier along India’s coastline. The programme will be implemented through convergence of various schemes – MGNREGS, Campa Fund, and other sources.¹⁰⁷ The **Amrit Dharohar** scheme envisions the restoration and protection of wetlands.
- Schemes like **PM PRANAM** aim at reducing the use of artificial and chemical fertilisers by incentivising all states in promoting a green agricultural model. Ensuring **effective convergence of these schemes with different departments will ensure effective planning** and implementation as well as better management of funds.
- In the DRR space, a new strategy has recently been approved under the Assam Disaster Risk Reduction Roadmap 2030, where **3% of the annual budget of all line departments of the state’s R&DM Department** shall now be allocated for disaster reduction.¹⁰⁸

The Government of Assam is also starting the **Green Budget Tagging** of various departments to address the climate change-related issues mapped to their SDGs and developmental planning. It is crucial that the government works towards developing **standardised metrics** for gauging the economic as well as qualitative benefits from central schemes. It is also essential to identify multiple financing sources at state and local levels, and have **strategies in place to attract more investments from large climate funds** as well as other national governments along with targeted, time-bound and measurable climate action points. Coupled with this, **transparency on climate-related expenditures, and identifying the financing gaps and leverage points** will be essential to help integrate the broader climate response agenda with development planning. Governments must look towards providing **special credit guarantee schemes**, particularly to communities vulnerable to climate change, by collaborating with public and private financial institutions in order to lower the cost of credit. New and innovative investment mechanisms could close the financing gap in adaptation and resilience projects. Cities and towns must be able to raise funds through **resilience bonds (such as through municipal bonds)** to finance climate-resilient urban development. **Risk-retention and transfer mechanisms (such as parametric insurance and sovereign catastrophic risk pools)** could also be explored. There is also a strong need to **improve synergies in fund utilisation** for climate change adaptation and strengthening resilience across various sectors of the economy. This could be facilitated through **improved cooperation and cross-departmental learning** at both state and national levels.



Scaling up innovative private sector and philanthropic financing

Private sector financing plays a crucial role as emerging nations, SIDs and the LDCs race for a transition to net zero economies and minimise the adverse effects of climate change like rising sea levels or intensifying dry seasons. It is estimated that USD 140 billion to USD 300 billion will be needed per year by 2030 to adapt to the physical consequences of climate change.¹⁰⁹ Thus, national governments should work proactively to get the private sector onboard to close the financing gap and improve accelerated climate action.

The private sector has a crucial role to play in providing attractive easy credit options to farmers. Union Budget 2023 announced a 11% hike in agriculture credit target to INR 20 lakh crore for the next fiscal year, which gives a huge impetus to dairy, fish production and animal husbandry.¹¹⁰ Therefore, institutionalising the private sector for opening alternative avenues of financing would enable in the

Decentralised governance through knowledge dissemination and capacity development

Climate change governance have been gradually veering towards a polycentric structure where vulnerable local communities are empowered to take decisions regarding their natural assets and livelihoods. Feasibility studies for public sector infrastructure projects usually involve context-specific climate risk assessments. For example, 2022 saw the launch of a **state-of-the-art GIS and UAV** to mainstream geospatial mapping techniques and drone operations in efforts to study risks. Furthermore, in Odisha, the **CAP** has played a significant role in its **zero-casualty mission**. Used widely in the neighbouring coastal states of West Bengal and Andhra Pradesh, this protocol is used to disseminate cyclone alert messages. As of 2022, a total of more than six crore bulk SMS/messages were sent in local languages alerting residents. India is the sixth country to have a nationwide location-specific alerting system. The **C-DOT** and NDMA aim to provide a platform of technology-based alerting solutions to all government stakeholders and first responders under its recently **inaugurated the Integrated Alert System**.

Although decentralisation of vulnerability and risk-mapping exercises have been initiated for a long time in India, village-level climate action planning is still lacking. Furthermore, existing policies and programmes fall short of formally decentralising risk-mapping processes to non-governmental stakeholders such as local self-governing bodies, community-based and philanthropic

offering of multiple livelihood protection opportunities for the agriculture sector. Following a mandate of 2% allocation to CSR funding, philanthropic funding by large conglomerates has seen a significant increase in India. Moreover, it is important that CSR projects are moulded to fit the on-ground reality experienced by vulnerable communities. The private sector should therefore be given **more liberty to invest directly** in beneficiary projects for **longer time periods rather** than focusing on tangible outcomes in the short term. More broadly, this sector needs to be sensitised about the importance of making CSR investments – industry associations and chambers of commerce could play an important steering and advocacy role in this regard. Financing mechanisms such as **regional or state-level CSR corpus funds** could also be considered. Furthermore, **pooling of CSR funds** can help aggregate philanthropic contributions from small, mid-sized as well as individual donors and focus on long-term theme-based allocations such as water security and community capacity building.

organisations, and private research institutions, who could also contribute to the same. This could facilitate effective community-enabled actions at a hyper-local level and devolve responsibilities to the communities who experience climate-induced risks most directly. The government also needs to undertake **regular and periodic upgradation of the district and village-level action plans**, especially for the hilly regions, to factor in the changing environmental developments/hazards over time. G20 leaders welcome the idea of the **availability of data** to better solve the complex challenges of climate change by addressing the major information gaps that impede in efficient policymaking. The IMD, WMO and NIDM can serve as **aggregators to make nationally and internationally comparable climate data available**



in order to monitor national progress and take effective mitigation and adaptation measures. Coastal states can also learn from the success stories of Andhra Pradesh. The use of innovative remote sensing technologies, GIS and improved communication systems coupled with **hydrodynamic modelling** has helped the state to adopt an **integrative climate modelling approach** to predict future climate and disaster risks. Integrated climate risk information and dissemination systems coupled with the roll-out of 5G and 6G spectrum would scale up connectivity to the remotest stretches, enabling EWS that reach the last man on the last mile and leave no one behind in times of a disaster.^{111,112}

A clear methodology must be standardised by state governments **for post-disaster loss and damage assessments** that can be used to estimate economic losses at a hyperlocal level. It is also essential to further crucial **scientific contributions from academia and research scholars** while creating new knowledge in this domain.

The NDMA also provisions for organising **annual workshops** in collaboration with the vulnerable states to encourage robust experience sharing and convergence of DMPs across states. Participation from multiple states should be actively promoted to ensure advanced planning, better preparedness, access to international climate finances and timely intervention across all vulnerable regions. Furthermore, the country has adopted a holistic approach towards disaster resilience by strengthening effective coordination and cooperation in timely response to disasters **through modernising and expanding the NDRF. The Central Government has also allocated INR 13,693 crore for the National Disaster Mitigation Fund and INR 32,031 crore for the State Disaster Mitigation Fund for the period 2021–22 to 2025–26.**¹¹³ Further strengthening of the NDRF and India’s disaster response framework calls for international collaboration. Here, platforms like the G20 can provide such an opportunities for India to model its initiatives to the world.

Institutional framework for federal collaboration and cooperation

Cooperative and collaborative federalism has proven to be quite effective in several democracies. A quick glance at India’s experience of dealing with the COVID-19 outbreak through inter- as well as centre-state cooperation vindicates the **adaptive nature of India’s federal structure** in crisis response and management. Emergency response and crisis management is deeply fragmented in India. Post

the Disaster Management Act of 2005, district and state authorities have been given more autonomy in decentralised planning, coordinating and implementing disaster management measures in line with the NDMA’s guidelines. However, how Centre- and cross-state collaboration and cooperation will be achieved in the face of natural hazard events has not been explicitly mentioned in the NDMA guidelines.

The Ministry of Home Affairs, Government of India, has however developed an **Inter-State Council Secretariat** and **Zonal Councils** to support Centre- and inter-state coordination and cooperation in India. These councils provide an excellent forum to bolster exchange of **institutional knowledge and capacities through continuous capacity building of states (such as tailored need-based trainings, workshops and regional centres of excellence) as well as raising of funds for emergency response and relief operations.** Regional zonal councils can cooperate in exchange of information, satellite data and experience sharing to adopt the best practices of disaster response, mitigation, planning and preparedness for region-specific disasters – for instance, the Eastern Zonal Council for coastal hazards. **Annual disaster management exercises and mock drills** can be held with different regional stakeholders in different geographic settings wherein government-first responders are trained with the latest technologies and knowledge on disaster management. Such initiatives will help to ensure the **inter-state exchange of advisories, early warning alerts, multi-hazard vulnerability information and multi-hazard risk assessment in diverse geographical contexts.**

A **repository of location-specific best practices** in DRR and climate-risk mapping can be made available to the public as well as private agencies for cross-learning and scaling up in similar geographies in the larger Indo-Pacific region to foster international collaboration. Similar practices have already been adopted by the NIDM through the **IDKN** which is a part of the **SADKN** that specifically caters to the SAARC nations. However, operationalising and activating these portals and ensuring usage by a large number of organisations, practitioners and policymakers call for an **appropriate networking model** feasible for application by all member nations in the region.

Investing in community-centred approaches

Investing in communities have proven to improve accountability among communities, strengthening cooperation with governments and enhancing community governance of critical natural assets. The state governments have been gradually recognising the importance of involving the community in DRR and climate adaptation. However, they are still not keen on enrolling the non-profit sector

in financing schemes. There is an urgent need for the **government and NGOs to work in tandem** if solutions are to be decentralised. One of the important solutions emanates from **community mobilisation**, which is not just limited to creating awareness in the community but also involves connecting with the people at a personal level (through culture and language) which facilitates in unravelling their real on-ground situations.

The SAPCCs and SDMPs of Assam and Meghalaya recognise that **ground-up approaches** for climate adaptation and disaster preparedness and response will be crucial. This study indicates that local communities often play a major role in reconstructing damaged bunds and embankments after floods and assisting government efforts to fortify small dams. There has been a **spate of community-led tree-planting initiatives** in recent years to support carbon sequestration and offset the losses caused by deforestation and soil erosion in Northeast India. Other community activities include the **creation of water channels to improve drainage, especially in cities** like Guwahati and Shillong, and in flood-prone rural districts. Assam and Odisha’s **flood- and cyclone-resilient indigenous housing practices** can be used as architectural inspirations to construct **sustainable infrastructure. Likewise, sustainably sourced** nature-based building materials can be used, and both private and government investors can leverage the potential of **traditional ecological philosophies** to scale up resilient practices in regions having similar geographies, climate and socio-economic contexts. This could be mainstreamed with India’s efforts in pioneering **sustainable food production through the promotion of millet (a superfood)** production in domestic as well as international markets. The establishment of the **Agriculture Accelerator Fund** by the government is a welcome step in this direction. However, when combined with recognition and reward programmes, these initiatives can attract many active citizens, particularly young people.

Maharashtra’s experience of dealing with frequent droughts shows that **investing in climate-resilient agricultural practices such as scientific agricultural research, zero-budget natural farming, coupled with livelihood protection interventions such as well-structured social security schemes and agricultural extension, could help in improving food security.**

To measure the devastating impacts of natural hazards, it is important to devise **effective damage and loss assessments** that can quantify the number of lives and livelihoods lost, properties damaged and services disrupted fulfilling the requirements of the Sendai Framework to better structure relief packages. Governments may consider providing **insurance coverage and risk transfer mechanisms** from **climate risks** for fishing communities who frequently battle with



intense storms and cyclones. There is an increasing **loss of lives, fishing vessels, fishing equipment and loss of fish catch** which are not adequately covered under the current set of risk-coverage schemes. Coupled with this, **sustainable land-use practices** in high economic value regions **and livestock systems management** by building local capacities can help with livelihood resilience, nutrient cycling and agriculture carbon emissions.

CSOs play a key part in both disaster response and adaptation efforts. The **role of CSOs must be clearly defined within the district** and local-level disaster management plans and must take immediate as well as long-term response measures into account to restore livelihoods lost due to climate change. DDMAAs could appoint a nodal person with specific mandate to coordinate with and provide relevant information to civil society actors to co-implement short- and long-term adaptation measures.

Investing in inclusive and efficient disaster-and climate-resilient infrastructure systems

Both the government and the private sector must pool their investments in resilient infrastructure building to ensure limited damage to infrastructures, and disruption of essential services and global supply chain, which are also key drivers of the country’s economic growth. At the World Economic Forum 2023, an estimated **global investment need of INR 4.5–5.4 trillion per year for urban infrastructure** has been brought to the attention of the global leaders. This translates into an estimated funding gap of USD 350 billion per year compared to current levels of infrastructure investment.¹¹⁴

To reduce direct and indirect losses to infrastructure from climate risks, **critical infrastructure assets** should be prioritised, planned, designed and built by retrofitting them with innovative engineering and nature-based cost-effective solutions. In terms of safeguarding its critical power infrastructure, Odisha has made successful strides

in making its power sector resilient to climate-induced damages. However, there is still potential to install underground cables, modify transmission line design criteria, and **improve building and industrial energy efficiency**.

The fragile and dynamic Himalayan ecology that is often plagued by natural hazards like landslides, soil erosion and land-subsidence calls for mainstreaming of decision support tools in settlement planning and investments in resilient infrastructure in these regions. Meghalaya's experience of dealing with landslides necessitates immediate action on the upgradation and monitoring of the implementation of **regulatory and economic standards (like building codes)** to strategically plan developments from high-risk zones. Hilly states like Uttarakhand and Nagaland can treat these experiences as a template to follow and thus develop and communicate infrastructure plans to encourage **PPPs** in bankable, resilient infrastructure projects in these regions. In the case of Assam, the government has recently started to **build 1,000 km of concrete embankments in the state** as majority of the existing embankments date back to the 1960s and require immediate upgradation, repairs and regular maintenance. These initiatives can also be mainstreamed with the **Urban Infrastructure Development Fund** announced at Union Budget 2023 to close the financing gap in investing in urban transportation, waste management infrastructure and healthcare infrastructure in tier II and III cities.

There is also an important socio-economic and gender dimension to climate and disaster-resilient infrastructure. The Odisha government takes immense credibility in mastering the art of evacuating people and saving as many lives as possible during extreme weather events. However, there is still scope for improvement when it comes to ensuring the **last-mile access to safe cyclone shelters**. Cyclone shelters often have inadequate space, and many have to vacate to make room for pregnant women and the elderly. Some are also forced to stand due to space constraints. Men often do not seek refuge in cyclone shelters and instead stay at home to protect their houses and important assets. Furthermore, the design of evacuation shelters could be reconsidered to make them accessible by all social and gender groups. Coastal states can also consider constructing **multi-story cyclone shelters and underground cellars with adequate accommodation capacity** for both human and livestock as done by other countries. In many cases, cyclone shelters remain inaccessible at the time of disasters in an emergency. Coupled with this, there is the problem of poor hygiene and caste discrimination within the shelters. Therefore, rather than having a few big shelters, it is important to have **many small physically and socially accessible community shelters**. Moreover, revenue generated from these community managed shelters can be used to pay the community volunteers to keep them engaged in the disaster relief programmes.

Active compliance with climate risk disclosures can help policymakers and investors to frame flexible and adaptive approaches in building climate and disaster-resilient infrastructure and services. Insurance providers can spur investments in India's infrastructure sector to close the gap in between overall losses and insured infrastructure losses. Public health and school infrastructures are still among the weakest infrastructure sectors showing potential of future growth.¹¹⁵ **Nature-based solutions** – such as sand dunes, seawalls and tree shelter belts – provide **flexible, cost-effective and innovative approaches** to infrastructure design and growth. These have a history of demonstrating positive outcomes in coastal and flood resilience. Sand dunes stabilised by vegetation provide a natural buffer from high-speed winds and storm surges. Majority of the sand dunes and Casuarina vegetation along India's east coast have almost started to vanish from the coastline owing to land conversion and use of the land along the coast for tourism and other allied activities. Therefore, the government should rigorously engage in maintaining these natural barriers to cyclones.

Establishing systematic connections: CCA, DRR and development planning

Establishing strong connection between the CCA (which is a gradual response to the negative impacts of climate change and extremes) and DRR (which looks to reduce disaster and climate risks by reducing vulnerabilities and limiting exposure and sensitivities) is important. This helps in garnering widespread support for coordinated and concerted sustainable action. The **NAPCC** has identified eight missions – The National Solar Mission, National Mission on Sustainable Habitat, National Mission for Enhanced Energy Efficiency, National Mission for Sustaining the Himalayan Ecosystem, National Water Mission, National Mission for Green India, National Mission for Sustainable Agriculture, and the National Mission for Strategic Knowledge on Climate Change. Exchange of cross-sectoral knowledge and action plans and leveraging the lessons and failures from each sector's performance can help to build upon the common goals of Agenda 2030, SDGs, the Sendai Framework for Disaster Risk Reduction 2015–2030 and COP27 agreements.

Odisha remains a pioneer in leading the country towards climate change adaptation and is globally acknowledged for its disaster management prowess. Odisha's initiatives of **inculcating CCA and DRR into developmental planning is key to attaining sustainable development**. However, Odisha's present approach of zero-casualty and pre-emptive rapid evacuation stresses heavily on disaster mitigation, with the state becoming proactive only in the event of an impending disaster. The paradigm of proactive disaster response needs to be shifted to one of continuous resilience building, which includes community

preparedness, adaptation individual survivability, livelihood security and disaster prevention over the long term. This means that state-level climate action plans must be complemented by ground-level climate change adaptation plans to better deal with the impacts of climate change as these differ, depending on the location. Moreover, government line departments at the district level must be trained with **adequate capacities to integrate CCA and DRR in their annual development action plans**.

It is essential to **consider systematic connections and dependencies** in reducing vulnerabilities and **strengthening coping capacities** while planning development interventions. In Northeast India, there is an urgent need for **transboundary dialogues on water management** and climate change adaptation due to the presence of transboundary river basins and the Himalayas, which is shared by Nepal and Bhutan. Differences in the governance regimes add to the complexity of climate governance and poorly structured adaptation and resilience-building measures.



Way forward

As per the Germanwatch Global Climate Risk Index, India is among the top five¹ countries at risk from climate change. Under moderate-to-worst climate change scenarios, India could face annual average losses ranging from USD 132 billion to USD 224 billion.¹¹⁶ However, in response to rising climate risks, India has recently pioneered a number of pathbreaking innovations to strengthen its infrastructure and community resilience. Apart from establishing its first domestic carbon credit market and issuing sovereign green bonds, it has been investing in innovative climate technology that uses satellite remote sensing and geospatial technology to improve climate information and decision support.¹¹⁵ At present, over 8,000 real-estate projects in India are adopting IGBC green building ratings. By improving the cost-effectiveness of these architectural designs, India can emerge as one of the world leaders in affordable and sustainable real estate development.

Emerging economies, including India, are persuading developed countries to agree to an NCQG on climate finance by 2024. This proposed goal, as per the cohort of developing nations, should be in the trillions as the costs of climate change adaptation are expected to increase exponentially in the coming years. This calls for a concerted action in **mobilising international climate finance** and L&D financing as there is a fear of countries returning to the use of fossil fuels, economies facing the double whammy of energy and food shortages, and the lack of synergistic financing slowing down climate action. India can help the SIDs, LDCs and other emerging economies, especially countries of the Global South, in mobilising and operationalising these funds for ground-level action. Countries and state governments must cooperate and collaborate in accessing and operationalising the L&D funds and have mechanisms and strategies in place for the same. Besides the plethora of examples in the Indian context, there are also several global best practices that India can refer to and glean valuable learnings from – like China’s sponge city initiative, the US’s EIB for nature-based storm water infrastructures in cities, Morocco’s land development taxes and Santa Clara’s Silicon Valley 2.0 Project that maps infrastructure assets. However, best practices from Indian states can be modelled and scaled up in similar geographies and contexts to help strengthen robust disaster preparedness mechanisms, multi-stakeholder decision making, and traditional philosophies and livelihood practices. In addition, to stay ahead of the curve in its race to resilience, India must first recognise the true worth of L&D financing within the country and its sector-specific requirements for the economy. Consequently, there is a need to better quantify the cost and benefits of resilience investments, and improve climate risk information and coordination among decision makers.¹¹⁵ For the first time, a separate **working group on Disaster Risk Reduction has been constituted for the G20**, to remind other G20 nations to allocate significant attention and resources to deal with the unprecedented challenges posed by climate change and future climatic shocks. Being at the helm of affairs at G20, India’s key priority would be to highlight the financing gap in fast-tracking DRR and CCA initiatives in a unified framework that looks at participatory approaches, increased women and youth participation, strengthened international collaboration, improved climate predictions, and enhanced climate governance.



Glossary

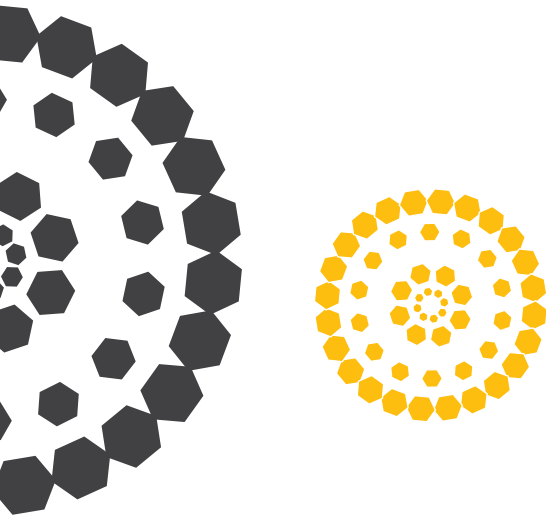
ACCMS	Assam Climate Change Management Society
ADB	Asian Development Bank
AIDM	Assam Institute of Disaster Management
ALVM	Ambedkar Lohia Vichar Manch
APMC	Agricultural Produce Market Committee
AR6	IPCC Sixth Assessment Report
ASDMA	Assam State Disaster Management Authority
ASDMP	Assam State Disaster Management Plan
BPL	Below poverty line
BSF	Border Security Force
CAP	Common Alerting Protocol
CBDP	Community-based disaster preparedness
CBOs	Community-based Organisations
CC	Climate change
CCA	Climate change adaptation
CCT	Continuous contour trenches
C-DOT	Centre for Development of Telematics
CDRI	Coalition for Disaster Resilient Infrastructure
CEEW	Council on Energy, Environment and Water
CEO	Chief executive officer
CIF	Climate Investment Funds
CISF	Central Industrial Security Force
CNB	Cement Nala Bund
COE	Centres of Excellence
CRED	Centre for Research on the Epidemiology of Disasters
CRPF	Central Reserve Police Force
CSO	Civil society organisation
CSR	Corporate social responsibility
DAMUs	District Agro Meteorological Units
DDMA	District Disaster Management Authority
DDMOs	District Disaster Management Officers
DDMP	District Disaster Management Plan
DMP	Disaster Management Plan
DMR	Digital mobile radio
DMTC	Disaster Management Training Cell
DPAP	Drought Prone Area Programme
DRR	Disaster risk reduction
EIA	Environment Impact Assessment
EIB	Environmental Impact Bond

EM-DAT	Emergency Events Database
EOC	Emergency Operation Centres
ESG	Environment, Social and Governance
EWS	Early warning systems
FFS	Farmer field schools
FGDs	Focus group discussions
FLEWS	Flood early warning system
FRBM	Fiscal Responsibility and Budget Management
FY	Fiscal year
G20	Group of Twenty
GCF	Green Climate Fund
GEF	Global Environment Facility
GEMEx	Guwahati Emergency Management Exercise
GHGs	Greenhouse gases
GIS	Geographic information system
GIZINDIA	Deutsche Gesellschaft für Internationale Zusammenarbeit
GSDMA	Gujarat State Disaster Management Authority
GSDP	Gross state domestic product
GSI	Geological Survey of India
IAF	Indian Air Force
PMAY	Pradhan Mantri Awas Yojana
ICAR	Indian Council of Agricultural Research
IDKN	India Disaster Knowledge Network
IFAD	International Fund for Agricultural Development
IGBC	Indian Green Building Council
IGWDP	Indo-German Watershed Programme
IIWBR	Indian Institute of Wheat and Barley Research
ILO	International Labour Organization
IMD	India Meteorological Department
INDC	Intended Nationally Determined Contribution
IOR	Indian Ocean Region
IPCC	Intergovernmental Panel on Climate Change
IRAF	Infrastructures Resilience Accelerator Fund
ITBP	Indo-Tibetan Border Police
JICA	Japan International Cooperation Agency
JNNURM	Jawaharlal Nehru National Urban Renewal Mission
KIs	Key informant interviews
kmph	Kilometres per hour
EIB	Environmental Impact Bond

EM-DAT	Emergency Events Database
EOC	Emergency Operation Centres
ESG	Environment, Social and Governance
EWS	Early warning systems
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G20	Group of Twenty
GCF	Green Climate Fund
GEF	Global Environment Facility
GEMEx	Guwahati Emergency Management Exercise
GHGs	Greenhouse gases
GIS	Geographic information system
GIZINDIA	Deutsche Gesellschaft für Internationale Zusammenarbeit
GSDMA	Gujarat State Disaster Management Authority
GSDP	Gross state domestic product
GSI	Geological Survey of India
IAF	Indian Air Force
PMAY	Pradhan Mantri Awas Yojana
ICAR	Indian Council of Agricultural Research
IDKN	India Disaster Knowledge Network
IFAD	International Fund for Agricultural Development
IGBC	Indian Green Building Council
IGWDP	Indo-German Watershed Programme
IIWBR	Indian Institute of Wheat and Barley Research
ILO	International Labour Organization
IMD	India Meteorological Department
INDC	Intended Nationally Determined Contribution
IOR	Indian Ocean Region
IPCC	Intergovernmental Panel on Climate Change
IRAF	Infrastructures Resilience Accelerator Fund
ITBP	Indo-Tibetan Border Police
JICA	Japan International Cooperation Agency
JNNURM	Jawaharlal Nehru National Urban Renewal Mission
KIIs	Key informant interviews
kmph	Kilometres per hour
L&T	Larsen & Toubro
LDC	Least developed countries
MAGNET	Maharashtra Agribusiness Network

MahaDBT	Direct Benefit Transfer portal of the Government of Maharashtra
MAHA-MADAT	Maharashtra Monitoring & Assessment of Drought Using Advanced Technology
MDB	Multilateral development bank
MDRM	Maharashtra Disaster Risk Management
MDRs	Major District Roads
MEA	Ministry of External Affairs
MGNREGA	Mahatma Gandhi National Rural Employment Guarantee Act
MGNREGS	Mahatma Gandhi National Rural Employment Guarantee Scheme
MoEFCC	Ministry of Environment, Forests and Climate Change
MRSAC	Maharashtra Remote Sensing Application Centre
NABARD	National Bank for Agriculture and Rural Development
NAPCC	National Action Plan on Climate Change
NCAP	National Clean Air Programme
NCDHR	National Campaign on Dalit Human Rights
NCQG	New Collective Quantified Goal
NDA	National Defence Academy
NDC	Nationally Determined Contribution
NDMA	National Disaster Management Authority
NDRF	National Disaster Response Force
NDRI	National Dairy Research Institute
NDW	National Dalit Watch
NGFS	Network for Greening the Financial System
NGO	Non-government organisation
NHIDCL	National Highways and Infrastructure Development Corporation Ltd
NHM	National Horticulture Mission
NIDM	National Institute of Disaster Management
NITI	National Institute of Transforming India
NMSKCC	National Mission on Strategic Knowledge for Climate Change
NSCCC	National Steering Committee on Climate Change
NSF	National Security Force
ODCH	Owner Driven Construction of Houses
OECD	Organisation for Economic Co-operation and Development
OEMF	Odisha Environment Management Fund
OSDMA	Odisha State Disaster Management Authority
OSDMP	Odisha State Disaster Management Plan
PDNA	Post-disaster needs assessment
PMGSY	Pradhan Mantri Gramya Sadak Yojana
PMKSY	Pradhan Mantri Krishi Sinchai Yojana
POCRA	Project on Climate Resilient Agriculture
PPP	Public private partnerships
PRI	Panchayati Raj Institution

PwCIF	PwC India Foundation
R&DM	Revenue and Disaster Management
RKVY	Rashtriya Krishi Vikas Yojana
RMSA	Rastriya Madyamik Shikshya Abhiyan
SAAPC	State Adaptation Action Plan on Climate Change
SAARC	South Asian Association for Regional Cooperation
SADKN	South-Asia Disaster Knowledge Network
SAPCC	State Action Plan on Climate Change
SCAP	State Climate Adaptation Plan
SDGs	Sustainable Development Goals
SDMP	State Disaster Management Plan
SDMRF	State Disaster Mitigation and Response Fund
SEEDS	Sustainable Environment and Ecological Development Society
SHG	Self-help group
SIDS	Small Island Developing States
SOPs	Standard operating procedures
SRC	Special Relief Commissioner
TC	Tropical cyclone
TERI	The Energy and Resources Institute
UAV	Unmanned aerial vehicle
UIDSSMT	Urban Infrastructures Development Scheme for Small and Medium Towns
UN	United Nations
UNDP	United Nations Development Programme
UNDRR	United Nations Office for Disaster Risk Reduction
UNESCAP	United Nations Economic and Social Commission for Asia and the Pacific
UNFCCC	United Nations Framework Convention on Climate Change
UNICEF	United Nation Children’s Fund
VDMPs	Village Disaster Management Plans
WMO	World Meteorological Organization
WOTR	Watershed Organisation Trust



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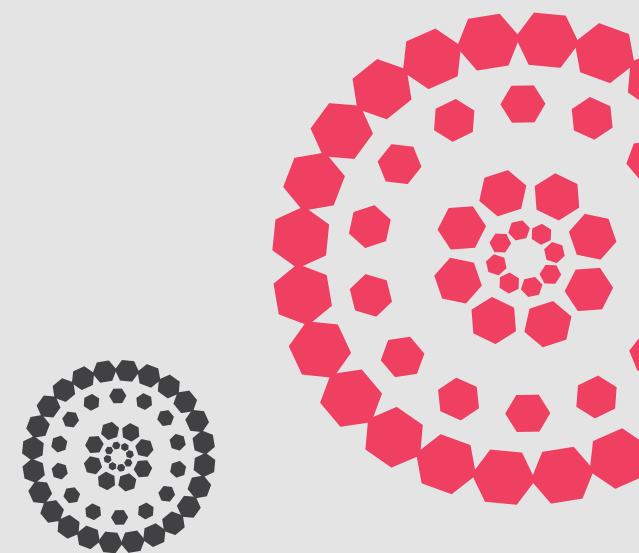
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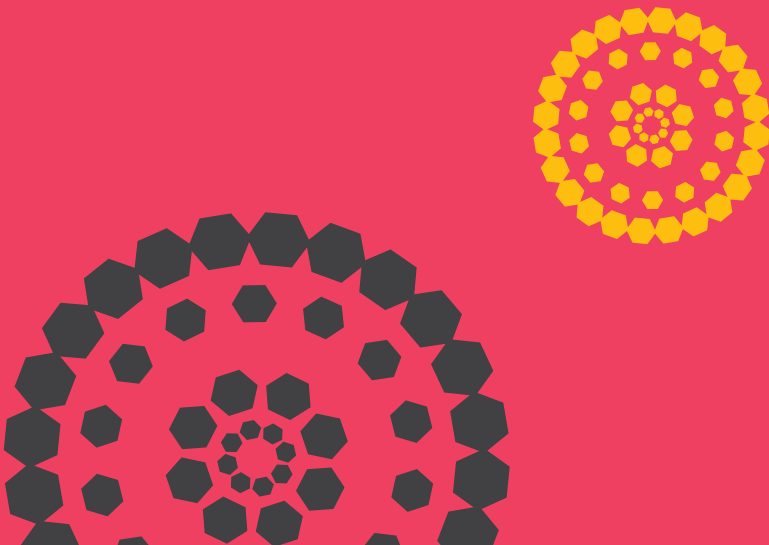
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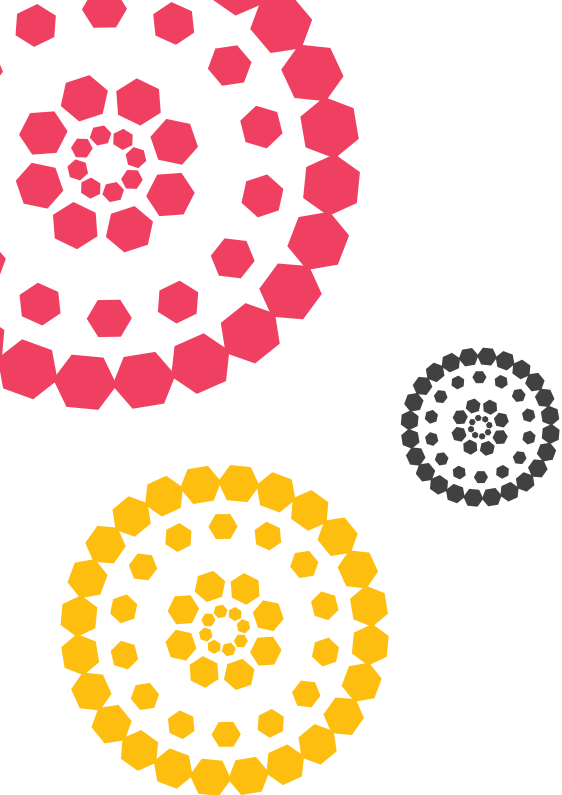
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