

Hydrologic conditions in India

What Is Hydrology & Hydrologic Cycle?

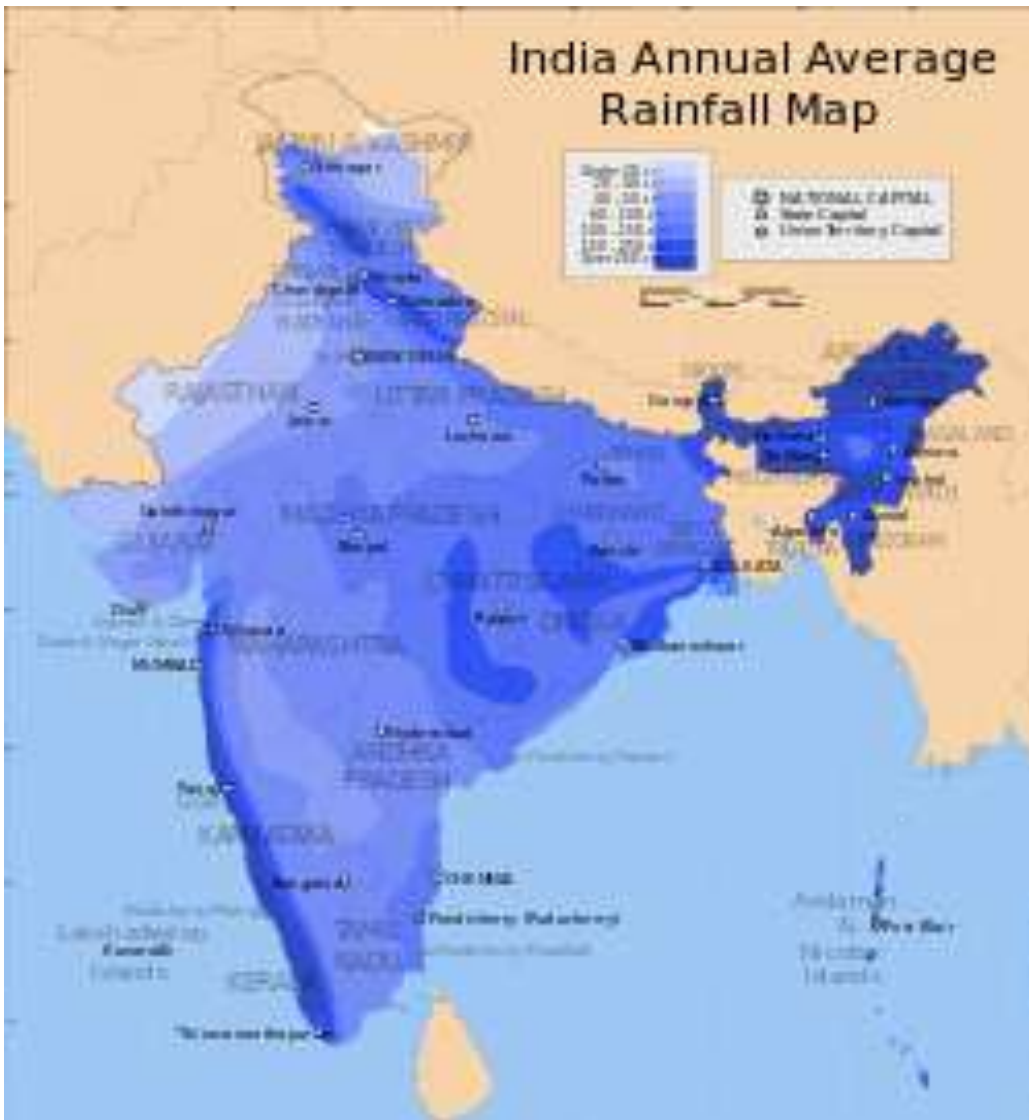
Hydrology is the scientific study of the waters of the earth. Hydrology examines the properties of water as well as its planetary occurrence, distribution, and movement.

The **hydrologic cycle** is often called the water cycle. It is the vertical and horizontal movement of water as either vapor, liquid, or solid between the earth's surface, subsurface, atmosphere, and oceans.

India experiences an average precipitation of 1,170 mm per year. 80 percent of area experiences rain of 750 mm or more a year. However, this rain is not uniform in time or geography. Most of the rains occur during its monsoon seasons (June to September), with the northeast and north receiving far more rains than India's west and south.

Other than rains, the melting of snow over the Himalayas after winter season enters the northern rivers. The southern rivers however experience more flow variability over the year. For the Himalayan basin, this leads to flooding in some months and water scarcity in others. Despite extensive river system, the safe clean drinking water and irrigation water supplies for sustainable agriculture is in shortage across India, in part because we have harnessed a small fraction of its available and recoverable surface water resource. India has harnessed 761 cubic km (20%) of its water resources in 2010, part of which came from unsustainable use of groundwater. Of the water it withdrew from its rivers and groundwater wells, India dedicated about 688 cubic km to irrigation, 56 cubic km to municipal and drinking water and 17 cubic km to industry.

Large area of India is under tropical climate, which is conducive throughout the year for agriculture due to favourable warm, and sunny conditions provided perennial water supply is available to cater to the high rate of evapotranspiration from the cultivated land. Though the overall water resources are adequate to meet all the requirements of the country, the water supply gaps due to temporal and spatial distribution of water resources are to be bridged by interlinking the rivers of India. The total water resources going waste to the sea are nearly 1200 billion cubic meters after sparing moderate environmental water requirements of all rivers. Food security in India is possible by achieving water security first, which in turn is possible with energy security to supply the electricity for the required water pumping as part of its rivers interlinking. It would be cheaper alternative to deploy extensively shade nets over the cultivated lands for using the locally available water sources efficiently to crops throughout the year. Plants need less than 2% of total water for metabolism requirements and rest 98% is for cooling purpose through transpiration. Shade nets or poly tunnels installed over the agriculture lands suitable for all weather conditions would reduce the potential evaporation drastically by reflecting the excessive and harmful sun light without falling on the cropped area.



Annual average rainfall in India.



Map showing rivers and flood prone areas in India

Water Scarcity and Droughts

Water scarcity occurs where there are insufficient water resources to satisfy long-term average requirements. It refers to long-term water imbalances, combining low water availability with a level of water demand exceeding the supply capacity of the natural system.

Droughts can be considered as a temporary decrease of the average water availability due to e.g. rainfall deficiency.

The precipitation pattern in India varies dramatically across distance and over calendar months. Much of the precipitation in India, about 85%, is received during summer months through monsoons in the Himalayan catchments of the Ganges-Brahmaputra-Meghna basin. The northeastern region of the country receives heavy precipitation, in comparison with the north western, western and southern parts. The uncertainty in onset of annual monsoon, sometimes marked by prolonged dry spells and fluctuations in seasonal and annual rainfall is a serious problem for the country. Large area of the country is not put to use for agriculture due to local water scarcity or poor water quality. The nation sees cycles of drought years and flood years, with large parts of west and south experiencing more deficits and large variations, resulting in immense hardship particularly the poorest farmers and rural populations. Dependence on erratic rains and lack of irrigation water supply regionally leads to crop failures and farmer suicides.

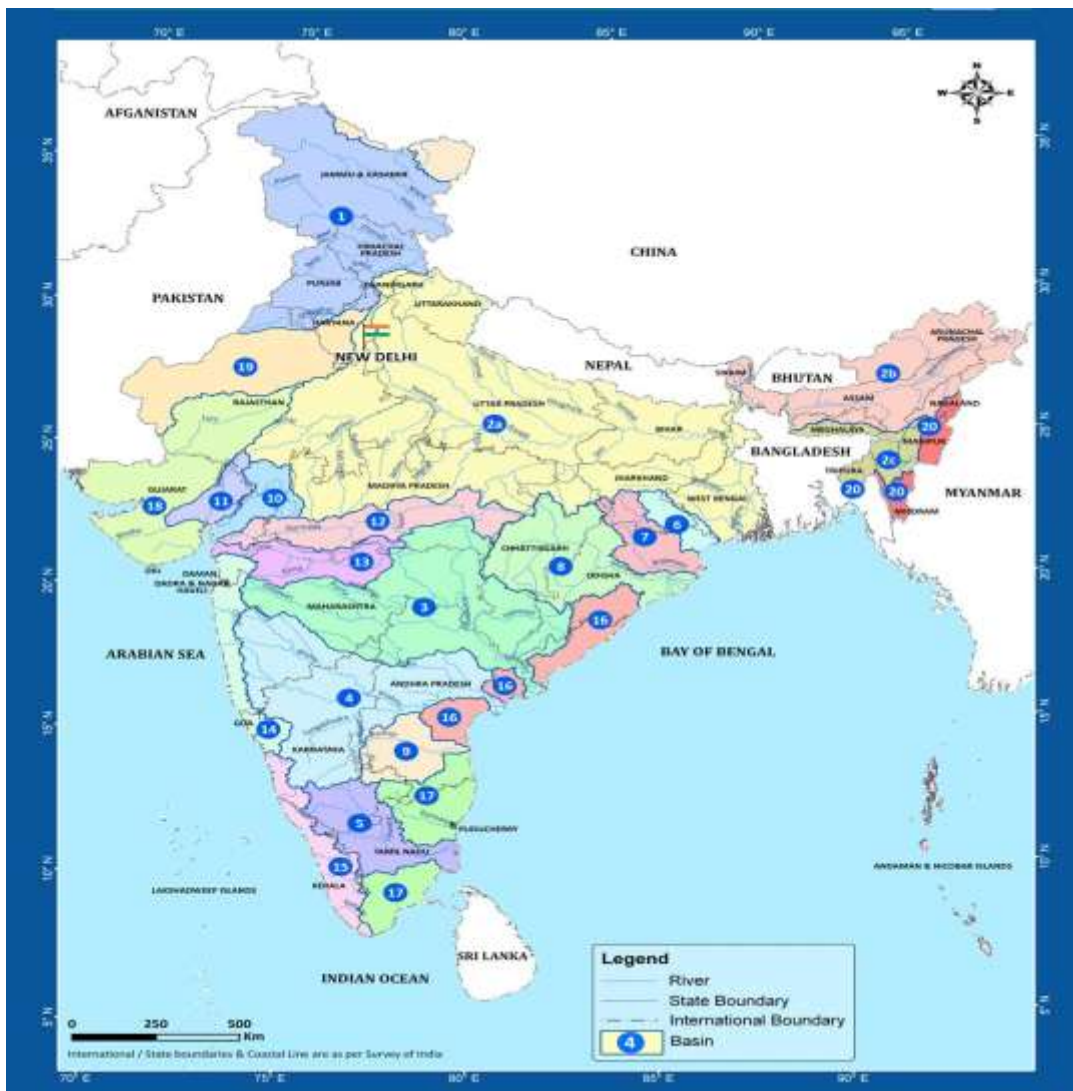
Despite abundant rains during July–September, some regions in other seasons see shortages of drinking water. Some years, the problem temporarily becomes too much rainfall, and weeks of havoc from floods.

Surface water and groundwater storages

India currently stores only 6% of its annual rainfall, while developed nations strategically store 250% of the annual rainfall in arid river basins. India also relies excessively on groundwater resources, which accounts for over 50 percent of irrigated area with 20 million tube wells installed. The end of the era of massive expansion in groundwater use is going to demand greater reliance on surface water supply systems.

Estimated annual precipitation (including snowfall)	4000 km ³
Average annual potential in rivers	1869 km ³
Estimated utilisable water	1123 km ³
Water demand ~ utilization (for year 2000)	634 km ³

Rivers



Map of River basins in India.

The major rivers of India are:

1. Flowing into the Bay of Bengal: Brahmaputra, Ganges, Mahanadi, Godavari, Krishna, Kaveri etc.
2. Flowing into the Arabian Sea: Indus, Narmada, Tapi, etc.

Wetlands

India is a signatory of the Ramsar Convention, an international treaty for the conservation and sustainable utilisation of wetlands. India currently has 26 sites designated as Wetlands of International Importance, with a surface area of 689,131 hectares.

Water supply and sanitation

In India's urban areas access to drinking water considered safe by the Government's standards rose from about 82% of the population in 1991 to 90% in 2001

In rural areas access to drinking water increased from about 65% of the population in 1990 to about 90% in 2001

However, Water supply and sanitation in India continue to be inadequate, despite long-standing efforts by the various levels of government and communities at improving coverage. In spite of adequate average rainfall in India, there is large area under the less water conditions/drought prone. There is lot of places, where the quality of groundwater is not good. Another issue lies in interstate distribution of rivers. Inter-state rivers serve water supply of the 90% of India's territory. It has created growing number of conflicts across the states and to the whole country on water sharing issues.

A number of innovative approaches to improve water supply and sanitation have been tested in India, in particular in the early 2000s. These include demand-driven approaches in rural water supply since 1999, community-led total sanitation, a public-private partnerships to improve the continuity of urban water supply in Karnataka, and the use of micro-credit to women in order to improve access to water.

Water quality issues

Water pollution is the contamination of water in water bodies such as rivers, oceans, lakes and swamps. This means that one or more substances have built up in water to the extent of causing problems to people, animals and plants.

Causes	Effect	Solution
Industrial process	Water becomes dangerous to drink	Stop using harmful chemicals at home
Inorganic Industrial waste	Less clean water for agriculture	Prevent industrial waste reaching water
Agricultural fertilizers	Economic costs	Sewage treatment
Untreated sewage from	Change in water color	Treatment of industrial

households		wastes before discharge
Garbage	Water-borne diseases	Recycle & Reuse
Urbanization	Treatment plants	Promote a love for waterways
Dumping solid waste	Fewer possibilities for leisure	Go organic
Oil spills	Acidic rain	Adherence to water laws
Dissolved gases	Genetic mutations	Improve oil tanker safety

Out of India's 3,119 towns and cities, just 209 have partial treatment facilities, and only 8 have full wastewater treatment facilities (WHO 1992). Open defecation is widespread even in urban areas of India.

Water disputes

Inter-State water disputes under Inter-State River Water Disputes Act (ISRWD), 1956			
River(s)	States	Date of Constitution of Tribunal	Date of Award
Krishna	Maharashtra, Andhra Pradesh, Karnataka	April 1969	May 1976
Godavari	Maharashtra, Andhra Pradesh, Karnataka, Madhya Pradesh and Odisha	April 1969	July 1980
Narmada	Rajasthan, Madhya Pradesh, Gujarat, Maharashtra	Oct 1969	December 1979
Cauvery	Kerala, Karnataka, Tamil Nadu and Union Territory of Pondicherry	June 1990	Report u/s 5(2) received 5.2.2007
Krishna	Karnataka, Andhra Pradesh and Maharashtra	April 2004	Report u/s 5(2) pending
Model/ Mandovi/Mah adayi/	Goa, Karnataka and	Under Construction	-
Vansadhara	Andhra Pradesh & Odisha	Under Construction	-

There is intense competition for the water available in the inter state rivers among the riparian states of India in the absence of water augmentation from the water surplus rivers such as Brahmaputra, Himalayan tributaries of Ganga and west flowing coastal rivers of western ghats.