



The five-year (2014-2018) Adaptation at Scale in Semi-Arid Regions (ASSAR) project uses insights from multi-scale, interdisciplinary work to inform and transform climate adaptation policy and practice in ways that promote the long-term wellbeing of the most vulnerable and those with the least agency.

During the first phase of our ASSAR work – the Regional Diagnostic Study (RDS) – we identified three semi-arid sub-regions in three states of India, in which to do our work. These are: **Bangalore in Karnataka, Sangamner in Maharashtra, and the Moyar Bhavani in Tamil Nadu.**

Working with stakeholders in these different contexts we developed several key questions which were contextualised within the larger national and regional development processes. These questions serve as the foundation for the next phase of our work, the Regional Research Phase (RRP), where we aim to identify equitable and transformative adaptation pathways for the medium-term future (2015-2030).

In this brief, we describe our broad insights from our RDS work and initial research in **Bangalore.**

KEY INSIGHTS

- ❖ In a dynamic sub-region such as Bangalore, we need a more nuanced understanding of the dimensions and differentiation of vulnerability in order for climate change adaptation policy and practice to better address the causes of this vulnerability.
- ❖ Dynamic small subsets (“micro-hotspots”) exist within the larger semi-arid sub-regions. Within these micro-hotspots, an understanding of (a) both current and future climate variability, (b) non-climatic risks, and (c) their coupled influence, are topics that need attention and further exploration.
- ❖ Inappropriate institutional regimes intensify existing inequity in accessing public services, natural resources, knowledge and power. A responsive governance framework is therefore imperative to meet local and sub-regional imbalances.

THE BANGALORE CONTEXT

Bangalore is located in the southeast of Karnataka state on the Deccan plateau approximately 900m above sea level. It is drought-prone and has a dry, tropical savanna climate with generally moderate temperatures. It receives rain during both the summer (June-September) and winter (October-November) monsoon phases, together yielding approximately 860mm of rainfall. The landscape of Bangalore was fairly dry and scrubby prior to the mid-19th Century, but this changed due to the extensive tree plantation drives across the city.

Bangalore's overwhelming growth – economic and physical alike – is driven by its expanding service economy¹ and its growing global importance as an information technology hub. Consequently, the population growth is steep, putting tremendous pressure on Bangalore's ecosystems and natural resources, and affecting the city's spatial spread and character. The increase in informal settlements and the shortage of housing and service infrastructure to accommodate rural-to-urban migrants have resulted in increasingly precarious and vulnerable conditions for migrating groups. This vulnerability is, however, equally experienced by the incumbent urban poor, and consequently, the rising social and economic inequality affects large sections of the population.



Bangalore's surging urban growth has been accompanied by a growing demand for water that is piped in from the Cauvery River, some 100km away. Water scarcity and drought concerns are prominently visible within the city. At the same time, Bangalore frequently experiences urban floods, resulting from unplanned urbanisation, inadequate bulk infrastructure and blockages of natural drainage channels. Increasing local pollution^{2,3}, shrinking groundwater levels, and the heat island effect are additional concerns that are expected to be exacerbated by climate change.

These problems are aggravated by fragmented governance, poor planning, overlaps and multiplicity in jurisdiction, and limited understanding of climate change and its impacts.



The urbanisation trends and structural changes observed in Bangalore are typical of many cities in the country. Ironically, across India, urbanisation is considered a remedy for a host of developmental issues (poverty, inequality and livelihood concerns). Yet, recent evidence suggests that this is seldom the case.

Key Questions for the Sub-region

- ❖ What are the prevalent socio-economic and environmental characteristics of Bangalore, and to what extent have these been determined by bottom-up choices, top-down (national, regional and sub-regional) policies and processes, or the compounded impact of the two?
- ❖ Which key social-ecological systems and dominant livelihoods are specific to Bangalore's poor and to those living in informal settlements?
- ❖ What are the important development dynamics in Bangalore? What are the major drivers of change, and what are important ways that climate interacts with these drivers?
- ❖ What are the critical risks and impacts (climatic and non-climatic) facing vulnerable groups?
- ❖ Who is vulnerable, how are they vulnerable, and what factors make them so? What are the important gender and other socially-differentiated dimensions of vulnerability?
- ❖ What are the prominent coping and risk management strategies, which groups employ which strategy, and why?
- ❖ How have existing risk management strategies (for a range of impacts) helped to reduce climate risks and build adaptive capacities?

EXPECTED CLIMATE CHANGE IMPACTS

Climate change is likely to impact certain hotspots, sectors and segments of the Bangalore population more than others due to the combination of geographic (i.e., biophysical) and socio-economic factors, as well as power imbalances and gender inequalities. The resulting vulnerabilities manifest in the form of multi-dimensional poverty, characterised by inequitable access to resources and public services, a lack of secure employment, a lack of voice, reduced opportunities, and perpetuated marginalisation. Some of the significant key climatic risks and impacts include:

- The urban heat island (UHI) effect which results in temperature variation and irregular untimely rainfalls⁴.
- The frequency of urban floods⁵, which has already increased substantially in the past few years, and is expected to be further aggravated by micro-climate changes (e.g., UHI), leading to intensified and localised water cycles and precipitation⁶.
- Bangalore's water availability depends on the rainfall in the Cauvery River catchment area, which is fed predominantly by monsoon rains. Given the reduction in average annual rainfall⁷, and the increasing demand on water sources (due to competing water uses and changes in land use), water scarcity is predicted to become a major threat.

DIMENSIONS OF VULNERABILITY

Economic and social vulnerabilities

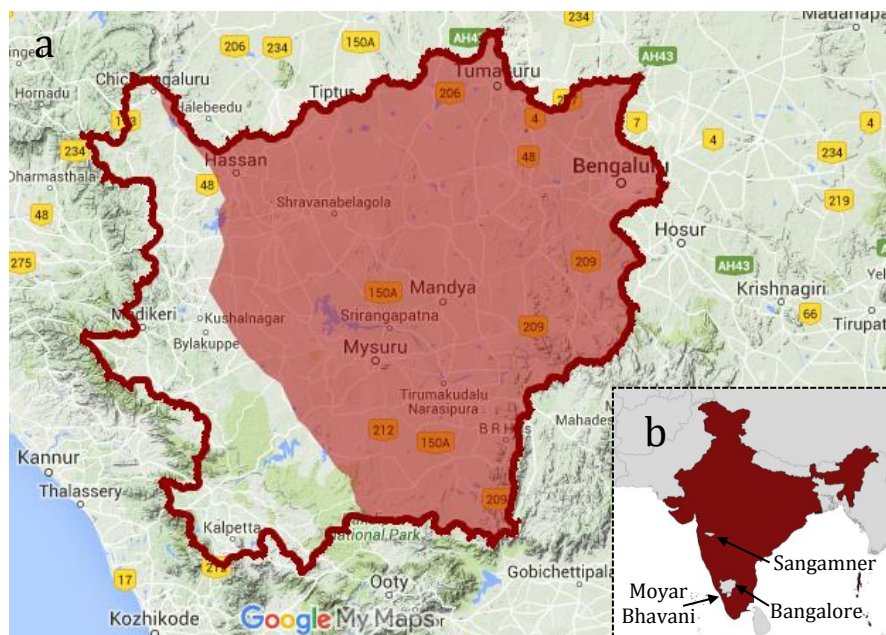
- ❖ Existing cultural norms and practices – especially those centred on caste and gender – lead to discrimination and marginalisation of certain groups.
- ❖ Addressing climate change vulnerability in India has been largely mainstreamed into the developmental agenda, and economic development and poverty alleviation are seen as the primary mechanisms for reducing vulnerability.
- ❖ Although the rapidly growing informal economy helps to alleviate poverty to an extent, it is characterised by unregulated low wages, poor working conditions and low job security. Informal workers are thus entwined in a cycle of informality, both in terms of their jobs and the lack of tenure security and basic services they experience in informal settlements.
- ❖ Because many informal settlements exist outside the purview of formal planning mechanisms, dwellers are typically excluded from the institutional support that could help them to manage the risks they face.

Governance

- ❖ Governance responses to critical vulnerabilities are fragmented, making coordination across different agencies and scales challenging.
- ❖ Planning often takes place at high levels of government, and leaves little space for cumulative engagement and action by different state and non-state actors. Local bodies, civil society, and communities seem to be mainly involved in implementation, with little room for innovation.
- ❖ Thus far, interventions are primarily local in nature with limited scaling options. The fiscal regime has not been uniformly supportive in achieving large-scale vulnerability reduction.

Resource access

- ❖ Water scarcity is a key challenge in Bangalore. Along with other socio-economic vulnerabilities, it leads to countless risks accumulated over time.
- ❖ As a result of the general absence of water supply by the local government, the newly developed peripheries of Bangalore rely heavily on groundwater through unregulated private supply. In many areas, this unregulated supply has caused the water table to recede to dangerously low levels⁸.
- ❖ Even where groundwater is plentiful, there can be problems with contamination due to a lack of adequate sanitation and sewerage infrastructure, leaking sewer lines and wastewater inflow from surface water bodies⁹.
- ❖ Resource availability and resource access are problematic, particularly for those whose livelihoods depend on ecosystem-based goods and services⁹.



(a) The Bangalore catchment area (solid red line), and the Bangalore sub-region (shaded red area) that forms the focus of this brief; (b) the three Indian sub-regions that form the focus of our broader work (in grey).

REGIONAL RISK MANAGEMENT

CURRENT DIMENSIONS

- ❖ Risk management strategies and adaptation measures are mainstreamed either through government-led development interventions and national- and state-level climate action plans, or through private sector and individual-led action. This approach mimics traditional development planning which focuses on infrastructure and service provision in cities and towns.
- ❖ Risk management tends to favour techno-centric, infrastructure-based and large-scale interventions. For example, in areas of Bangalore, housing infrastructure has been put in place without consideration for natural drainage channels or for the internal water bodies that act as buffers to extreme heat events and dry spells.
- ❖ Recent evidence points towards spikes in in-migration to Bangalore, part of which is a coping mechanism for vulnerable groups from nearby rural regions. However, this migration in the context of Bangalore may be addressing immediate risks, evidence¹⁰ suggests that it can create new vulnerabilities (women, children and elders left behind face additional household burdens) and erode present and future capacities (e.g., migrants have lower access to social safety nets and public services).

BARRIERS

- ❖ It is difficult for decision makers (at all levels of governance) to identify and avoid maladaptive risk management strategies given the lack of understanding of micro-level issues, the limited understanding of the differences between adaptation and coping strategies at the local level, and absent or insufficient data.
- ❖ Governance acts as a barrier to effective regional risk management on account of: top-down decision processes; multiple actors with unclear roles; different actors have different objectives) and institutional rigidity (efforts not framed as adaptation responses); and limited capacity. Urban regions like Bangalore are grappling with these problems partly because of the inefficiency in decentralisation processes.
- ❖ Economic development, unplanned urbanisation and poor or disproportionate access to services will exacerbate natural resource exploitation and the erosion of ecosystem services.
- ❖ Instruments for developing the region need to take climate change impacts into account. The current fiscal regime is far too inflexible to drive a recognition of climate change into regional development planning.

¹ Contributing to almost 34% share of the Karnataka State: Goldman, M., 2011. Speculative urbanism and the making of the next world city. *International Journal of Urban and Regional Research*, 35(3): 555-581.

² Jumbe, A.S., Nandini, N., Tandon, S. and Sunitha, N., 2008. Bangalore lakes—issues and perspectives on pollution, restoration and management. In *Proceedings of Taal 2007: The 12th world lake conference* (pp. 1699-1706).

³ D'Souza, R. and Nagendra, H., 2011. Changes in public commons as a consequence of urbanization: The Agara Lake in Bangalore, India. *Environmental Management*, 47(5): 840-850.

⁴ Ramachandra and Kumar, 2010 (<https://goo.gl/rU1pEi>)

⁵ 1077 areas were identified as flood prone, of which 85% were categorised as critical by the Bruhat Bangalore Mahanagara Palike (BBMP, administrative body responsible for civic and infrastructural assets for the Greater Bangalore Metropolitan Area).

⁶ Ramachandra, T.V., Aithal, B.H. and Kumar, U., 2012. Conservation of wetlands to mitigate urban floods. *Journal of Resources, Energy and Development*, 9(1): 1-22.

⁷ Expected to reduce by 10-20% by 2050: State of Environment Report (SoER), 2008, Report prepared for Ministry of Environment and Forest- Karnataka, 374 pages (<http://goo.gl/UsrWzu>)

⁸ Plus, A., Jerome, C. and Sharma, N., 2012. Evaluation of groundwater quality in and around Peenya industrial area of Bangalore, South India using GIS techniques. *Environmental Monitoring and Assessment*, 184(7): 4067-4077.

⁹ Recorded by the Research and Development Wing of the Karnataka State Pollution Control Board as part of the routine monitoring and assessment of the status of lakes, tanks and groundwater levels.

¹⁰ Sridhar, K.S., Reddy, A.V. and Srinath, P., 2013. Is it push or pull? Recent Evidence from Migration into Bangalore, India. *Journal of International Migration and Integration*, 14(2): 287-306.



ASSAR is a five-year, multi-country research project, which aims to deepen the understanding of the barriers and enablers for effective, medium-term adaptation within the dynamic and socially differentiated semi-arid regions of Africa and Asia. ASSAR will generate new knowledge about how adaptation processes – especially those linked to governance systems, policies and adaptation responses – can be modified or improved upon to achieve more widespread, equitable and sustained adaptation. We are particularly interested in understanding people's vulnerability and, in doing so, exploring the dynamic structural and relational aspects linking vulnerability to social difference, governance and ecosystem services.

For more information visit www.assaradapt.org or email spgajjar@cariiaa.net or abazaz@cariiaa.net

This work was carried out under the Collaborative Adaptation Research Initiative in Africa and Asia (CARIAA), with financial support from the UK Government's Department for International Development (DfID) and the International Development Research Centre (IDRC), Canada. The views expressed in this work are those of the creators and do not necessarily represent those of DfID and IDRC or its Board of Governors.



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