Keysheet
5

Climate Change Impacts on

Water Resources in India

Water is important for economic development, and many parts of India already face issues of water scarcity. This study predicts that intensity of rainfall will increase under climate change. Issues such as water scarcity may also become more prevalent. The marked rise in precipitation intensity and variability in extremes will have impacts for a range of sectors, including water resource management, urban planning, and agriculture.

Water and climate change

Water supply is not only necessary to sustain human life, but is also a key input to many industries such as manufacturing and agriculture. Therefore, the conservation and optimal utilisation of this scarce resource is extremely important for economic development. While India has about 16% of the global population, it only has 4% of total water resources, and many parts of India already face water scarcity.

Water is not only greatly affected by climate change, but is also a core component of climate. The hydrological cycle includes processes such as evaporation and precipitation that are predicted to shift with climate change, and can have important implications for fresh water supply for drinking water, rain-fed agriculture, groundwater supply, forestry, biodiversity, and sea level.

The Indian Institute of Tropical Meteorology (IITM) carried out this study on the impact of climate change on water resources with the following objectives:

1. To make a detailed analysis of the spatio-temporal variability of precipitation over the major river basins of India based on long term recorded data.
2. To estimate past changes in surface water availability and their sensitivity to climatic variability.
3. To validate climate model simulations of daily precipitation over major river basins in India.
4. To estimate the changes in water quality at selected sites in the Krishna basin.
5. To prepare scenarios of water availability and extreme events, under different climate change scenarios, using the model simulated data as described in Keysheets 2 and 3.

The Indian Institute of Tropical Meteorology

The Indian Institute of Tropical Meteorology (IITM) is an autonomous research organisation under the Department of Science and Technology, Government of India. It functions as a national centre for basic and applied research, and covers all aspects of atmospheric sciences and meteorological research.

One of the major activities of IITM has been to undertake hydro-meteorological analysis of various river basins of India, with special attention to precipitation extremes. The Hydromet Group of IITM has been providing consultancy to several water management agencies in planning and designing hydrological projects for optimal utilisation of resources.
http://www.tropmet.res.in

Description of methodology

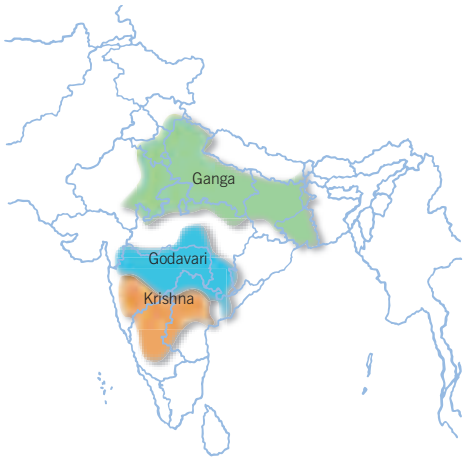
The project focused on an impact assessment of climate change on the country's three major river basins: the Krishna, the Ganga, and the Godavari, given their hydrological and economic importance. Summer monsoon rainfall contributed 70 – 90% of rainfall in these basins.

IITM began by conducting a daily precipitation analysis, to determine a baseline for assessing future changes. The analysis was carried out using daily-observed rainfall data from about 1,000 stations throughout the country for the period from 1901-1995. The observed data was then compared with control simulations, in terms of monthly, seasonal and annual climatologies as well as spatial patterns of extremes, numbers of rainy days, precipitation intensities, etc., to assess the strength of the model predictions.

The regional climate model HadRM2 (see Keysheet 2) was then used to study the impacts of climate change on water resources.

Predicted climate change impacts on water

- The hydrological cycle is predicted to be more intense, with higher annual average rainfall as well increased drought.
- There is a predicted increase in extreme rainfall and rainfall intensity in all three river basins towards the end of the 21st century (Figure 5.1). The Godavari basin is projected to have higher precipitation than the other two.
- The intensity of daily rainfall is also predicted to increase.
- Changes in the number of rainy days were also examined, with results indicating decreases in the western parts of the Ganga basin, but with increases over most parts of the Godavari and Krishna basins.
- Thus surface water availability showed a general increase over all 3 basins (though future populations projections would need to be considered to project per capita water availability.



What are the policy implications of these predictions?

Changes in precipitation can affect a variety of planning issues, such as:

- Planning and design of hydrological structures;
- River basin management, flood control and drought management; and
- Urban planning and industrial development.

Other policy implications beyond immediate water supply issues include:

- Agricultural policy will require more flexible food policies that can anticipate the selection of crops for the planting season.
- Forest policy will need to account for erosion mitigation measures in areas where precipitation is predicted to be high.

Figure 5.1

Changes in Annual Number of Rainy Days (A2 Scenario)

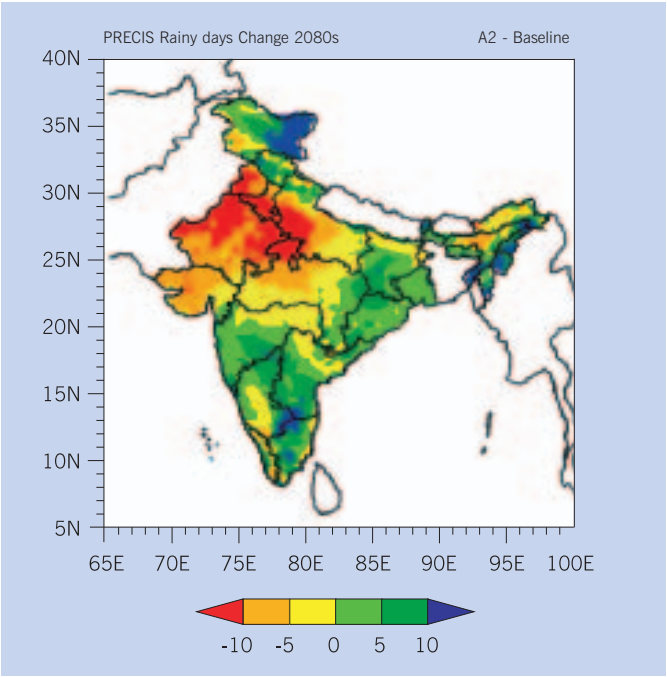


Table of findings

River Basin	Baseline (1961-1990)		Future (2071-2100)	
	Annual Rainfall (cm)	Annual Flow (km^3)	Annual Rainfall (cm)	Annual Flow (km^3)
Krishna	91	60	112	67
Godavari	166	98	201	116
Ganga	134	482	150	543

- Wastewater treatment and sewerage planning will need to address overflow and capacity issues related to intense precipitation.
- Development of water-intensive industries will need to take account of siting issues related to changes in precipitation.

Needs for further research

Potential areas for further research include:

- Spatial development of existing models to allow greater precision in climate change predictions.
- Agricultural research on crops that are drought/flood resistant.
- Social science research on the impacts of higher precipitation throughout these river basins on water quality / management.
- Anaylsis of river discharge data.
- Water availability including groundwater.

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