



## INDIAN SCENARIO OF WATER RESOURCES - AN OVERVIEW, INTEGRATED WATER MANAGEMENT AND MAJOR ISSUES RELATED TO INDIAN WATERS

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### ABSTRACT

Water is life sustaining liquid. It is one of the most important natural resources which is essential for the existence of living organisms and things including humans and wildlife, food production, food security, sustainable development and alleviate the poverty of the country. Despite of having blessed with enormous water resources (e.g., Mt. Himalaya's originated Holy River Ganges, and its several tributaries from the north, Kaveri River in the south, ever rain forests [e.g., Mousinram near Cherrapunji], world's tastiest waters of the Siruvani River in Coimbatore, Western Ghats Basin, network of fresh water resources etc.), "water problem" is huge 'a big threat and cross cut problem in India'. Water is most essential and widely distributed key resource to meet the basic need for livelihoods, growing population, social and economic ambitions, demanding agriculture, energy production, expanding urbanization, increasing industrialization and for several other potential consumptions. Due to hectic population increase and drinking water consumption, decreased rainfall, the 'water problem' in India is becoming a major threat. In India, 'water problems' arise mainly due to poor management, negligence, in appropriate technology and poor responsibility by the peoples and needed to be taken special precautionary measures. Particularly, water pollution, poor sanitation, dwindling/decrease in rainfall, groundwater levels and water scarcity design the world's second most populous nation. The requirements for water are becoming more and more challenging day by day. Hence water in all its forms (solid, liquid and gas) should be harnessed properly. Drinking water is one of the basic needs for all of us. Unfortunately, about 5.76 lakh villages have been facing scarcity of water in India. In many tribal and backward areas un-hygienic and unsafe water collected in ponds, tanks etc., during rainy season are the only source of drinking water. In India, people in certain pockets have to wait for hours to collect one bucket of water from water tankers brought by the trains, trucks and tractors. In many hilly areas, the situation is the same. Our country is facing frequent floods and drought often at the same time in different parts because of variable nature and uneven distribution of rains. Besides these, due to large scale deforestation and soil erosion the rivers are silted up causing floods. For sustained and increased agricultural production, industrial development and economic emancipation of the country the most vital resources are soil and water, which need to be conserved, developed and managed efficiently. In India, floods, water-logging, soil erosion, drought salty groundwater, etc. are some of the major problems of water management for agriculture and other needs. Water resources are under major stress in many regions in India. Rivers,

lakes, and underground aquifers supply fresh water for irrigation, drinking, and sanitation, agriculture, and industry, while the oceans provide habitat for a large share of the planet's food supply. Today, however, expansion of agriculture, damming, diversion, over-use, and pollution threaten these irreplaceable resources in many parts of India. Providing safe drinking water for the more than one billion people who currently lack it is one of the greatest public health challenges facing central government today. In many developing countries, safe water, free of pathogens and other contaminants, is unavailable to much of the population, and water contamination remains a concern even for developed countries with good water supplies and advanced treatment systems. And over-development, especially in coastal regions and areas with strained water supplies, is leading many regions to seek water from more and more distant sources. Consequently, in this paper some major issues related to Indian waters during the past and currently have been reviewed and highlighted.

Keywords: Water resources, Exploitation, Flood, Drought, Benefits, water Sharing, Water Policy, water management, major issues, Indian waters.

### 1.1 Introduction

India has 2.45 per cent of the world's landmass supporting 16 per cent of the world's population whereas the freshwater resources are only 4 per cent of that of the world. The average annual precipitation, including snowfall, received in the country is 4000 BCM. Of this, the average annual water availability in the river-systems of the country is assessed at 1,869 BCM. The usable surface water is 690 BCM and replenishable groundwater is 432 BCM. Thus, total usable water is around 1,122 BCM. There has been a considerable development of water resources since independence. With less than 293 large dams at the time of independence, the number of dams has grown to more than 4000 at present. This will provide a storage capacity of about 252 BCM against that of less than 16 BCM at the time of independence.

At present countries irrigation potential is about 94 million hectares (M. ha) against 22.6 M. ha before the first five-year plan. At the time of commencement of the first five-year plan in 1951, the annual food grain production was only 51 million tonnes which at present is more than 210 million tonnes. Out of 40 M. ha of flood prone area in the country, about 15 M. ha has since then been well protected.

At present, average annual per capita availability of water for the country as a whole is about 1,820 cubic meter as against 5177 cubic meter in 1951 (Table1.1). Due to large variation of

rainfall in space and time, some areas have relatively less per capita water availability. Arid and semi-arid and regions of the country are prone to repeated drought conditions. We must aim for an equitable economic growth for all round development and poverty alleviation, through efficient use and continued sustainable development of water resources with emphasis on people's participation. This will help India emerge stronger in the 21st century.

Although irrigation will continue to be the major consumer of water in coming times, its share in the total water use may reduce while the share of water uses for domestic, industrial and energy purposes will rise due to urbanisation and industrialisation.

**Table 1.1 per capita Fresh Water availability in India**

| Year | Population (in million) | Per capita fresh water availability (in M <sup>3</sup> /Year) |
|------|-------------------------|---|
| 1951 | 361                     | 5177  |
| 1955 | 395                     | 4732  |
| 1999 | 846                     | 2209  |
| 2001 | 1027                    | 1820  |
| 2025 | 1394 (Projected)        | 1341  |
| 2050 | 1640 (Projected)        | 1140  |

Source: Government of India, 2009.

The requirement of water for other uses such as navigation, ecological and recreation, although not so significant in terms of consumptive

use, will continue to be important and will have specific quantity and temporal needs.

Therefore, long term perspective planning for sustainable development of water resources in a holistic and integrated manner, with emphasis on more efficient use is necessary to achieve the goal of economic prosperity.

**1.2 Water Resource Exploitation-Use and over use:**

India is rich in surface water resources. Average annual rainwater discharge into river is about 1880 BCM, which is about 1/3rd of the total rainfall. Because of temporal and spatial variation of rainfall pattern in the country, some part experience drought and while in other parts, there may be severe flood at a time. Thus, water resource management will be a great challenge for India in future Table 1.2.

**Table 1.2: India's fresh water resources, 2015**

| Source          | Total (BCM) estimated | Available for use (BCM) approximate |
|-----------------|-----------------------|-------------------------------------|
| 1.Surface water | 4000                  | 690                                 |
| 2.Ground water  | 1869                  | 432                                 |

Sources: *Water and Related Statistics, April 2015, Central Water Commission*

In India over 75% available fresh water is used in agricultural practices. Such a requirement for agricultural irrigation needs to be reviewed and efficient irrigation planning, crop scheduling and use of wastewater irrigation in agriculture should be examined seriously.

**1.3 Flood**

This is a recurring phenomenon in several states of India. Out of the country's total geographical area of 329 M. ha, out of which 40 M. ha is prone to floods. In spite of considerable measures, flood devastation in Assam, north Bihar, in parts of Uttar Pradesh, West Bengal, Orissa and Punjab, are major problem still exit.

The National Programme for Flood management now targeted to help the state government to take up long term effective management of flood control in problem areas. The Central water commission is engaged in flood forecasting on inter-state river basins through 161 stations out of which 134 are river level forecasting

stations and 27 inflow forecasting stations on major dams/barrage throughout the country.

Floods refer to the inundation of large parts of land by water, which otherwise remain dry for some duration of time. Flood causes heavy loss to agriculture, livestock and property. Deforestation, overgrazing, mining, industrialisation, global warming, etc. have contributed largely in the incidence of floods.

The best solution to overcome such damage is large scale irrigation projects, which will also protect from other environmental hazards. These hazards may be in the form of increase in water logging, soil sedimentation in reservoirs, damage to forest areas, large scale growth of aquatic weed of nuisance value, displacing wildlife and degradation of valuable landscape etc.

Plantations can reduce the impact of water flow on soil erosion. For water management, Land use State Boards were set-up in 1980 in order to protect the soil and water to enhance their productivity through proper land and water use practices.

**1.4 Drought**

It is well known that rainfall pattern is highly variable in different states as well as year to year variation is also quite significant. An overview of rainfall pattern of India is shown in Table 1.3. Drought is a condition of abnormally dry weather within a geographic region.

**Some solutions to overcome drought are as follows:**

- I. Development of additional surface water resources
- II. Direct pumping from streams, rivers and open water bodies
- III. Proper regulation of water use
- IV. Increase utilization of ground water resources
- V. Efficient distribution of canal water Irrigation according to requirement of crops

**Table 1.3 Rainfall Pattern in India (State wise Spectrum)**

| Categories                              | Annual rainfall (Average) mm |
|---|------------------------------|
| <b>I. High Rainfall states:</b>         |                              |
| Andaman and Nicobar Islands, Assam & NE | 2000-3000                    |

region, West Bengal & Sikkim, Uttaranchal, UP, Goa, Coastal Karnataka, Kerala.

### II. Moderate rainfall

**states:** 1000-2000

Orissa, Bihar, Himachal Pradesh, Andhra Pradesh, Karnataka, Lakshadweep

### III. Low rainfall states:

Haryana, Chandigarh, Delhi, Western UP, 500-1000 Panjab, Rajasthan, Madhya Pradesh(west), Gujarat, Maharashtra, Tamil Nadu, Pondicherry

So, by and large in states or regions having low rainfall particularly during monsoon spell, drought situation often prevailed. Surface water diversion through canals and ground water development in some places help in mitigation of problems partially. The 'National Commission for Integrated Water Resources Development Plan', which was constituted in September 1996, submitted its report to the Union Government in December 1999 and made several recommendations for development of water resources for drinking, irrigation, industrial, flood control, transfer of surplus water to deficit areas and so on.

### 1.5 Dam-Benefits and Conflicts

Construction of "Dam" is one of the major activities for water resource management in different parts of the world. For multipurpose water resource development such as flood instigation, water resource storage and diversion for irrigation and community water supply and also for hydel power generation, the creation of water reservoir and dam in river basin area is a major activity. For a long time, creation of "Dam" symbolized as integrated water resource development planning components.

With the passage of time, it was realised that mega dam all over the world have several negative impacts on Environment and human community in and around. As a consequence, antidam movement started against the creation of any mega dam project. Several thousand of

"Environmental Refugee" was created due to a number of large dam projects.

### 1.6 Water Sharing Conflict

Sustained water supply in major rivers and its distributaries in dry months is a major concern which induces conflicts between two neighbouring states or countries. Thus, there were a number of international treaties made over the years on water sharing viz., India-Bhutan Cooperation, India-Bangladesh cooperation, India-Nepal cooperation and Waters treaty between India-Pakistan.

All these treaties involve the setting up of joint teams for hydro meteorological and flood forecasting network on rivers and also their water sharing issues. Periodically all the treaties were re-evaluated. Identically inter-state water sharing issues now come up very much in news headlines, due to disagreement on water discharge from various dams during dry months.

This problem is very serious in southern and north-western states. Central water commission (CWC), New Delhi is responsible for initiating coordination with the state governments concerned, schemes for the control, conservation and utilisation of water resources for the purpose of flood management, irrigation, navigation and water power generation throughout the country.

### **There are also a number of tribunals for resolving inter-state water disputes:**

- (i) The Godavari water Disputes Tribunal,
- (ii) The Krishna-water Disputes Tribunal,
- (iii) The Narmada water Disputes Tribunal,
- (iv) The Ravi and Beas water Disputes Tribunal, and
- (v) The Cauvery water Disputes Tribunal.

### 1.7 National Water Policy (2012)

National Water Policy is formulated by the Ministry of Water Resources of the Government of India to govern the planning and development of water resources and their optimum utilization. The first National Water Policy was adopted in September, 1987. It was reviewed and updated in 2002 and later in 2012.

This policy was adopted by the National Water Resources Council. The policy envisages the formulation of a State water policy and preparation of an operational action plan in a time bound manner to achieve the desired objectives. The devel-

opmental strategy includes many effective water conservation and management plans as a component of the long-term perspective planning of water resources.

**The following activities were suggested in perspective planning:**

1. Stakeholder's participation in optimum utilisation of water resources, and its development as state govt. have inadequate fund to maintain such facilities. This includes participatory irrigation management.
2. Renovation and modernisation of irrigation projects is essential as the average water use efficiency of irrigation projects (2003) is about 20 to 40 for canal water and about 60% for ground water irrigation schemes. This situation can be improved by better management and up gradation of the system to realise optimum benefits; and through mitigation of the consequential side effects like water logging and inequity in supply of water to tail end reaches.
3. Preservation and maintenance of quality of water resources are very important for various kinds of water uses. Contaminated ground water quality can be improved by rainwater harvesting and groundwater recharge.
4. Watershed management is one of the major useful methods of providing sustainable irrigation. It also helps in soil erosion control and water conservation.
5. Rainwater harvesting and groundwater recharging are two very important interlinked processes of water conservation, when there is a danger signal of groundwater depletion.
6. Interlinking of rivers is another significant proposal of water distribution in a countrywide network. However, environmentalists opposed this idea due to several reasons especially due to the misleading concept of surplus water.
7. Flood management includes water storage, dispersion and early evaluation of water logging areas. Long term planning for such

a situation is highly essential in flood prone areas.

8. Mass awareness campaign for water conservation is extremely essential otherwise any amount of water development will not be sufficient for requirement of the society. How to save water in the household level? This should be explained to every citizen.

**How to Save Water:**

There are some simple ways by which we can hold on to our natural resources.

**In the kitchen:**

1. Fill your sink or basin when washing and rinsing dishes.
2. Wash the vegetables and fruits in a basin. Use a vegetable brush to remove dirt.
3. Store drinking water in a refrigerator rather than letting the tap run when you want a glass of cold water.
4. If you wash the dishes by hand. Don't let the water run, if you have two sinks, fill one with soapy water and other with clean water to rinse off the dishes.

**In the bathroom:**

1. Turn off the tap when washing your face, teeth or shaving just by changing the way of a family brushes, it can save up to 80 % of water.
2. Never use the toilet as ashtray or waste basket. Use a waste basket instead.
3. Don't take marathon showers. Just five minutes can get you clean out of the bathroom.
4. Close the tub drain before turning on the water. Fill your bathtub only halfway.
5. To check your toilet for leaks. put a few drops at food colouring your toilet tank. wait for 10 minutes. If without flushing, the colour appears in the bowl, there is a leak.
6. Fill a milk container with water and put it in your toilet tank, safely away from the mechanism. The jug can save you 10-15 lit. of water a day.

**In the garden:**

1. Water plants in the cool parts of the day (early morning is the best) to cut down on evaporation.

2. Check for the leaky hose connections and the sprinkler valves.
3. Porous paving materials such as brick, decomposed granite, or gravel used in patios help keep water in the garden.
4. Add compost to the soil to improve its water retention capacity.
5. Water trees and shrubs with deep root systems longer and less frequently than shallow, rooted plants which require smaller amounts of water. more often.

#### 1.8 Integrated Water Management:

Fresh water crisis is now a global phenomenon. Thus, there is a great need for integrated water resource management in terms of water collection, storage, efficient use and recycle of wastewater.

**To meet future needs, urban, agricultural and national interests will need to deal with a number of issues such as the following:**

1. Increased demand for water will generate pressure to divert water to highly populated areas or areas capable of irrigated agriculture.
2. Increased demand for water will force increased treatment and reuse of existing water supplies.
3. In many areas where water is used for irrigation, evaporation of water from the soil over many years results in a build-up of salt in the soil. When the water used to flush the salt from the soil is returned to a stream, the quality of the water is lowered.
4. In some areas, wells provide water for all categories of use. If the groundwater is pumped out faster than it is replaced, the water table is lowered.
5. In coastal areas, sea-water may intrude into the aquifers and ruin the water supply.
6. The demand for water-based recreation is increasing dramatically and requires high quality water, especially for activities involving total body contact, such as bathing and swimming.

By and large water management is one of the major concerns of any country which needs much more comprehensive planning on a long term basis.

#### 1.9 Major issues related to Indian waters

Water may become a very big source of deaths in India i.e. lack of water, polluted water and the fights/riots over water. Time is running out and there is really not much action on the ground. There are various organizations and activists working for it but what they need is support from you and me. Let us understand the various issues that we are facing right now.

**1. Water scarcity:** Increasing gap between requirement and supply Water demand in India is roughly distributed as follows: 90% agriculture, 5-6% industry and rest for domestics and other uses. Demand from domestic and industry sources is expected to increase with the growth in economy and population. It's not just the lack of water that is the problem but also the efficient usage of available water. For example, in irrigation 40-50% water is wasted because of inefficient management of water resources. Then government policies like provision of free electricity to farmers results in laxity on the part of farmers.

**2. Depletion of groundwater:** Underground water accounts for close to 50% of irrigation needs and most of the rural domestic needs. Whenever the rate of extraction is more than the rate of replenishment, depletion of aquifers take place and this is happening at a rapid pace in India.

**3. Worsening quality of water:** Water pollution is a very serious problem in India with over 70% of surface water and a lot of groundwater sources are already polluted with biological, toxic organic and inorganic wastes.

There are two broad categories of water pollution i.e. Point Source (direct emission into the rivers or other water bodies) and Non-Point Source (delivers pollutants indirectly through environmental change or transport). Another way to classify is agriculture, industry and domestic sources of pollution.

#### 4. Disputes and fights over water

1. The Krishna-Godavari water dispute - Maharashtra, Karnataka, Andhra Pradesh, Madhya Pradesh and Orissa.
2. The Cauvery water dispute - Tamil Nadu, Karnataka.

3. The Ravi-Beas water dispute - Haryana, Jammu Kashmir, Rajasthan, Punjab.
4. The Yamuna Dispute - Delhi, Haryana, Uttar Pradesh.

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#### A brief Bio of Author

**Mr. Venkata Raju Badanapuri** was born on 1<sup>st</sup> July 1966 in Golagamudi village of Venkatachalam Mandal, SPSR Nellore District, Andhra Pradesh, India and graduated from Andhra University, Visakhapatnam in 1992. He attended the Andhra University College of Engineering at Vishakhapatnam in the year 1987 to 1991 and received his bachelors of Degree in Civil Engineering with a specialization in Multi-storey Structures and Pre-stressed concrete Structures in January 1992, and then he joined in the Water Resources department, Government of Andhra Pradesh, India as Assistant Executive Engineer and rendered 11 years of service and he was promoted as Deputy Executive Engineer and rendered 5 years of service. He has member of the Institution of Engineers (India) since 2003. He then came to Hyderabad April 2006, to pursue higher education at JNTUH College of Engineering, Kukatpally Hyderabad – 500085, Andhra Pradesh, India. He has started his Master of Technology, in the Department of Civil Engineering with the specialization in Structural Engineering and successfully completed his Master's degree requirements in July 2009. He was placed in first class with distinction. He has further promoted as Executive Engineer in the year 2008-09 and joined in Telugu Ganga Project; Gudur of SPSR Nellore, in Andhra Pradesh, India. Presently he is working as Executive Engineer in Drainage Division, Chirala of Prakasham District, in Andhra Pradesh, India. He is member fellow of Prestigious Technocrats Autonomous body i.e. Institute of Engineers India.