



KEY POINTS

- Over the next 50 years, the semi-arid areas of India are expected to become warmer with continued variation in average rainfall and an increase in extreme weather.
- Increases in the frequency and intensity of droughts and floods are predicted to negatively impact food security, economic growth, infrastructure and human health.

Why focus on the semi-arid regions of India?

Although India's economic growth has been notable in the last 20 years the country still faces stagnant agricultural growth, rising inequality, unemployment, and inadequate access to public services for the poor including domestic water.

The semi-arid regions (SARs) of India face dynamic climatic and non-climatic risks. These risks, separately and in interaction, make people and communities living in these regions highly vulnerable. These vulnerabilities and risks are deeply embedded within the existing social and biophysical conditions of the social-ecological systems, and serve as critical barriers to effective, widespread and sustained adaptation. Further, the SARs of India are relatively neglected in national conservation strategies and are frequently targeted for irreversible land-use transformation – often for development purposes – as they are considered wastelands.

It is therefore essential to guide further development and adaptation in SARs of India, in the context of climate change and other global change, towards vulnerability reduction and long-term resilience.

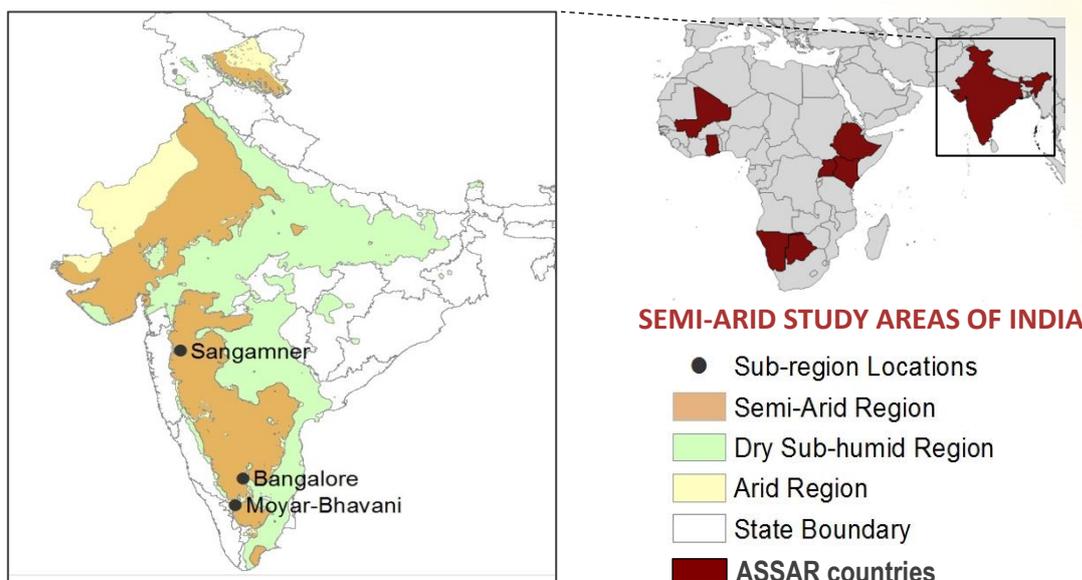
What are the key climate patterns of the past and projected trends for the future?

- ◆ Although slightly variable across study sites, the SARs of India have experienced accelerated warming trends between 1971 and 2007. Mean daily temperatures have increased marginally faster than the national average (0.02 °C/year).
- ◆ Rainfall patterns for the same period have been highly variable across SARs of India, and the country in general. Across the ASSAR states, the average summer monsoon rainfall has decreased by 0.01-1.40 mm/year, and the monsoon onset and rainfall patterns have become more erratic.
- ◆ Extreme weather events are expected to increase in most of India and some semi-arid regions are considered to be high vulnerability areas. The SARs are particularly prone to flash floods, and have witnessed a noticeable increase in hot days and heat waves between 1961-2010, lasting as long as 12–16 days in some areas.

What are the expected impacts of future climate in semi-arid areas?

- ◆ Critical sectors (e.g., agriculture, forestry, water resources) will be affected as drought and flood hazards intensify the demand for land, food, water and livestock forage.
- ◆ Heat-stress related impacts will be more severe for rural and urban communities as thresholds on livestock, crops and infrastructure will be reached sooner.
- ◆ India faces rapid and unplanned urbanization, resulting in poor quality of urban life. Migrants are more vulnerable due to a lack of access to public services and limited livelihood options. Extreme weather exacerbates existing locational risks through urban flooding, heat stress and disease dynamics.

ASSAR is a research programme being undertaken in the semi-arid regions of Africa and Asia, examining the dynamics and drivers of vulnerability, while exploring ways to enhance the resilience of people, local organisations and governments. ASSAR aims to promote climate adaptation policies and practices that are effective, widespread and sustained. In India, ASSAR is working in the Bangalore, Moyar-Bhavani and Sangamner semi-arid sub regions, in a mix of urban and rural landscapes.



Understanding the past and future climate of semi-arid India

Temperature

- ◆ In the past 60 years, temperatures have been increasing steadily in the Bangalore and Moyar-Bhavani sub-regions (0.01 °C per year). This warming trend was not observed in the Sangamner sub-region.
- ◆ In some instances, areas that are upstream of the semi-arid sub-regions are warming faster than the rest of the country.
- ◆ Climate projections based on multiple recently developed climate models suggest that under business-as-usual scenarios, average annual temperatures are projected to increase by 1.7–2 °C by the 2030s and 3.3-4.8 °C by the 2080s relative to pre-industrial times.

Rainfall

- ◆ In the Bangalore and Moyar-Bhavani sub-regions average annual rainfall has been decreasing, echoing a broader national trend. There are also been a decrease in the proportion of moderate rain events and increase in contribution of more intense rains. In the Sangamner sub-region, there was high variability in the contribution of sparse rain and moderate rain events.
- ◆ Regions upstream of the semi-arid sub-regions (especially in the Western Ghats) have seen a rapid decline in rainfall (as much as 25 mm/year) since the 1950s. When considered with the increases in temperature, the changes in these catchments can further decrease water availability in the semi-arid sub-regions.
- ◆ Although climate models produce varied projections for future annual rainfall, extreme rainfall events are expected to increase in most of India, and some semi-arid regions identified as high vulnerability areas.

The way forward

- ◆ Through rainfall variability, drought, and flood hazards, climate change presents many risks to human livelihoods and wellbeing in the semi-arid areas of India. These risks include: resource degradation and conflict, food insecurity, human health, and plant and animal diseases. However climate change is only one of the major stressors, and there are other global and regional drivers such as spread of introduced invasive species, unsustainable exploitation of ground-water, CO₂ fertilization and nitrogen deposition that could have major impacts on semi-arid ecosystems in the future.
- ◆ In rural and urban India climate change necessitates a multi-institutional and multi-sectoral response. A spectrum of factors that includes market forces, emerging development dynamics, depleting natural resources and climate change leaves communities fractured and vulnerable.
- ◆ To enable effective adaptation, there has to be a recognition of, and response to, multiple governance regimes – including the need for governance to engage with relevant actors and institutions, links between planning and execution, engagements in both top-down and bottom-up planning, and the involvement of state, civil society, citizens and private sectors.
- ◆ The existing base of impact studies are limited in scope and restricted to the water sector and major agricultural crops. Additional research is needed to understand climatic impacts in addition to other global change drivers on these social ecological systems. Additionally, improved understanding of the northeast monsoon behaviour will have major policy implications, especially for southeastern India. Assessing climatic risks—and the corresponding climate impacts—at much finer scales is crucial.

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